

TerraGreen

₹60



VOLUME 14 | ISSUE 3 | June 2021

SPECIAL HIGHLIGHTS

World Day to Combat
Desertification and Drought
Sustainable Nitrogen Management

TERRA YOUTH

World Environment Day 2021: Setting
Goals for Our Planet's Restoration

IN CONVERSATION

Sandeep Poundrik
Director General, CDRI

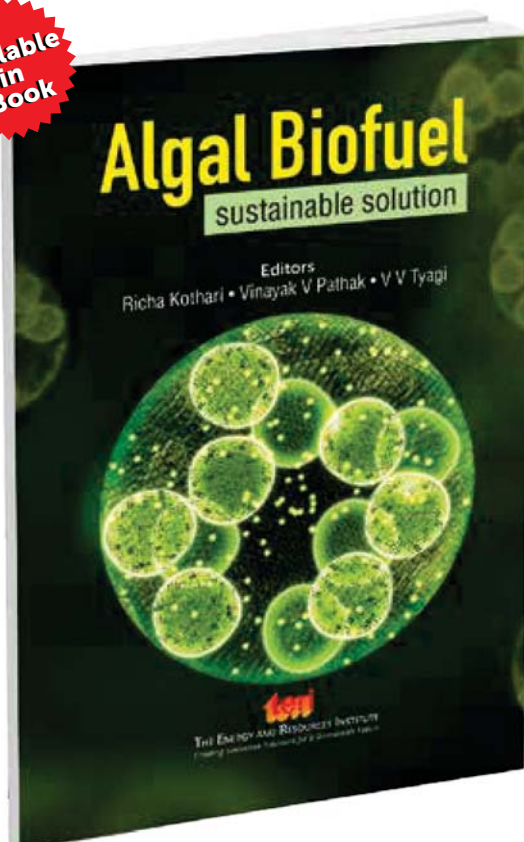
Altered River Flows and Nature's Fury

Need for Efficient Water Resources Management



SUSTAINABLE ENERGY SOLUTIONS FROM BIO SOURCES

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Major topics covered

- Algal biomass harvesting for biofuel production
- Biogas as bioenergy option
- Application of algal biomass as a feedstock
- Bioethanol production from lignocellulosic/ algal biomass
- Crop residues as a potential substrate for bioenergy production
- Biodiesel production from non-edible oilseeds

- ISBN: 9789386530943
- eBook Subscription Price: ₹795
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Algal Biofuel: sustainable solution explores a wide spectrum of bioenergy sources, including their applications. It provides latest information in the field of bioenergy technologies and their future prospect including lipid content. It discusses governance of biofuel at global and national levels and the potential of biofuel to meet the rising energy demand. The book focuses towards the strategies to ensure the availability of algal biomass, effective cultivation and harvesting techniques. The strategies to enhance the algal lipid synthesis and its conversion for biodiesel production have been also elaborated.

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EDITORIAL



“The crucial linkage between conservation of ecosystems and human health has not yet received adequate public attention.”

While the devastating second wave of COVID-19 seems to have peaked in the urban hotspots, it is now gripping the smaller towns and villages of India, which are far more vulnerable owing to weak public health infrastructure and services. On the other hand, doctors are now grappling with rising cases of ‘black fungus’ that is affecting India’s COVID-19 patients. This adds to the many challenges that the government needs to address urgently, including adequate supply of vaccines and raising awareness on COVID appropriate behaviour amongst the general public.

On June 5, we will be observing the World Environment Day. The theme for this year is ecosystem restoration. The day will mark the launch of the UN Decade on Ecosystem Restoration. The COVID-19 pandemic has shown us the calamitous consequences of ecosystem losses. As the area of natural habitat for animals shrinks further, ideal conditions for spread of pathogens such as coronavirus are created. This crucial linkage between conservation of ecosystems and human health has not yet received adequate public attention.

This month’s cover story on altered river flows and nature’s fury, highlights how unplanned developmental projects have caused irreversible damages to our river ecosystems leading to significant loss of life and property. Rivers not only function as a natural habitat to innumerable species of living organisms, they also nourish wetlands which provide numerous ecosystem services such as supply of clean water, flood risk reduction, protection from storms and droughts, prevention of soil erosion, groundwater recharge, nutrient retention, and maintaining local climatic conditions. These services are essential for the survival of all forms of life. Human activities, such as creation of dams, sand mining, overextraction of groundwater, land use changes, and indiscriminate disposal of untreated non-biodegradable solid wastes have significantly altered river ecosystems, impaired river water quality, and concurrently increased the severity of disasters such as droughts and floods. These activities have further impacted food production and livelihoods, along with causing serious public health impacts.

Better planning, increased community awareness, improved institutional mechanisms, and stringent implementation of environmental bye laws are urgently needed to restore our river ecosystems. Not to forget the importance of extensive ecosystem service assessments and hydrological and hydrogeological analysis.

With this article and many more stories of current interest, we hope that you enjoy reading this issue of *TerraGreen*. This also happens to be the 17th anniversary issue of the magazine. We do look forward to receiving your feedback and letters. Please stay safe and healthy.

A handwritten signature in black ink, reading 'Vibha Dhawan'.

Vibha Dhawan
Director-General, TERI



Air pollution is defined as the release of pollutants into the air that is detrimental to human health and the planet as a whole. Due to current world trends, air pollution has been on the rise with the highest rate in the past 100 years. Emissions from factories, vehicles, and various other things have resulted in this increase. The increase in air pollution results in severe problems, such as respiratory and health problems, global warming, ozone layer depletion, and so on. Apart from this, an increase in air pollution has also been proven detrimental towards our fight with SARS-Cov-2 or COVID-19.

An increase in air pollution in recent years has resulted in more people getting various respiratory problems like chronic obstructive pulmonary disease, lung cancer, etc. Now, SARS-Cov-2 being a virus that attacks the respiratory system of humans, damage to our respiratory system due to air pollution has made us more vulnerable to COVID-19. In a study conducted by IQ Air, India was ranked third in the

world's most polluted countries. This made India one of the most vulnerable countries to this pandemic in the world. The recent increase in deaths in India due to COVID-19 can be attributed to air pollution. Due to higher pollution, the majority of the population has some kind of lung damage which resulted in more deaths than there should have been.

This pandemic has taught us a lot of lessons and the most important being that we should mend our ways with nature and start to treat it with more care and respect. We were the people who covered it with plastic and now it has covered us with plastic. Our situation would have been far better if we had not caused so much damage to nature. We still have some time and with hard work and determination, we can make save our planet from further destruction.

Pranay Arora

Class 12th student, Lucknow

The article on electronic waste published in the May 2021 issue of *TerraGreen* is very informative. The author is very correct when she says that not many know about electronic pollution, that poses a major challenge to the environment. What makes it even more detrimental for the environment is that it significantly contributes to all the other forms of pollution. Kudos for publishing such apt articles. We expect further enriching environmental stories in the forthcoming issues of the magazine.

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Contents

VOLUME 14 • ISSUE 3 • JUNE 2021

4	NEWS	30	SPECIAL REPORT
8	TERI ANALYSIS		Sustainable Nitrogen Management
	'Paani Bachao, Paisa Kamao' Scheme	34	GREEN CHALLENGES
10	ENVIRONMENTAL RESEARCH		Are We Ready for a Circular Economy?
	Inviting Birds of All Feathers: What We Must Do for the Birds	37	TERRA YOUTH
12	FEATURE	46	WILDLIFE
	Restore Land; Sustain Lives; Promote Equality		Who Killed Assam's 18 Asiatic Elephants?
18	IN CONVERSATION	48	MANEKA SPEAKS
	Sandeep Poundrik, Director General, Coalition for Disaster Resilient Infrastructure	50	PIONEER
		53	SPECIAL FEATURE
22	COVER STORY	56	FIGHT CORONAVIRUS TOGETHER
	Altered River Flows and Nature's Fury: Need for Efficient Water Resources Management		

12
FEATURE



30
SPECIAL REPORT



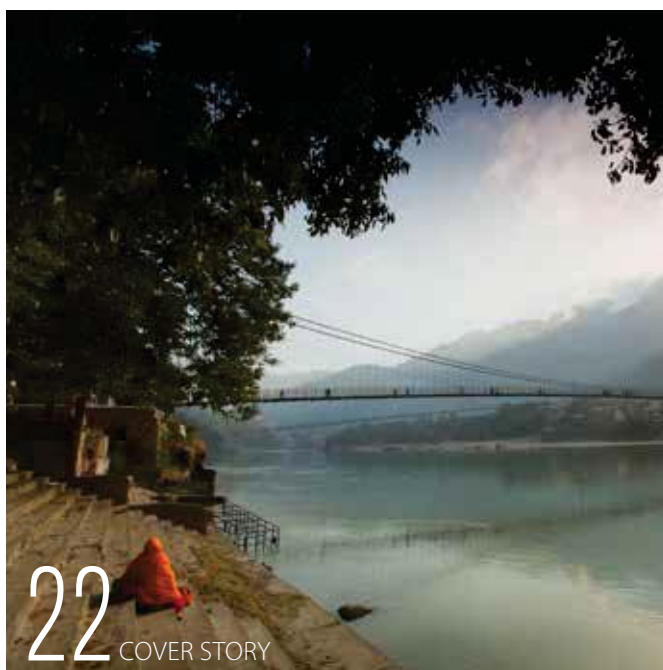
10 ENVIRONMENTAL RESEARCH



37 TERRA YOUTH



22 COVER STORY





River Yamuna to Get Bubble Curtain

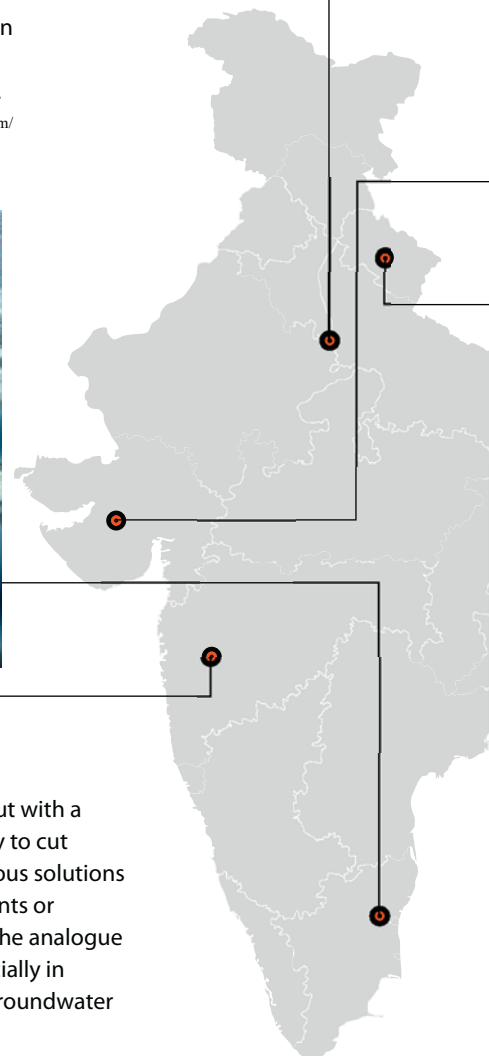
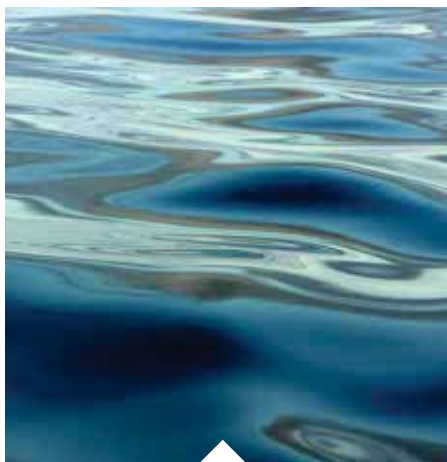
Geocycle—the global waste management arm of LafargeHolcim, that manufactures building materials, will implement the innovative ‘bubble curtain’ technology for the first time in India to stop plastic from entering the Yamuna River. A bubble curtain is a non-invasive solution to stop plastic from entering the oceans. Ships and fish can pass through the air bubbles, but plastics will be stopped. The bubble screen is created by a specially designed air tube which is placed diagonally on the bed of the canal or river. It brings waste to the surface, channels the plastic onto the banks where it can be extracted.

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

Pollution Levels Rising in Pune

The air quality of Pune that is mainly regulated by particulate pollutants ($PM_{2.5}$ and PM_{10}) have both seen a considerable rise in the past seven years, according to a joint report by the Indian Institute of Tropical Meteorology (IITM) under the Ministry of Earth Sciences along with Savitribai Phule Pune University (SPPU) and the expert advice of Sarojkumar Sahu of Utkal University. According to the study, $PM_{2.5}$ has seen an increase of 70 per cent while PM_{10} has seen an increase of 61 per cent from 2012–13 to 2019–20 in Pune. One of the major contributing factors to this rise in pollution is the enormous growth of vehicles during the past seven years.

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



IGCAR Scientists Develop ‘Breakthrough’ Technology

Scientists at the Indira Gandhi Centre for Atomic Research (IGCAR) in Kalpakkam have come out with a ‘breakthrough’ technology which could help the water-based solutions industry in the country to cut down on costs and enhance quality by real time monitoring of electrical conductivity of aqueous solutions in industrial plants and field applications. Under this technology, the water-based solution plants or industries could measure electrical conductivity, which is highly accurate when compared to the analogue ones and would give the industries an upper hand when it comes to quality of products especially in paint, water and other industries. The technology could be used in identifying the quality of groundwater as well as seawater, thus benefiting water managers and environmentalists also.

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



Cyclone Tauktae Causes Devastation in Western India

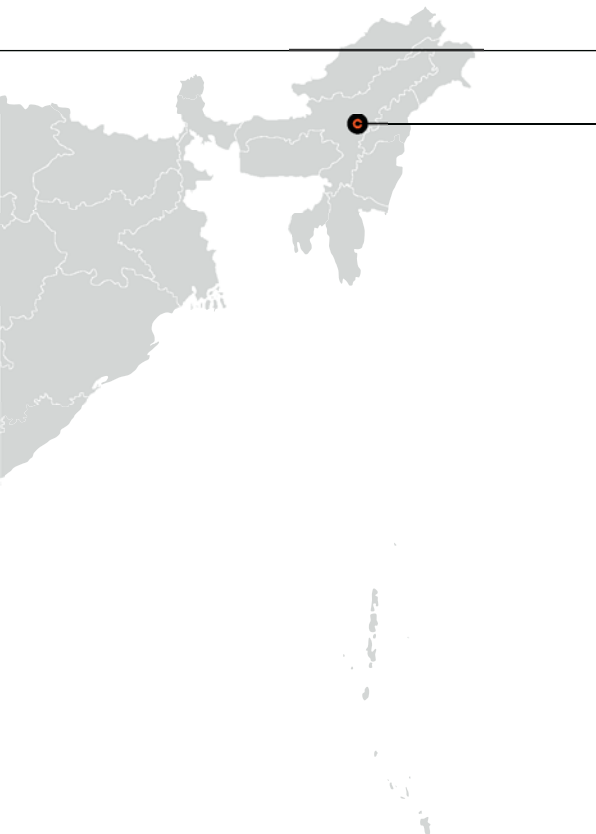
Cyclone Tauktae is a unique cyclone event that impacted all the western coastal states of India in May 2021. Gujarat and Diu were badly impacted. The impact to Kerala, Karnataka, Maharashtra and Goa was primarily due to flooding and soil erosion along the coast due to a mild surge. The wind impact was primarily on electric poles and telecom towers, disrupting power supply and communication in certain areas. Cyclone Tauktae is estimated to have caused losses to the tune of ₹15,000 crore, including ₹9,000 crore to the agriculture and transportation sectors, an initial assessment by RMSI, a provider of geospatial and engineering solutions, shows.

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

Chipko Movement Pioneer Sunderlal Bahuguna Passes Away

Noted environmentalist and Padma Vibhushan Sunderlal Bahuguna, who was being treated for COVID-19 at AIIMS hospital in Rishikesh, passed away on May 21, 2021. The 94-year-old Chipko movement pioneer was admitted to the hospital on May 8 after his oxygen levels started fluctuating. Sunderlal Bahuguna was a life-long environmentalist and was credited for founding the Chipko movement—the grassroots movement that swept through the Garhwal region in the 1970s with villagers hugging trees to stop them from being axed. Later in the 1990s, he spearheaded the Anti-Tehri Dam movement and even went to jail for it in 1995.

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



Biodegradable Yoga Mat Developed

A biodegradable and compostable yoga mat called 'Moorhen Yoga Mat' developed from water hyacinth by six young girls from the fishing community in Assam could turn this water plant from a nuisance to wealth. The girls belong to the fishing community living in the fringe of the Deepor Beel, a permanent freshwater lake in the southwest of Guwahati city, recognized as a Ramsar Site and a bird wildlife sanctuary. The lake has been a source of livelihood for nine villages of the fishing community who shared this biome for centuries, but over the years suffered from excessive growth and accumulation of water hyacinth. The innovation by the girls could contribute significantly towards the environmental conservation and sustainability of Deepor Beel and also ensure local livelihood.

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



New NASA Earth System Observatory to Help Address Climate Change

The National Aeronautics and Space Administration (NASA) will design a new set of Earth-focused missions to provide key information to guide efforts related to climate change, disaster mitigation, fighting forest fires, and improving real-time agricultural processes. With the Earth System Observatory, each satellite will be uniquely designed to complement the others, working in tandem to create a three-dimensional, holistic view of Earth, from bedrock to atmosphere, according to a press release published by NASA. Over the past three decades, much of what we've learned about the Earth's changing climate is built on NASA satellite observations and research. NASA's new Earth System Observatory will expand that work, providing the world with an unprecedented understanding of our Earth's climate system.

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



Holograms Increase Solar Energy Yield

Researchers at the University of Arizona recently developed an innovative technique to capture the unused solar energy that illuminates a solar panel. As reported in the *Journal of Photonics for Energy* (JPE), they created special holograms that can be easily inserted into the solar panel package. Each hologram separates the colours of sunlight and directs them to the solar cells within the solar panel. This method can increase the amount of solar energy converted by the solar panel over the course of a year by about 5 per cent. This will reduce both the cost and the number of solar panels needed to power a home, a city, or a country.

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

Algae Proteins Partially Restore Man's Sight

The vision of a completely blind man in Brittany, France has been partially restored using light-sensing proteins first found in algae. The man was treated with a type of therapy called optogenetics, which uses the proteins to control cells at the back of his eye. He first knew it was working when he realized he could see the painted stripes of a pedestrian crossing. He can now grab and count objects on a table, *Nature Medicine* reports. He was diagnosed with retinitis pigmentosa—which leads to the death of light-sensing cells on the surface of the retina—40 years ago.

He was treated with optogenetics—a field new to medicine, but one that has long been a staple of fundamental neuroscience. It uses light to control precisely the activity of brain cells and was used by the scientists to restore the ability of one of his eyes to detect light.

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





Climate Crisis Inflicting Huge 'Hidden Costs' on Mental Health

The climate crisis is damaging the mental health of hundreds of millions of people around the world but the huge costs are hidden, scientists have warned. Heatwaves are increasing rates of suicide, extreme weather, such as floods and wildfires, are leaving victims traumatized, and loss of food security, homes and livelihoods is resulting in stress and depression. Anxiety about the future is also harming people's mental health, especially the young, the scientists said in a report. Mental health conditions already affect a billion people and cost trillions of dollars a year. The researchers said global heating would worsen the issue unless action was taken. They described a vicious circle where climate impacts increase mental health difficulties, leaving people even more vulnerable to further consequences.

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



Antarctica Gives Birth to World's Largest Iceberg

A giant slab of ice bigger than the Spanish island of Majorca has sheared off from the frozen edge of Antarctica into the Weddell Sea, becoming the largest iceberg currently afloat in the world, the European Space Agency said recently. The newly calved berg, designated A-76 by scientists, was spotted in recent satellite images captured by the Copernicus Sentinel-1 mission, the space agency said in a statement posted on its website with a photo of the enormous, oblong ice sheet. Its surface area spans 4320 sq. km (1668 sq. miles) and measures 175 km (106 miles) long by 25 km (15 miles) wide

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

High Growth of Solar PV installations in Australia by 2030

The solar photovoltaic (PV) capacity in Australia, which stood at 17.99 GW in 2020, is estimated to reach 80.22 GW by 2030. The solar PV accounted for 21.7 per cent of Australia's total power capacity in 2020 and it is estimated to reach 47.56 per cent in 2030, according to GlobalData, a leading data and analytics company. GlobalData's report reveals that during 2000–2020, thermal power dominated Australia's power mix with 58.6 per cent share in the total power capacity in 2020. Aditya Sharma, Power Analyst at GlobalData, comments: 'Australia plans to compensate the decline in thermal and hydropower capacity with renewable power capacity growth. By 2030, the share of renewable power capacity is set to reach 69.9 per cent, driven mostly by solar PV installations.'

Source: GlobalData



‘Paani Bachao, Paisa Kamao’ Scheme

Another Innovation in Punjab

To address the electricity–water–agriculture nexus problem in Punjab that has long confined the farmers, power utilities, consumers, and governments, an innovative approach was the need of the hour. In this article, **Apoorva Bamal**, **Prajnasish Swain**, and **Amit Kumar** tell us about the innovative ‘Paani Bachao, Paisa Kamao’ scheme in Punjab.

To achieve food security and make agriculture the primary source of livelihood for approximately 58 per cent of India’s population, remunerative for farmers; state governments across the country have been providing various subsidies for inputs such as fertilizers, power, water, and seeds, among others. However, over a period of time, these interventions have resulted in unintended adverse impacts, such as soil degradation, overuse of fertilizers and pesticides, groundwater depletion, and rising fiscal burden on governments. Also, the system of public procurement and minimum support price (MSP) has led to a shift from traditional, geographically more appropriate crops to water-intensive crops in many states. Free or highly subsidized electricity tariffs caused a rapid increase in the use of electrified pumpsets and a resultant proportionate surge in electricity consumption by agriculture consumers, leading to over-extraction of groundwater. As per the 15th Finance Commission report on agriculture subsidies, during 2015–16, the cumulative state governments’ agricultural power subsidy was approximately ₹90,000 crore, which is increasing exponentially.

During the Green Revolution in the 1960s, the state of Punjab was encouraged to increase area under

agriculture, especially in paddy and wheat cultivation in order to urgently meet the food demands of the country. Since then, a large percentage of farmers in Punjab have shifted to paddy and wheat cultivation due to assured procurement and MSP with minimum or no risk involved. This also proved to be beneficial to the farmers and the state economy. However, in the current scenario wherein despite the surplus paddy stock, the area under paddy cultivation is increasing and paddy being a water-intensive crop has 30–35 per cent more water requirement than other crops. This has subsequently led to over-utilization of water resources in the already existing water-scarce situations.

In addition to this, over the years, free agricultural electricity in Punjab has also led to unchecked use of pumps and inefficient use of water in the state. Past researches have shown that there is an undersupply of 12.7 billion cubic metres of water for agriculture in Punjab. Consequently, even as the groundwater tables decline, free electricity for agriculture is resulting in increase in pumpset capacity to be able to draw water from greater depths, creating a cyclic situation. Moreover, as per the Central Ground Water Board, the categorization of 105

administrative blocks in over-exploitation of groundwater category in Punjab is evident of more water consumption than that of potential supply and increasing groundwater depletion. Therefore, it is indicative that there is a need of newer and advanced strategies to control this exploitation of water resources as it has resulted in a crisis where despite agriculture production being plateaued (Punjab contributes 12 per cent of the country’s total paddy production), the state is reeling under huge economic and water depletion pressure due to free electricity supply to agriculture.

To address this electricity–water–agriculture nexus problem in Punjab that has long confined the farmers, power utilities, consumers, and governments, an innovative approach was the need of the hour. Therefore, based on the research conducted by SE4ALL and the World Bank in 2010 on ‘Direct Delivery of Power Subsidy to Agriculture in India’, the Government of Punjab (GoP) in 2018, launched the ‘Paani Bachao, Paisa Kamao’ (PBPK) scheme {Direct Benefit Transfer for Electricity (DBTE) to agriculture} on a pilot basis on six feeders in three districts—Fatehgarh Sahib, Hoshiarpur, and Jalandhar. The scheme in the state offers a choice to the farmers to increase their income while using groundwater and electricity more efficiently. The

scheme design takes into account two prerequisites—the current policy of free power to agriculture cannot be discontinued and crop diversification will not take place in the near future. The conceptual framework of the PBPk scheme was developed in 2012–13 with the support of the World Bank.¹ The design was based on consultations with multiple stakeholders, recommendations arising from field work with farmers, review of global experiences, and critical analysis of multi-sectoral data and policies. It aimed to develop a strategy, which not only addresses the electricity–water–agriculture cross-sectoral issues but also meets the requirements of agriculture and farmers.

To support GoP implement PBPk in the three designated feeders in Hoshiarpur and Jalandhar, the World Bank² appointed Implementation Assistance Consultant (IAC), a consortium of TERI, ITP India and Punjab Agricultural University (PAU) for 2 years (2018–20) to provide intensive, on-the-ground support to Punjab State Power Corporation Ltd (PSPCL), including popularizing PBPk scheme as a consolidated package to farmers, undertake baseline and end line surveys, design a farmer outreach and consultation strategy, and help PSPCL to implement it, among others.

PBPk is a voluntary scheme that does not change the present policy of free electricity supply to agriculture pump (AP) consumers in Punjab. Instead, it has a provision to pay farmers for saving electricity with no charge for the excess consumption. Broadly, the scheme has three steps: enrolment (voluntary), automated meter reading (AMR) meter installation, and direct incentive transfer. The AP consumers are given a fixed electricity allocation



every month (kilowatt hour (kWh)/brake horse power (BHP)/month) linked to their sanctioned loads. This fixed allocation was calculated for each scheme feeder by PSPCL on the basis of average electricity consumption (last 5 years) in the feeder. The allocation is different for Rabi and Kharif seasons as electricity consumption is higher for paddy cultivation in Kharif season as compared to that for wheat in Rabi season. A smart meter that can be read remotely (through a SIM card) is installed on the AP connection enrolled in the scheme while no metering is done for non-PBPk consumers. If the consumption of electricity is less than the allocation, the units of electricity saved are paid at the rate of ₹4.00 per kWh and the amount is transferred into the bank account of the respective enrolled AP consumer. Neither the consumption which is in excess of the fixed allocation is charged nor are any electricity bills being issued to the enrolled AP consumers. The enrolled AP consumers receive a one-time information from PSPCL through an SMS about the status of their enrolment and periodic SMS updates are also provided about their electricity consumption with respect

to their allocation. Though the PBPk scheme was offered to AP consumers in the state, its implementation faced certain challenges at the initial stages. These were majorly due to lack of consumers' knowledge or understanding of the scheme's benefits and processes, procedural delays related to the design of the scheme, and lack of motivation amongst consumers to adopt new technologies and practices. In addition to these, while the AP consumers were apprehensive that enrolling under the scheme would expose them to the danger of being billed in future, they also feared that someone might fraudulently withdraw money from their accounts on the pretext of taking account details for enrolment under the DBTE scheme.

A series of articles on these challenges, their addressing mechanisms and key learnings from the project is planned for the upcoming editions.

To be continued in the next issue... ■

Apoorva Bamal, Project Associate, CSR (Project Management Unit), TERI; Prajnash Swain, Project Associate, CIEEA, TERI; and Amit Kumar, Senior Fellow & Senior Director, CIEEA, TERI.

1 Gulati, M., and Pahuja, S. (2015). Direct Delivery of Power Subsidy to Manage Energy–groundwater–agriculture Nexus. *Aquatic Procedia*, 5 (September 2014), 22–30

2 PBPk scheme was funded by the Energy Sector Management Assistance Program (ESMP) and implemented by the World Bank group

Inviting Birds of All Feathers

What We Must Do for the Birds

Urbanization poses a major threat to bird diversity. **Preeti Mehra** tells us about a study backed by Azim Premji University that suggests ways to help combat it.

Last year on March 20, World Sparrow Day, we received the good news that the house sparrow which had disappeared for many years was back in the Delhi-NCR region. Many bird watchers said they were now seeing the bird in areas from where it had gone missing. How and why had the sparrow gone missing? Ornithologists say the bird was never in extinction, but due to increased urbanization its natural habitats had got destroyed. Without sufficient nesting spaces and a decrease in food material, sparrows deserted the urban environs. But now with green cover improving in Delhi, they can be seen in select areas.

A recent research paper, 'Which Traits Influence Bird Survival in the City?'

precisely probes this question. In the study four scientists, Swaroop Patankar, Ravi Jambhekar, Kulbhushansingh Ramesh Suryawanshi, and Harini Nagendra, with backing from the Azim Premji University, explore how bird diversity can be maintained in urban environs. They also review previous research undertaken on the subject between 1978 and 2020. The study is an aggregated one, based on five groups of traits seen in birds—ecological traits, life history, physiology, behaviour, and genetic traits. The findings could help city administrations in their quest to maintain adequate biodiversity.

It has been seen that the urban bird community is dominated by generalist species, while specialist species are

declining. This is attributed to the lack of specific food and shelter resources for them. Urban birds have also been noticed to have different behaviour traits from their rural counterparts. They show an increase in song frequency and amplitude and bolder behaviour.

Due to differential food resources and predatory pressure in the city, changes in their life history traits have been observed. These include prolonged breeding durations, and an increase in clutch and brood size to compensate for low survival rates. There are species-specific changes as well, such as changes in hormonal state, body state, and genetics.

Increase in Subset of Species

The study made certain pertinent observations. As cities increase in urbanization, there is an overall decrease in bird diversity and an increase in a small subset of species. Most of these are generalist species, which use multiple habitats and are less affected than their specialist counterparts who are dependent on select habitats. In fact, it is pointed out that the generalist species benefit greatly when the specialist species stay away as there is now less competition in terms of feeding and nesting. No wonder then that we are surrounded by pigeons and more pigeons in high-rise buildings in Delhi.



Scientists point to a loss in migratory behaviour in urban-centric birds such as the Eurasian blackbird and house sparrow, as there are enough food sources to support them in the winter months. Such a trend, they say, may eventually lead to reduced richness in urban areas. However, birds that have specific dietary requirements tend to avoid migrating to cities as they do not find the food they want. For instance, birds that eat insects (insectivorous birds) may find it a challenge to come across insects in cities and avoid the environment, in turn reducing their population in cities. There are also studies done on the indirect impact of urbanization on resident versus migrant bird dynamics. One such study says, 'resident species may occupy good quality nesting sites in cities before migrants arrive, thus driving migrants away from urban areas by competitive exclusion.'

The scientists found that 'diet breadth' is one of the most important traits affected by urbanization. The city attracts more bird species that eat fruits and grains as they are more fruiting trees in cities. Also, in India there is a trend to throw out grain for birds in public places, such as crossroads and walkways. Bird feeders are also used on the house terrace or balcony. Besides this, omnivorous species, such as the Eurasian blackbird, great tit (*Parus major*), and house sparrow—birds that are the subject of many studies—eat food scraps that humans discard. Hence, they are also attracted to city garbage dumps and landfills.

Birds' Role for the City

All said and done, in the urban environment birds help more than they are helped. The study reveals that birds are one of the successful urban adapters and provide a host of ecosystem services. In fact, the urban bird community structure is a mirror to the structure and functionality of cities as habitats.



Scientists found that habitat specialists such as the woodpecker and other hole-nesting birds always remain in the periphery of the city, while generalist species tend to hover around the city centre and populated colonies.

The UN millennium ecosystem cites four kinds of ecosystem services provided by birds in cities. Their regulatory services include pest control by feeding on disease-causing insects, preying on rodents, and foraging garbage dumps; their provisioning services and supporting come into play when they disperse seeds after eating fruits—helping plant regeneration and become nutrient recyclers via their excretory products. Cultural services are well known and include the most crucial—giving solace and inspiration to nature-loving urbanites through their presence and song.

What We Must Do for the Birds

So, what must city dwellers do to encourage more birds to be part of their habitat? The researchers say that as cities experiment with managing and increasing their green spaces, there are steps administrations, urban planners and citizens can take to improve urban avian diversity conservation. Pointing

out that omnivorous and cavity nesters have more success in the city compared to insectivores and ground-nesting birds; they suggest that park managers enclose small patches of land to keep them safe from urban predators, such as feral dogs, cats, and rodents. This would ensure ground-nesting birds a haven for roosting and nesting.

When feeding birds, a variety of food items including nuts and dried insects must be scattered or placed in bird feeders. This would ensure that birds with varied diets can have access to their type of food. 'Studies have shown that frugivores and granivores seem to do well in cities, as these birds feed on the seeds that are provided by people in bird feed. There has been evidence that, when artificial food is provided birds expand their ranges, thus having a positive effect on bird populations,' says the study.

The scientists are quick to add that along with maintaining patches of native vegetation, it is pertinent to conserve local water bodies as these are key to the survival of many urban species. Last, but most importantly is the recommendation that further studies on the traits of urban biodiversity could be an effective approach for preserving the ecosystem functions and services in urban areas. ■

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Preeti Mehra, editorial consultant, Delhi.

Restore Land; Sustain Lives; Promote Equality

World Day to Combat Desertification and Drought

In this article, **Biba Jasmine** helps deconstruct various ways in which the rate of land degradation and desertification can be seized. Given an understanding, desertification has an impact on the land area causing poverty rise, food insecurity, and high mortality rates, among other hardships, further leading to impoverishment, migration, and conflict. It is imperative to gauge ways in which land degradation and desertification have implications on ecosystem functioning and livelihoods. Let us come together this World Day to Combat Desertification and Drought and identify need for the concurrent attainment of social equity, environmental health, and economic wealth through addressing the challenge of land desertification, and degradation.





In the discourse organized by The Energy and Resources Institute (TERI) on the sidelines of Conference of Parties-14 of the United Nations Convention on Combating Desertification, the focus was laid on the issue of combating land degradation. It was also brought to the notice of a larger audience that India so far has believed to have invested ₹315 billion by 2013 through various schemes and plans to fight the issue of land degradation. Not just this but also the fact that in order to achieve land degradation neutrality (LDN), India has a significant cleft of ₹2240 billion to be plugged. Further, TERI's study titled 'Economics of Desertification, Land Degradation and Drought in India, 2018' highlighted that the annual costs of land degradation are about ₹3177 billion and total costs of reclamation in 2030 will be about ₹3175 billion. Simply put, it costs far less to

reclaim land than it does to degrade it. This conundrum, to a large extent, can be won if the public and private sector, along with communities, act as a whole.

We know that without fertile, productive land ecosystems, life on planet Earth is not possible. Healthy soils are home to a fifth of the world's biodiversity, and that the rich soil ecosystem plays an important role in a variety of ecological functions and services. Healthy soil is a non-renewable resource and its formation is a long and complex process since it can take up to more than 1000 years to form 1 cm of soil.

Therefore, our efforts towards sustainable development are bound to fail, if our soil becomes unproductive. Land loss is no longer limited to Africa and Asia, though these areas remain the most severely affected. Land loss has even more negative consequences when

it occurs in conjunction with poverty, a lack of institutional efficiency, and a lack of social welfare.

Land Degradation and Desertification

We all agree that land degradation and desertification is one of the world's greatest environmental challenges and is currently being accelerated by a growing world population, alongside climate change and increasing demand for goods produced from the land, such as food and fibres. Desertification has impacted about 33 per cent of the global land surface over the last four decades, and deforestation has taken nearly one-third of the world's arable land out of cultivation. Asia has been hit the hardest in terms of people affected since the continent is home to nearly 60 per cent of the world's population. Of this,

almost 70 per cent live in rural areas, and their livelihoods and sustenance directly depend on productive land-based ecosystem services.

Stopping land erosion may be one of the answers to the changing climate, which requires a multilateral, concerted strategy focused on equality and the concept of shared yet distinct obligations and capabilities. Land can help, but if other sectors of the economy and society, especially in the developing world, do not participate responsibly, the effects of climate change will overwhelm it.

Sustainable Development and Land Conservation

Land-related problems are a critical component of achieving sustainable growth, with new challenges arising as a result of factors such as urbanization. Urban development is an unstoppable global trend. It also directly relates to the reduction of pressure on land and habitats, as well as the expansion of their roles and services. This is an essential requirement for economic development and overall human well-being but is an expensive venture requiring substantial financial and technological support. In the land-use sector, collaboration is



typically an agreement between two or more parties to plan, encourage, or enforce policies and practices to improve land management and mitigate land degradation. Different levels and intensities of government and stakeholder involvement, as well as a delineation of obligations and profit-sharing, are invariably involved in these structures. In an ideal world, the collective gains of these different actors' joint efforts would result in new arrangements of state agencies, private institutions, and civil society—at all levels, from local to regional to global. This kind of partnership also results in transformational or structural change,

which promotes more environment-friendly land use.

Land Supports Food Security

Food protection and supply of food remains one of the most important development priorities today and will remain so in the future. Agriculture's sustainable intensification is a central component of soil, and other factors must understand this role's overall importance. With newer and scientifically developed varieties, yield gaps in crop production, horticulture, and tree crops must be fixed promptly. The manner in which food is manufactured, on the other hand, is important. Soil organic carbon, an indicator of soil quality, has been lost globally over the last two centuries as a result of unsustainable land use and management activities, amplifying the effect of growing occurrence and frequency of severe events. Significant quantities of water can be stored in healthy soils with high organic matter content. This is critical for sustaining food production and improving flood and drought resistance.

If we take a closer look at the Indian diet—it continues to be significantly plant-based, with overall meat consumption below the world average, which helps reduce our carbon footprint as per one of the Special Reports by the



Intergovernmental Panel on Climate Change. This also ensures popular demand for the conservation and the continued protection of the complex and rich agro-biodiversity of India. Food across the country is grown in different climatic conditions, thus, strengthening food security and increasing India's adaptive capacity by arresting land degradation is paramount.

Land Degradation, Poverty, and Inequality

Land loss, poverty, and inequality are major obstacles to countries' growth. Land degradation reduces the availability of ecological resources for human well-being, such as food, electricity, groundwater recharge, soil fertility, carbon sequestration capability, and biodiversity, to name a few. Physical declines in ecosystem resources have a direct effect on households' ability to generate income as a result of lower labour, livestock, and land productivity, as well as their ability to harvest natural products for their livelihoods. On the other hand, land loss limits agricultural productivity, which has an indirect impact on household relative incomes through rises in food prices. These direct and indirect negative effects of land depletion on individual households

have an impact on social welfare, rising poverty, and increasing income disparities across society.

Since people at the bottom of the income distribution in rural areas depend primarily on land-related activities for their livelihoods, the land loss can have an impact on their ability to generate income. Hence, land degradation and its allied issues contribute significantly to the increase in poverty. All these things present an urgent need to focus on land improvements that will contribute significantly to poverty alleviation. Land restoration and rehabilitation can generate multiple benefits, such as supporting agricultural livelihoods, increasing labour, livestock, and land productivity, creating jobs and access to markets, and stabilizing land tenure and food prices.

According to a briefing note released by the United Nations Convention to Combat Desertification (2019), places with the highest proportion of degraded land have the most adverse socio-economic performance, both in terms of high poverty rates and high levels of income inequality. Land loss is endangering the livelihoods of billions of people around the world, and drastic measures are needed to reverse these trends.

Do We Have a Strong Partnership for Arresting Land Degradation?

Partnerships can link up with existing organizations, multilateral agreements, and measurable objectives, such as achieving land loss neutrality by 2030, in the form of Sustainable Development Goals (SDGs) and the 2030 Agenda for Sustainable Development. They can also promote more effective leadership and guidance at various scales that benefit from improved accountability, systematic reviews, and monitoring mechanisms.

Environmental problems are frequently embedded within the competing interests of various stakeholders, such as government, corporations, land cooperatives, labour unions, consumers, NGOs, etc., who commonly view one another as adversaries. The government has traditionally been responsible for the preservation of public goods, while the private sector is seen as the driving force for economic development and civil society organizations as guardians of social stability and environmental sustainability. As a result, decisions about environmental partnerships must consistently balance multifaceted sustainability challenges with state, bilateral, and multilateral strategic priorities.

At the same time, we must recall, as we have all noted on many occasions, that local and community participation must be at the core of any effort to reduce environmental risks, especially in relation to climate and land. Strengthening such participation is one of our foremost common tasks.

As rightly highlighted by the Ministry of Environment, Forest, and Climate Change, at one of the TERI's roundtable meet during COP-14 UNCCD, India has spent nearly ₹7 lakh crore on land-related issues. Many business opportunities exist where land recovery is a co-benefit. There are umpteen examples of how





both large and medium business entities could work together towards restoring nearly large swaths of land. Therefore, both the business and private sectors are important players who could strengthen our efforts towards restoring and reviving lands.

Time to Link National and Regional Processes

Land degradation problems must be integrated into planning processes, plans, and policies, with cultural implications that affect livelihoods taken into account. Policy proposals should be directed at all industries involved in land use and management, using each sector's capabilities to further ameliorate land management. There is a need for more detailed information on how action can be implemented, and; larger investments and sustainable land management technologies are required across the Asian continent to harness the full potential and achieve food security and zero poverty.

To capture the benefits and costs associated with land services, more effort is needed. Policies that do not

take a comprehensive perspective to value land-based resources would need to be amended to ensure that land loss is tackled in its entirety, avoiding both visible and hidden social and economic costs. Asia's nations, as well as regional and global stakeholders, must take steps to combat nutrient depletion caused by topsoil loss, which exacerbates agricultural land degradation and productivity loss.

This is not just it! Land is just one of the world's current environmental issues, the most pressing of which is climate change. Our cultures and practices, on the other hand, remind us that land must be viewed holistically, not only from the prism of climate change. Throughout centuries, our farmers, women, indigenous peoples, and indigenous communities have had a close economic, social, and cultural partnership with the land. Climate action, in terms of adaptation and mitigation, as well as sustainable development in general, must understand that land governance differs throughout nations, cultures, and legal traditions, as well as their specific needs and demands. Even as we accept the importance of global

collective action on these issues, we must respect this diversity and the role of individual, sovereign governance, which is embedded in respective national laws. National growth and environmental protection must find a fair and reasonable balance.

While formulating the SDGs, the international community recognized the threats that erosion poses to peace, food security, and livelihoods. Target 15: Life on Land states that terrestrial habitats should be protected, restored, and promoted for long-term use. The Target 15.3 under Goal 15 specifically states that 'by 2030 combat desertification, restore degraded land and soil, including land affected by desertification, drought, and floods, and strive to achieve a land degradation-neutral world'. Reading and re-reading the Goal is a reminder that the goalpost is yet to be secured. World Day to Combat Desertification and Drought celebrated every year in the month of June is a reminder of aggravating changing climate and the need for developing strategies for improved resilience and sustainability across sectors. Let's make it a collective battle against environmental degradation, in hope of (re)connecting societies and environments, and human well-being.

Amidst global economies slowing down, unemployment reaching new records, poverty levels aggravating, growing unsustainable natural resource use, reduced industrial productivity, loss of life, business closures, trade disordering, let's pledge to minimize anthropogenic activities on land leading to degradation thereby strengthening India's commitment to restoring 5 million hectares of degraded land by 2030, in addition to a previous commitment of 21 million hectares. ■

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“CDRI Promotes Resilient Infrastructure to Withstand Climate and Disaster Risks”

Sandeep Poundrik is the Director General, Coalition for Disaster Resilient Infrastructure (CDRI). Here, he is in an exclusive email conversation with **Abhas Mukherjee** for *TerraGreen*.

Please tell us about the concept of the Coalition for Disaster Resilient Infrastructure (CDRI). Who proposed the idea of the need of this organization and what are its objectives?

Infrastructure systems are key drivers of economic growth. But they are regularly exposed to climate change events and natural hazards. Moreover, with the increasing population and its demands,

the existing infrastructure is expected to be placed under additional stress with new infrastructure to be built in hazardous areas.

To reduce the loss of life and property, there is a grave need to address the challenges of building resilience into new and existing infrastructure systems. Aligning the need to build resilient systems, the Prime Minister of India, Shri Narendra Modi, launched the Coalition

of Disaster Resilient Infrastructure (CDRI) at the UN Climate Action Summit on 23 September, 2019.

Today, CDRI has grown to a global partnership of 29 members which includes national governments, UN agencies and programmes, multilateral development banks and financing mechanisms and the private sector.

Its objective is to promote the resilience of infrastructure systems prone

to climate and disaster risks, thereby ensuring sustainable development. CDRI functions as a multi-stakeholder platform to generate and exchange knowledge and resources from members on different aspects of disaster resilience of infrastructure, thus contributing to each other's economic growth.

CDRI aims to create a mechanism by which it can assist countries to upgrade their capacities, systems, and devise standards, regulations and practices with regards to infrastructure development in accordance with their risk context and economic needs.

This initiative will benefit countries in multiple ways: For countries in the early stages of infrastructure development, CDRI provides access to best practices on developing standards and regulatory mechanisms to manage and foster resilience for infrastructure development; while for countries at an advanced stage of infrastructure development, CDRI provides an opportunity to actively engage in developing robust infrastructure systems that are interconnected globally.

Could you please clarify the difference between climate resilient infrastructure and disaster resilient infrastructure?

Climate resilient infrastructure broadly means making infrastructure resilient to disasters which will occur with a greater frequency and intensity due to climate change. However, disaster resilient infrastructure is a much broader term and includes climate resilient infrastructure, as well as geophysical and geomorphological hazards, such as earthquakes, landslides, tsunamis, volcanoes, and so on. Secondly, it also covers man-made disasters, such as nuclear radiation, dam failures or chemical spills.

Hypothetically, if there is no climate change, you still require disaster resilient infrastructure as disasters will continue to happen. Although climate change is occurring with severe consequences,

but even if it did not increase, disasters will still occur in the present conditions. Hence, disaster resilient infrastructure encompasses the building of resilience from all hazards, originating from all sources.

As infrastructure is built for long term, it is imperative that disaster resilient infrastructure addresses risks emanating from low- and high-impact events.

How does CDRI respond to the Sustainable Development Goals' requirements of expanding universal access to basic services, enabling prosperity and decent work with respect to climate and disaster risks?

CDRI promotes resilient infrastructure which can withstand climate and disaster risks, thereby ensuring sustainable development.

Along with its member countries, it seeks to expand the development and retrofit of new and existing infrastructure and its connected systems which can respond to sustainable development imperatives of expanding universal access to basic services, enabling prosperity and decent work.

There are three Sustainable Development Goals (SDGs) which are directly connected with the work of CDRI. These are SDG 9 – Build resilient infrastructure, promote sustainable industrialization and foster innovation; SDG 11 – Make cities and human settlements inclusive, safe, resilient and sustainable; and SDG 13 – Action to combat climate change and impacts.

Other SDGs are also connected with CDRI's work. For example, if you take SDG 6 (Clean water and sanitation), or SDG 7 which is Affordable and clean energy, these are related to CDRI's work too. Without disaster resilient infrastructure you cannot reduce the cost of services, cost of energy, or provide clean water especially in the case of disasters. So, while the three SDGs (9, 11, 13) are directly connected with CDRI's work, other SDGs are also connected, although indirectly with the work of CDRI. Overall,



infrastructure underpins the success of most SDGs with direct tangible results or indirectly by creating the necessary enabling environment and systems.

We know that the Sendai Framework for Disaster Risk Reduction (SFDRR) was approved at the Third World Conference on Disaster Risk Reduction in March 2015, held in Sendai, Japan. How is it different from or an improvement over its predecessor, that is, the Hyogo Framework for Action (2005–2015)?

The Hyogo Framework (HFA) was the first-of-its-kind international plan to explain, describe, and detail the work required from all different sectors and actors to reduce disaster losses. Being its successor instrument, the Sendai Framework for Disaster Risk Reduction (SFDRR) has been built on the experiences of nations around the world of implementing the HFA.

SFDRR highlighted the role of improved disaster resilience of infrastructure as the keystone for sustainable development.

A key difference was the shift in focus from protecting social and economic development against external shocks, to transforming growth and development by managing risks in a holistic manner.

The SFDRR also recognized the primary role of the State to reduce disaster risks, and that responsibility should be shared with other stakeholders

including local government, the private sector, and other stakeholders.

Each framework reflected our global understanding on dealing with disasters' risk and development at the time.

I feel the main advantage this time around, is that the SFDRR works hand in hand with the other 2030 Agenda agreements, including the Paris Agreement on Climate Change, the Addis Ababa Action Agenda on Financing for Development, the New Urban Agenda, and ultimately the SDGs.

SFDRR's target four on reducing disaster damage to critical infrastructure is an important prerequisite to achieving the other loss reduction targets set out in the framework.

Will we see the International Solar Alliance (ISA) and the CDRI complementing each other's activities?

ISA and CDRI are indeed complementary. There are two approaches for disaster resilience, rather for climate resilience—one is climate mitigation which is about reducing the carbon footprint, and the other approach being climate adaptation.

If we increase the share of solar power and reduce the dependency on fossil fuels, then we reduce the carbon footprint. This falls under climate mitigation action, which will help with combating climate change and its impacts which include, increase in frequency and intensity of extreme weather events. With the global concern to keep the temperature rise below 1.5 degree Celsius and the actions required to be taken globally to be carbon-neutral in coming years, reducing emission of greenhouse gases is becoming more and more important. Different countries have set different years to achieve these goals. ISA, as we know promotes solar power, which is an important intervention to reduce the greenhouse gas emissions from the energy sector.

CDRI focuses more on the adaptation side. As per the adaptation approach, our infrastructure and its connected

systems must be able to adapt to the changing climate. When we talk about climate resilient infrastructure, we (CDRI) refer to the adaptation approach to tackling climate change. CDRI is trying to make the infrastructure systems resilient to climate and disaster risks, thereby reducing their adverse impact on lives and livelihoods.

What were the highlights and some of the takeaways of the International Conference on Disaster Resilient Infrastructure (ICDRI 2021)?

ICDRI is the annual international conference of CDRI, in partnership with member countries, organizations and institutions to strengthen the global discourse on disaster and climate resilient infrastructure. This year, it was held from 17–19 March, 2021. ICDRI saw over 2000 registrations from over 100 countries. The Conference was a platform to discuss challenges and opportunities towards achieving the SFDRR targets, SDGs and the Paris Agreement on Climate Change for resilient infrastructure.

Highlights

The inaugural session was graced by the Honourable Prime Minister of India, Shri Narendra Modi; Honourable Prime Minister of the United Kingdom, Rt Hon Boris Johnson MP; Honourable Prime Minister of Italy Mario Draghi OMRI; and Honourable Prime Minister of Fiji, H.E. Josaia Voreqe Bainimarama.

The Policy Forums at ICDRI highlighted the overarching risk governance perspectives critical for building resilient infrastructure. The Technical Forums delved deeper into CDRI's key thematic areas. The Regional Forums shared the lessons, gaps and opportunities from climate and disaster risk-prone regions to contribute to the overall infrastructure resilience agenda in the Caribbean and Pacific Island Countries. Apart from the main event, two tracks for Masterclass and webinars as well as an exhibition space (Resilient

Infrastructure Marketplace) was rolled out.

Key Takeaways

The Conference highlighted the need for creating solutions, and engagements in capacity development, governance, knowledge sharing and communications, and global collaborations for developing disaster resilient infrastructure. There was an underlying emphasis on the need to build resilient infrastructure assets as well as integrated systems that accelerate the transitions, to net-zero emissions over the coming decades; a balance between investments, growth, and adaptation. All of these require innovations to address the three pillars of infrastructure resilience, namely—risk informed infrastructure investments and programmes (development), improved infrastructure governance (preparedness and capacity development), and building back better (early recovery, restoration, and development).

Countries have pledged their support to CDRI through funding and knowledge-sharing mechanisms at the conference. With the need for risk assessment being vital across all infrastructure sectors, CDRI will continue to roll out risk and resilience assessment projects for various sectors at national and sub-national levels to inform policy and practice.

The discussions at the conference emphasized factoring resilience into the conceptualization, planning, design, regulation, and management of infrastructure. This with complementarity of the private finance industry—in partnership with public institutions—can play a critical role in mobilizing private capital to advance investments in resilient infrastructure. Infrastructure planning and investments that can pay back in strong multipliers and encourage sustainable and genuine partnerships for resilient infrastructure development—this is a priority for the future and also the overarching message of ICDRI 2021. ■

Highlights of Our Green Journey in 2020–21





Altered River Flows and Nature's Fury

Need for Efficient Water Resources Management

The theme of this year's World Environment Day is Ecosystem Restoration. Ecosystem restoration can take many forms, such as growing trees, greening cities, rewilding gardens, changing diets or cleaning up rivers and coasts. In this regard, **Simi S Nair** says that human-induced drivers, such as dams, sand mining, over-extraction of groundwater, land use land cover changes, and indiscriminate disposal of untreated non-biodegradable solid wastes have significantly altered river ecosystems, impaired river water quality, and simultaneously increased the severity of disasters, such as droughts and floods.

In recent years, India has witnessed several natural as well as anthropogenic disasters. The devastating effects of the 2018 floods in Kerala have been a wake-up call to understand the threat of anthropogenic activities on river catchments. Accelerated implementation of developmental projects has caused irreversible damages to river ecosystems leading to considerable loss of life and property. Rivers are often viewed as an economically valuable resource for driving agriculture, tourism, aquaculture, and hydropower sectors. However, their environmental value far exceeds the value of the water they carry. Rivers not only function as a natural habitat to innumerable species of living organisms, they also nourish wetlands which in turn deliver numerous ecosystem services important for the survival of all forms of life, such as supply of clean water, flood risk reduction, protection from storms and droughts, prevention of soil erosion, groundwater recharge, nutrient retention, and maintaining local climatic conditions. However, human interventions in the form of construction of dams, illegal sand mining, overexploitation of aquifers, alteration of land use land cover (LULC) patterns, and indiscriminate disposal of

untreated liquid and solid wastes, have negatively impacted several ecosystem services offered by rivers.

Changing Land Use Land Cover Patterns are Affecting River Flows

In Kerala, a land blessed abundantly by rivers, rapid socio-economic growth has fuelled a large number of infrastructure development projects causing changes in LULC patterns, which have drastically affected the flow regime of many important rivers. Changes in LULC patterns are observed as a result of accelerated deforestation, encroachment of floodplains, and conversion of agricultural lands into built-up areas.

According to a LULC study conducted on the Chalakudy river basin in Kerala, 70.5 sq. km increase in built-up area was observed in a span of 23 years from 1995 to 2018 leading to 22 per cent increase in flood peak, which contributed to inundation of larger area during 2018 Kerala floods.¹ The study noted that if the LULC pattern of 1995, with a smaller percentage of

¹ Parvathy and Thomas, 2021



Houses submerged in the flood water in August 2018 in Pathanamthitta, Kerala, India



built-up area and higher percentage of forest cover, was maintained unaltered throughout these years, the flood peak could have been reduced by a factor of 22 per cent and the severity of devastation due to floods could have been minimized. A similar LULC mapping study conducted on the Pamba River basin in Kerala linked alternating cycles of recurring flood and drought to a marked rise in the built-up area from 31.30 sq. km in 1995 to 70 sq. km in 2012, and a steady decline in forest cover from 1156 sq. km in 1995 to 1114 sq. km in 2012.² Changes in LULC patterns altered flow regime of River Pamba, which was traditionally known as sustainable and perennial source of water.

During the 2018 monsoon floods in Kerala, maximum devastation occurred along the banks of the rivers Periyar, Chalakudy, and Pamba. Declining groundwater levels, a reduction in river water flows and occurrence of deep cracks both in the hills and floodplains after the flood event indicate failure of floodwater in replenishing groundwater and occurrence of long dry spell. The reason for reduced river flows was attributed to the leaching of topsoil from the hills upstream due to the destruction of natural vegetation (which would have supported storage of excess water in soil pipes as a result of the infiltration process), changes in land use patterns and granite quarrying in the upland areas altering the natural characteristics of the river.

Low flows have also been observed in River Gomti as a result of changing LULC patterns. A study observed reduction in forest cover, wetlands followed by fragmentation of rivers and floodplains coupled with exploitation of groundwater resources as contributing factors to drying of several tributaries feeding River



Heavy drought in Kerala; after effects of Kerala Flood 2018, Idukki, Kerala

Gomti, thereby causing reduced river flows and water scarcity.

Depletion of Groundwater Storage is Running Rivers Dry

During pre-monsoon dry periods, groundwater seeps into nearby rivers maintaining requisite river water levels. However, overextraction of groundwater has significantly altered this phenomenon causing a substantial reduction in river water levels. A declining trend in River Ganga's water levels at the rate of -0.5 to -38.1 cm/year between the summers of 1999 and 2013 has been attributed to the depletion of groundwater storage in the adjoining Ganga aquifers owing to excessive groundwater pumping.³ For millions of people dependent on the waters of the River Ganga, reduced river flows will negatively impact drinking water supply, agricultural crop water demands, power-generating projects, and means of livelihood.

In-river Sand Mining and Floods

Exponential population growth has created increased demands for infrastructure development projects which require huge quantities of sand to meet construction requirements. However, sand is also vital for the sustainability of river ecosystems. The presence of sand and boulders help in regulating river flows, recharge groundwater, filter pollutants, and support biodiversity. Rapid urbanization and the increase in the number of construction projects fuel the need for illegal sand mining to reduce costs. Illegally mined river sand can have disastrous consequences including but not

² Mayaja and Srinivasa, 2017

³ Mukherjee, *et al.*, 2018

limited to change in river course, river-bank erosion, flooding, adversely impacting groundwater table, and habitat destruction for countless aquatic fauna and flora. Interruption in sediment transport due to extraction of sand from floodplain can force the river water flow to become sediment starved (hungry water) causing channel bed erosion, channel incision, and coarsening of bed material inducing channel instability and lowering of water tables leading to river bank degradation and therefore increasing the probability of floods.

Small Developmental Projects with Big Impacts

Hydropower projects of capacity below or equal to 25 MW are classified under small hydropower projects (SHPs) in India. These projects are promoted as a clean energy alternative to big hydropower projects. However, they are not as eco-friendly as they are deemed to be, since they can cause deleterious environmental impacts. SHPs can cause considerable flow reductions in the downstream end of constructed dam, altering stream geometry, water quality, and disrupting freshwater fish communities. In Himachal Pradesh, Hul hydropower project in Chamba or the Haripur Nallah project in Kullu, has negatively impacted



local irrigation systems, water-powered mills, and fisheries. Construction of SHPs in ecologically fragile areas can cause fragmentation of rivers, decrease in river depth, and velocity resulting in siltation, drying of river beds, and habitat degradation.

Deteriorating Water Quality of India's Sacred Rivers

From time immemorial, rivers have been the nucleus of socio-cultural values defining their cultural and spiritual representation. Value of water has thus extended beyond just supporting and sustaining life for



Image of low-capacity dam on River Ganga for power generation



human civilization. Water has also played an important role in the well-being of people across diverse faith and traditions. Since the well-being of humanity is inseparably linked to a range of water-related functions that contribute to the vital elements of their overall social, cultural, and spiritual well-being, many cultures have supported and promoted protection and conservation of water.

In India, rivers such as Ganga, Yamuna, Saraswati, Indus, Narmada, Krishna, Godavari and Pamba are highly revered and even personified as deities in Hinduism. Hindus have an organic association with these holy rivers which forms an integral part of their festivities, culture, and customs from birth to death. Once pristine, waters of these holy rivers are now carrying massive amounts of untreated sewage. Apart from industrial effluents, these rivers are known to carry huge amounts of untreated solid waste generated during religious festivals. Reports indicate one such large religious gathering on the River Ganga in 2019, generated around 2000 tonnes of unsegregated solid waste.⁴ This raw sewage left untreated owing to non-functional/partly functional sewage treatment plants, made its way into River Yamuna which ultimately pollutes waters of River Ganga making it unfit for human consumption as well as negatively impacting aquatic flora and fauna. Similarly, study points towards

another religious gathering in 2018, where 100 million litres per day (MLD) of sewage was generated and exceeded the sewage plant capacity of 45 MLD causing untreated effluents to drain into the River Ganga.⁵ Open defaecation near river banks, bathing and disposal of non-biodegradable wastes during these mega festivals, generate huge quantities of toxic solid and liquid wastes which are left unmanaged and end up in the drains and rivers, thereby choking and polluting them. These rivers receive a lot of non-biodegradable wastes in the form of idols, plastic garlands, frames, wrappers, bottles, and so on after the festivals. Immersion of idols made of Plaster of Paris (PoP), that contain calcium sulphate hemihydrate with small quantities of plastic and cement, often covered in toxic paints during festivals takes several years to degrade, and reduces dissolved oxygen levels of water, threatening aquatic life. In the past, traditional rituals were performed using biodegradable decorations and frames made principally of clay, mud, flowers, and cotton fabrics. These sustainable practices have now been completely abandoned and instead several non-biodegradable items containing toxic and harmful substances are used, which are economically cheaper but detrimental to river water quality and environment. The immeasurable and complex value of water for social, cultural and spiritual needs of the human population has not faded,

⁴ Details available at <https://www.downtoearth.org.in/news/pollution/faith-to-filth-thanks-to-kumbh-prayagraj-sinks-in-solid-waste-64579#:~:text=The%20Kumbh%20Mela%20generated%20more,the%20open%E2%80%94untreated%20and%20uncovered>. Last accessed on May 21, 2021.

⁵ Details available at <https://timesofindia.indiatimes.com/city/dehradun/ganga-left-polluted-with-human-waste-as-kanwariyas-defecated-in-open-during-yatra/articleshow/65392408.cms>. Last accessed on May 21, 2021.



A group of men mine sand by extracting silt residue from the river bed

rather increased with rising population, improvement in economic status, and access to transport and communication. At the same time, it has to be noted that industrialization and urbanization have alienated human populations from their rivers, thereby disintegrating their vital role in water conservation and protection which has tremendous impact on the water resources of the country.

Conclusion

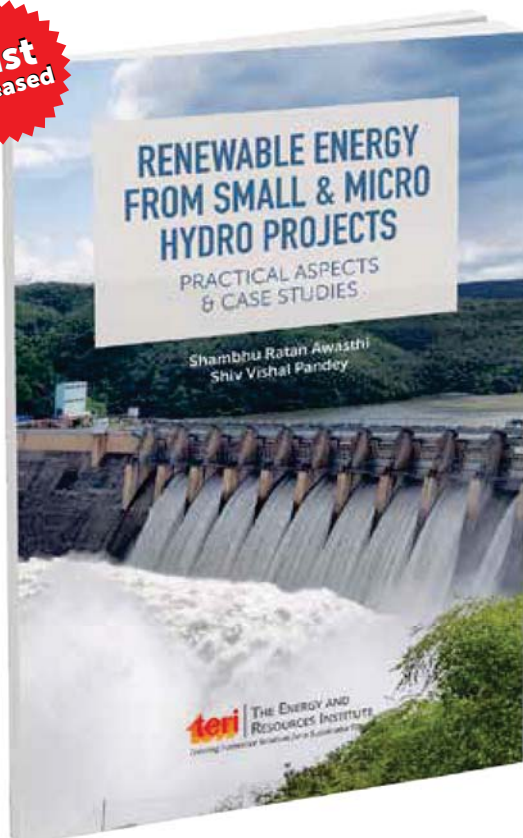
Human-induced drivers, such as dams, sand mining, over-extraction of groundwater, LULC changes, and indiscriminate disposal of untreated non-biodegradable solid wastes have significantly altered river ecosystems, impaired river water quality, and simultaneously increased the severity of disasters, such as droughts and floods. Fragmentation of river basins, pollution, alteration of river flows and drying up of groundwater storage have significantly impacted food production, livelihoods and have caused water scarcity along with causing severe public health impacts. Trade-off analysis between developmental projects and river ecosystem functions is a critical challenge lying ahead of decision-makers at the local and national levels. River ecosystem service assessments with improved insights into interactions between various ecological and socio-economic processes will help in decreasing

potential damage to the quality and quantity of existing water resources from anthropogenic activities. Sustainable water resource management calls for conservation programmes and policies focused on hydrogeological characteristics of the watershed as well as increasing awareness about zero waste generation, and adopting eco-friendly traditional practices. The current state demands additional measures built upon comprehensive scientific research dedicated to altered river ecosystems and their future impacts on our environment. While the pressures from socio-economic development incessantly rise, the implementation needs a profound understanding of scientific research and local conditions. Increased community awareness, planning, improved institutional coordination, and stringent implementation for addressing crucial issues related to river ecosystems need to be augmented. Effective policy formulation requires holistic approach to current issues related to water management. Enhanced community participation to better understand lessons from the past, present impacts and future development goals coupled with extensive ecosystem service assessments, hydrological and hydrogeological analysis, will help in implementing successful national policies for valuable water resources management. ■

Simi S Nair is Consultant, Mu Gamma Consultants Pvt. Ltd, Gurugram, Haryana.

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Sustainable Nitrogen Management

Desideratum of the Decade and Afar

In this article, **Dr Anil Pratap Singh** highlights that there is an urgent need for sustainable nitrogen management as nitrogen pollution threatens to become a major environmental challenge in the years to come.

Nitrogen and its compounds lavishly present in the nature are vital for sustenance of life at the threshold, but their disproportionate amounts threaten human health, biodiversity, livelihoods, and overall well-being. In the recent past, the amount of nitrogen in chemically-reactive forms has almost doubled. Due to relevance to most of the Sustainable

Development Goals (SDGs), scientists are now harmonizing and hastening with the United Nations (UN) towards the goal to halve nitrogen waste by 2030. There is an urgent need of global action diversely—as nitrogen pollution is before us to pose problems as a major environmental challenge.

The United Nations Environment Assembly (UNEA) gravely highlighted

intensification of the levels of reactive nitrogen in its fourth session that was held in Nairobi (Kenya) during March 11–15, 2019. Here, the first-ever ‘UN Resolution on Sustainable Nitrogen Management’ was adopted and created provisions for smooth progress of coordination of policies across the global nitrogen cycle at the national, regional, and global levels. In this assembly,



the Government of India played a momentous role and led the resolution on nitrogen pollution towards global accord which entails a down-to-earth programme of action.

Ineluctability of Nitrogen for Lives on Earth

Humanity's very existence depends on nitrogen. Despite the fact that nitrogen (N_2) is present abundantly, that is—around 78 per cent in the Earth's atmosphere—it is metabolically unusable by living organisms except some microbes such as *Rhizobium*. To make nitrogen usable, it requires to be transformed into its other forms or reactive nitrogen. Nitrogen essential for all living organisms, is part of DNA, amino acids, proteins, chlorophylls, vitamins, and many other organic compounds. The betide of Green Revolution was principally attributable to the use of nitrogen fertilizers.

Intricacies of Extravagant Use of Nitrogen Fertilizers in Agriculture

Wasteful use of nitrogen fertilizers in agriculture is polluting the land, air, and water. This defying inefficient use of nitrogen is measured in terms of nitrogen use efficiency (NUE). Large amounts of nitrogen used as fertilizers gets wasted and leaks into rivers, lakes, and seas—feeding algal blooms that diminish oxygen and annihilate life.

The world uses more than 100 million metric tonnes of nitrogen fertilizers on yearly basis. However, data sources indicate that India consumes 17 million tonnes of nitrogen fertilizers per annum, of which over 60 per cent is missed in being utilized by crops in the form of nitrates. The remaining stays either in the soil or seeps into the contiguous environment, thereby dipping down the



NUE. Globally, 50 per cent of nitrogen fertilizers added to farm field wind up as pollution or is shattered by denitrification back to N_2 .

Consequence of Greater Applications of Nitrogen Fertilizers

Plants sop up nitrogen from the soil through their roots, in organic form as an amino acid, nitrate (NO_3^-), nitrite (NO_2^-), and ammonium ions (NH_4^+). Greater applications of nitrogen fertilizers not only cause higher farming expenditures, but also have a detrimental bearing on the soil, environment, and plants. Excess nitrogen remnants in the soil not only budge into water resources but also move into the atmosphere causing nitrogen pollution. Nevertheless, long-term application of ammonium-based fertilizers causes soil to become acidic, depressingly affecting crop production. In aquatic bodies, nitrates chip in progressive enrichment with minerals and nutrients; the process called eutrophication in terms of limnology and also referred to as dystrophication or hypertrophication leading to harmful algal blooms, dead-zones and biodiversity loss in freshwater and marine environments that largely impact fisheries and water quality including potability. The excessive amassing of

nutrients may also increase unfavourable health impacts, such as blue-baby syndrome, due to high levels of nitrate in potable water. Moreover, nitrogen smashes up ecosystems through acidification of soils and marine waters.

Nitrogen Pollution as Prevailing Environmental Concern

The United Nations Environment Programme (UNEP) brought out its publication, 'Frontiers-2018/19' that dealt with 'emerging issues of environmental concern' wherein pollution caused by the reactive forms of nitrogen was discussed. It is worthwhile to mention that reactive nitrogen includes all forms of nitrogen other than the inert dinitrogen of the air, which includes nitrate, nitrite, nitrogen oxides, nitrous oxide, ammonia, organic compounds, etc. Nitrogen is present in air, water and soil, in its various forms and nitrogen oxides (NO_x) from vehicles produced from the reaction of nitrogen and oxygen gases in the air during combustion emanate into the atmosphere. Atmospheric emissions of oxides of nitrogen diminish air quality and deplete protective layer of stratospheric ozone and contribute to climate change.

Nitrogen oxides when combined with ammonia passing through particulate

matter, amplify the perils of respiratory ailments and cancer. Not just that, at times, acute and chronic exposures to NO_2 are fatal and linked to respiratory and cardiovascular diseases both among children and elderly people together with its susceptibility among persons with asthma. Diversely, 80 per cent of the global ammonia emissions come from human activities, largely fertilizer applications and animal husbandry. Also, ammonia and nitric acid react to form ammonium nitrate in particulate matter which also enhances risks of respiratory and heart diseases. Nitrogen pollution is one of the most imperative environmental issues of the 21st century, responsible for air and water pollution as well as climate change and stratospheric ozone depletion. Nitric acid rain due to mixing of N_2 emissions with rainfall is also a potential danger.

Links Between Sustainable Nitrogen Management and SDGs

Accredited by scientists and other researchers, sustainable management of nitrogen is highly linked to the accomplishment of multiple SDGs,

which required appropriate attention of policymakers, businesses, politicians, farmers, civil society, and the general public. In recent years, obligatory policies and actions are being taken by many countries in order to mitigate the effects of reactive nitrogen while maintaining agricultural production. The scientific community is further working with the United Nations to coordinate and accelerate the necessary action in order to halve the nitrogen waste by the end of the decade which would save \$100 billion annually.

Incessant Ventures and Looking at Cosmopolitan Alliances

Despite enormity and intricacy, requisite endeavours to curb down nitrogen pollution were insufficient but incessant. In October 1988, Sofia Protocol concerning the control of emissions of nitrogen oxides or their trans-boundary fluxes called for controlling or reducing emissions of nitrogen oxides. This Protocol was further amended in 1996.

Thereafter, launched in October 2017 for a 4-year period and led by UN Environment with funding through

Global Environment Facility (GEF), \$6 million project delivering towards the 'Targeted Research for improving understanding of the global nitrogen cycle towards establishment of an International Nitrogen Management System (INMS)' simply called 'Towards INMS-project' rather creates optimism. INMS aimed to bring together the science community, the private sector and civil society to gather and synthesize evidence that can support international policy development to improve global nitrogen management.

It has been realized that nitrogen as used in agriculture and in industries including pharmaceuticals, needs to be at threshold through effective implementation of regulatory mechanisms. International Nitrogen Initiative (INI), which dubbed nitrogen as the 'new carbon', was set up in 2003 under sponsorship of the Scientific Committee on Problems of the Environment (SCOPE) and the International Geosphere-Biosphere Program (IGBP), which also holds conferences on nitrogen issues.

The United Nations Global Campaign on Sustainable Nitrogen Management was launched in Colombo in 2019 with a theme of 'Nitrogen for Life' as a crucial step to create awareness among policymakers and the public. Created by Grammy Award winner Ricky Kej, 'The Nitrogen Song' was also premiered at this launch with the aim of raising wakefulness among masses. The 'Colombo Declaration' endorsed the 'UN Roadmap for Sustainable Nitrogen Management, 2020–2022' as prepared under the leadership of UK Centre for Ecology and Hydrology (UKCEH). UKCEH and UNEP co-developed the 'Inter-convention Nitrogen Co-ordination Mechanism' (INCOM). In May 2020, the European Commission included the goal to reduce nitrogen pollution by 50 per cent by 2030.

The United Kingdom has invested more than £20 million for the sake of research on nitrogen pollution. In



Denmark, a series of policy action plans have been implemented with significant effects on the surplus, efficiency, and environmental loadings of nitrogen. The United States, the European Union (EU) and India have also assessed the environmental impact of nitrogen on their respective regions and are therefore exploring global cooperation for its feasible management.

Circular Economy Towards Reducing Carbon Footprints and Clean Farming

Replicable potential of the track of adoption of Circular Economy Packages (CEP) by the EU, which aimed at maximizing the efficiency of resource use in each and every step of value chain, that is, production, consumption, waste management and recycling of raw materials, is also getting the attention nowadays. In these arrangements, the EU recognized the management and trade of organic and waste-based fertilizers as key in the recovery and recycling of bionutrients, such as nitrogen and phosphorus, back in its economy. Hence, the recovery of nitrogen from biowaste is anticipated to reduce or substitute the need for synthetic or inorganic nitrogen fertilizers. This will minimize carbon and energy footprints while production and also help to reduce losses of reactive nitrogen into the environment. Presently, recovery and recycling of nitrogen is not only essential for sustainably clean farming practices but also for circular economies.

Certain Realistic Way-outs

At this point in time, policies to change farmer behaviour and incentivize the adoption of good practices might be a boon in preventing nitrogen pollution. Such policies could do with free advisories and trainings for farmers.



Indicating the economic benefits to farmers of adopting good practices will prove more effective. Additionally, towards optimized crop yields along with minimal losses to water and air, some scientific recommendations for nitrogen management are worthy enough to be opted and scaled up. For example, applying nitrogen as close as possible to the period of rapid crop uptake; since the amount of nitrogen desired to optimize crop yield often differs significantly from field to field, hence meticulousness in farming is necessary in order to reduce over-application; proper considerations of timing and consistency of applications, geographic location, crop and soil type, residue level, expected rainfall, temperature and soil moisture levels, etc., are also a few of the decisive factors while making applications of nitrogen fertilizers. Also, according to a study published in 2018 in *Nature Geoscience*, 'multiple wetlands' or 'wetland complexes' in a watershed are extremely effective at reducing excess nitrate from crop fertilizers in rivers and streams. The research was conducted in more than

200 waterways in the 17,000-square-mile Minnesota River Basin (MRB). 'Wetland complexes can be five times better at reducing nitrate than the best land-based nitrogen mitigation strategies,' researchers suggested.

In 2020, as per the satellite imagery from the European Space Agency (ESA), there was noticeable fall in NO₂ levels over cities and industrial clusters in Asia and Europe due to coronavirus pandemic and related shutdowns.

Future Outlooks

Inclusive consensus on increased NUE is a pressing priority. Apart from nitro-awareness, Green Economic Recovery (GER) in the times of COVID-19 must be considered as a necessity by politicians, policymakers, businesses, farmers, civil society, and the public in the current decade and afar towards broader and sustainable approaches of nitrogen management. ■

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

Are We Ready for a Circular Economy?

Challenges and Solutions

On the occasion of World Environment Day on June 5, **Ram Ramprasad** presents his views on circular economy and feels that it is time for all stakeholders, individual citizens, companies, and global leaders to start dismantling old paradigms of thought and action. Building a circular economy is the responsibility of every individual, not just governments.

Famous physicist Albert Einstein correctly stated that we tend to do the same things over and over and expect different results, which is the familiar old-wine-in-a-new-bottle mindset. We see it everywhere, as in linear economics, wherein ideas and policies change within the same framework, yet we believe the results will be different.

Experts speak of a circular economy, which is generally defined as having two pillars: 'restorative' and 'regenerative'.

Restorative is where we try to nurture an idea by preserving it, and by keeping it in its original state. For example, cell phones or laptops being recycled and aiming towards achieving zero waste. The regenerative pillar embellishes the idea and in fact transcends it by enabling a far healthier reality for the next generation. For example, the science of Ayurveda was not just an ancient tradition of consuming the right plant food for health and healing; deeper aspects of the science encouraged holistic farming and

right agricultural practices to promote good soil health and organic vegetation, including a right way to raise animals. Ayurveda enabled an appropriate balance in nature and demonstrated that human digestive anatomy in all of its aspects resembles that of herbivores. The saints of India, not to mention contemporary western scientists as well, have validated this. Related non-governmental organizations, including People for the Ethical Treatment of Animals (PETA) have endorsed it too.

Dr Ulrich Berk, President of the German Association of Homa Therapy (homa therapy is an allied science to Ayurveda and an ancient Vedic practice) has shown astonishing results with respect to homa therapy in major areas of clean global development—environment, air quality, soil health, and human health. Vasant Paranjpe (founder president of Fivefold Path, Inc., a Virginia-based non-profit organization) has also done extensive work in the area of homa therapy. Governments and entrepreneurs could leverage this science by serving related domestic and international stakeholders; this will further validate a near-forgotten science which could well be one of our last hopes for reversing the crisis of climate change according to Vasant. Similarly, the science of Vastu



Vidya (Feng Shui in some countries) emphasized proper layout planning of houses, towns, and cities so that individuals and institutions can enjoy vibrant living communities, where cross-culture and cosmic energy can be better utilized. The Vastu philosophy helps understand physical aspects of nature and encourages utilization of harmony-inducing materials to optimize life and living.

To date, the world has given minimal attention to the 'regenerative' pillar. Eco-villages aim to focus on both pillars of a circular economy, but only few such villages exist. Smart city concepts have overshadowed the need to have smart villages. Similarly, every state in India can do its part to protect sacred trees from going extinct by simply developing an ecological 'ayur-vanam' or holistic forest where these trees can serve as living—and breathing—laboratories and facilitate ecological innovations. These forests could also be our hope to address the acute water crisis. There are illuminating talks on TED on how animals can help enrich the soil by simply roaming around and stomping on their own excreta. Plenty of examples also



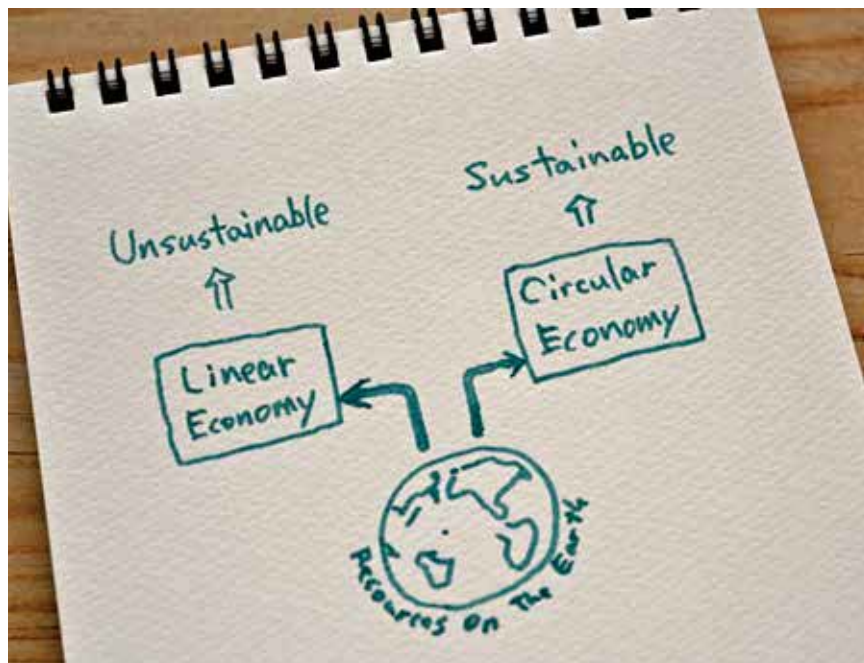
exist on biomimicry, such as creating highly energy-efficient buildings based on how termites build their mounds.

If any country has to address inequality, holistic economic progress, low crime, good health (both physical and mental), and several associated ills of linear economics they need to focus on restorative as well as regenerative pillars of a circular economy. It is a tragedy that people still tend to think that linear

economics lead to higher economic growth and progress. The outcome has been just the opposite, leading to more trash in our air, soil, oceans, and our own bodies. This crisis is now called climate change; one suspects it may also be the breeding ground for the current COVID-19 pandemic.

A vision to build a circular economy must be embraced collectively by individuals and global societies. Wisdom of the East and sciences of the West need to coalesce. The West needs to open its mind to Eastern ideas to build harmony within oneself (ability to realize our true nature) and to build harmony outside ourselves by doing the least harm to the five natural elements—air, water, fire/energy, soil, and space. The East needs to re-explore its lost wisdom instead of blindly emulating the West on linear economics.

At the same time, we also need to gradually discard and dismantle all brute force technologies, such as fossil fuels and plastics. These non-compostable relics of an industrial era have acidified our oceans and our soil. Material science has now advanced significantly. Today, most products—from textiles, rubber and leather to bricks and diamonds—can be grown in a lab using microbes. New buzzwords,



My mother the beautiful
 My father the strong
 Together they supported the six of us
 True souls living in perfect communion with nature
 The house we lived in was a haven for recycling
 Orange peels were made into pickles
 Seeds of mango, papaya, and grape were given to farmers
 Plastic bags were knitted into delightful mats
 Leftover milk was converted to curried dish
 Fresh mud with coconut husk was used to clean pots and pans
 Our humble pet cow gave us milk
 Its dung when sprayed kept pests away
 We shampooed with shika nuts,
 My sister rejuvenated her face with turmeric,
 Not one tooth lost at 84, my father brushed with finger and herbal tooth powder
 My mother knew all of grandma's remedies
 Yet, when the time was right
 She rushed my brother to hospital for an appendectomy.
 Mom and dad faced calamities with common sense
 Not surprisingly they communed with nature
 As youngest child I was bitter wearing recycled clothes
 But, alas I knew mom's wisdom,
 I read comics and books from the library while sitting on a bicycle
 Old newspapers were sold back to the recycling vendor.
 My father, a horticulturist, taught kitchen gardening skills on radio
 In his spare time, if he had any
 He invented through natural means a seedless custard apple
 And was honoured with a Doctoral degree from the US of A,
 I read all about it in my 6th grade Telugu textbook.
 Doctoral degree then was given for enabling simple solutions to complex problems
 Doctoral degree now is conferred for complex solutions to simple problems.
 My mother revelled in her culinary skills
 Bagged prizes in national contests
 She transformed grated potato skin into a culinary delight
 Nothing was wasted in her presence
 She watered the garden using water from the well
 She bartered plantains for mango and guava
 She nourished our bodies with a variety of fruits
 Cross-legged we ate breakfast, lunch, and dinner
 Instinctively she knew it would prevent arthritis
 Everything was recycled and nothing was polluted
 Not the water that left our drains
 Nor the air that breezed through our windows
 She celebrated festivals with zest and zeal
 Stringing garlands of flowers with jasmine and hibiscus
 She woke us up at 4 am to celebrate Diwali,
 And made us crack the dawn with incense and fireworks
 Dad and mom touched everyone and created magic where we lived
 Indeed, by understanding nature and subtle energy
 They created a circular economy in a place we called home...

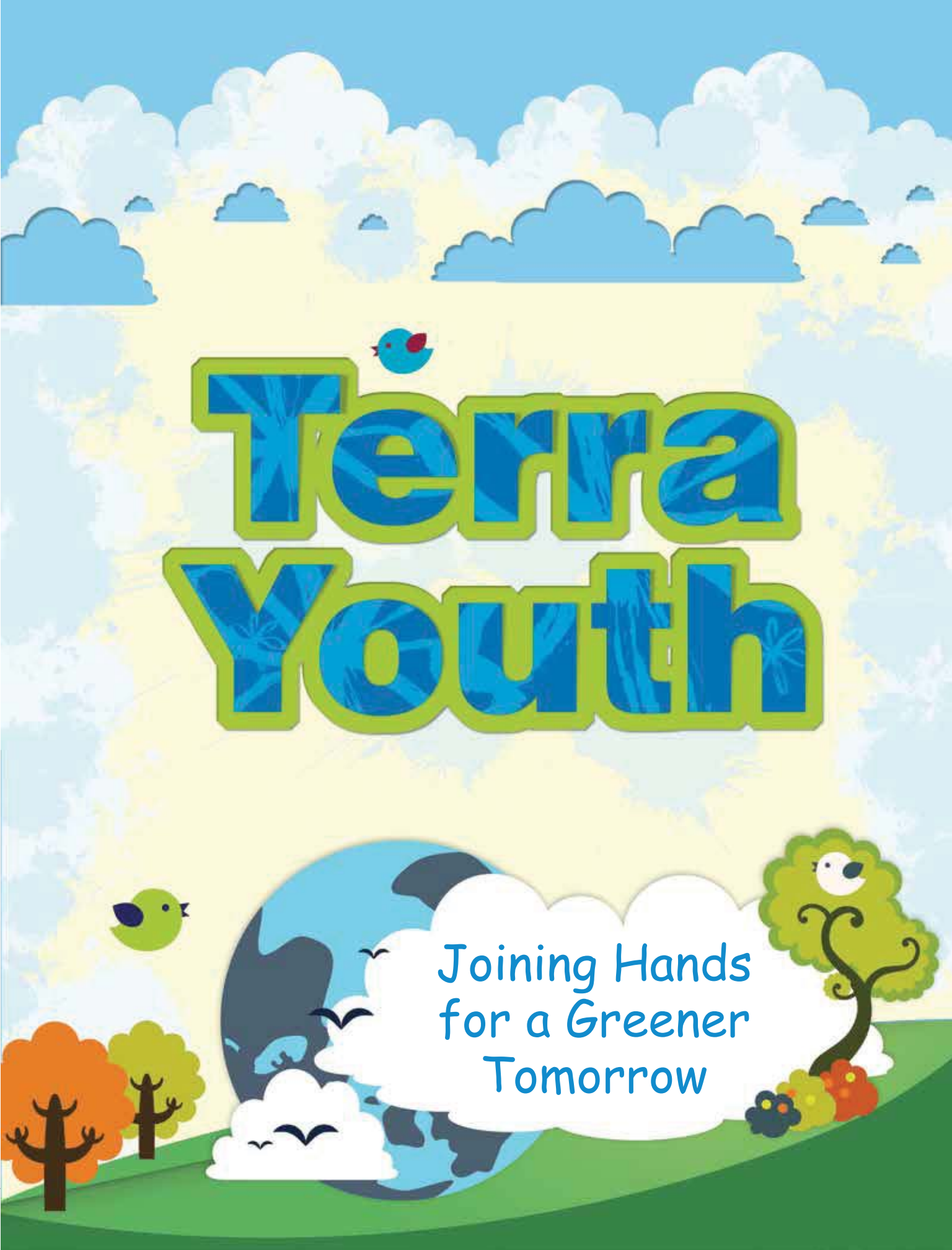
such as biofabrication, renewables, and green technology have entered into our social lexicon, but they have yet to find expression as transformational policy within institutions and governments. Citizens of every country need to press policymakers to provide the right framework that support a circular economy. Communities and companies should get together to champion such initiatives.

True individual and corporate social responsibility begins when one dials up innovation on 'restorative' or 'regenerative' pillars. For example, households moving from chemical to natural cleaners, and online retailers shifting from fossil based to compostable packaging. When everyone—individuals and institutions—constantly and continuously focus on restorative and regenerative pillars of a circular economy they add value, increase employment, address inequality in wealth, and above all improve the overall prosperity and health of a nation. Carbon neutral economies, such as Costa Rica and Bhutan, have demonstrated that a slow shift towards a circular economy has increased their GDP over the years and enhanced overall health and happiness within.

It is time all stakeholders, individual citizens, companies, and global leaders start dismantling old paradigms of thought and action. Change only happens from the bottom-up. Building a circular economy is the responsibility of every individual, not just governments. The journey to make the shift will be soul satisfying. Let us all leave the world a better place than when we came.

The poem on the left side illustrates how my parents created a circular economy in the 1960s. Compare and contrast with what we have today. ■

Ram Ramprasad authored the books, *Creating a Green and a Cultural Economy and Healthcare Reborn: Innovative essays that will lower costs and improve well-being through balance and harmony.*



Terra Youth

Joining Hands
for a Greener
Tomorrow

Setting Goals for Our Planet's Restoration

An Upcoming Decade of Hope

In consonance with the stated goals of the United Nations Environment Programme, this article attempts to disseminate fundamental aspects of ecosystems to our young readers with an intention to assist them in doing their bit by knowing the local ecosystems around them, identifying the drivers of degradation, and thinking about ecosystem restoration.

World Environment Day 2021 will mark the formal launch of the United Nations 'Decade on Ecosystem Restoration 2021–2030'. India's neighbouring country Pakistan will act as global host of the day. World Environment Day 2021 will see the launch of the UN Decade on Ecosystem Restoration in association with the United Nations Environment Programme (UNEP) on the theme 'Ecosystem Restoration'. The objective for the upcoming decade will be to raise awareness of the importance of

various ecosystems and take action for ecosystem restoration.

What is an Ecosystem?

Well-known American Biologist E P Odum defined ecosystem as 'any unit that includes all of the organisms in a given area interacting with the physical environment so that a flow of energy leads to clearly defined trophic structure, biotic diversity, and material cycles within the system is an ecological system or ecosystem'. The term 'ecosystem' is often considered synonymous with the word

'environment.' However, the physical environment (abiotic) and the living organisms (biotic) are the two essential components of the ecosystem. The interaction between the two components leads to ecosystem functions, such as energy flow, primary production, decomposition, nutrient cycling, etc. Also, healthy ecosystems provide various benefits to human beings, known as ecosystem services. Provisioning, regulating, cultural, and supporting services are the four categories of ecosystem services. Provisioning services include food, potable water, timber, fuelwood, oils, and medicinal benefits. Regulating service is the benefit provided by ecosystem processes and includes pollination, water purification, erosion and flood control, decomposition, carbon sequestration, and climate regulation. A cultural service is a non-tangible benefit that contributes to the development and cultural advancement of people. Ecosystems themselves could not be sustained without natural processes, such as photosynthesis, nutrient cycling, soil formation, and the hydrologic cycle. Without the above-mentioned supporting services, provisional, regulating, and cultural services would not exist. These benefits are available free of cost, and therefore it is being proposed that putting a price tag on ecosystem



services will give reasons to protect the ecosystems.

The Ecosystem Around Us

From the lawn gardens to the prairies and the Amazon rainforest, from those small backyard ponds to the lakes and the oceans, the fish tanks in the corner of the room, to the mighty Himalayas, and the estuaries—all are examples of the ecosystem. This article will dive into different ecosystems such as forests, freshwater ecosystems, urban ecosystems, oceans, croplands and grasslands, mountains, and peatlands. Forests and trees provide us with clean air and water, capture CO₂ and harbour most of Earth's biodiversity, supply food and fodder, fuel, and materials. Forest ecosystems, unfortunately, face massive pressure due to over-population. Vast areas of forests are being cleared and degraded at an unprecedented pace. Restoring forest ecosystems involves planting trees and assisting natural regeneration. Freshwater ecosystems, such as rivers and lakes, provide unique habitats for many aquatic flora and fauna. These ecosystems face severe degradation due to pollution. Steps that can play a part in the restoration of freshwater ecosystems include cleaning them, regulating their access, restoring vegetation, and using their resources sustainably. Urban areas such as towns and cities occupy less than 1 per cent of the Earth's land surface but host more than half of the total population on Earth. Characterized by crowds and traffic, paved and concretized surfaces, steel, and metal-based infrastructures, wastes, and emissions—cities and towns are still considered ecosystems. Healthy urban ecosystems can help clean air and water, cool urban heat islands (UHIs), host urban biodiversity, and protect and provide recreation opportunities. Urban ecosystems, in general, are highly degraded. Approaches aimed towards creating green public spaces through the



restoration of urban water bodies and wetlands and tree plantation along roads and railways and in public spaces help improve the health of urban ecosystems.

Oceans cover almost two-thirds of the Earth's surface, regulate the global climate, and host huge biodiversity. Oceans and coasts face immense threats, mainly due to pollution and global warming. We can restore ocean ecosystems by cleaning them and judiciously using the ocean resources. Croplands and grasslands supply food, fodder, and fibre. Intensive agriculture, overgrazing, and soil degradation are severe threats to these ecosystems. We can restore these ecosystems by reducing the use of chemical fertilizers and pesticides and using green manure to boost crop productivity and improve soil health. Mountains harbour most of Earth's biodiversity hotspots and supply fresh water. Mountain regions are susceptible to degradation from anthropogenic pressures, particularly rising global temperatures. Restoring mountain ecosystems may include replanting forests, limiting extraction of mountain resources, and promoting and adopting sustainable farming techniques, such as agroforestry. Peatlands store nearly 30 per cent of terrestrial soil carbon and control the supply of water, food, and fuel, and prevent floods and droughts. Globally, peatlands are being converted to agriculture fields and sites for infrastructure development, mining, and oil and gas exploration. Also, to prevent dangerous climate change, we

need to hold peatland carbon where it is. To restore peatlands, they may be declared protected areas, and the sustainable use of peatlands may be allowed outside protected areas.

The Way Forward

The upcoming decade provides an opportunity to reset our planet Earth by taking steps towards ecosystem restoration. Restoration experts worldwide have finalized three principles applicable to all ecosystem restoration projects: get everyone on board, set goals and measure progress, and help nature help itself. Sustaining healthy ecosystems is essential for human well-being. It, therefore, requires all of us on board—individuals, workers, farmers, teachers, youth groups, civil societies, authorities, local people, women, government, religious leaders, and scientists. The second principle is to set many small but achievable goals such as learning the basics of ecosystem restoration, sharing the necessary skills and knowledge with others, deciding the timeline of the action plan, and assessing the progress made towards restoration. Lastly, we should help nature recover itself. Converting a degraded ecosystem to a pristine condition cannot always be done. However, we can make them heal and recover naturally by reducing anthropogenic pressures. ■

Article contributed by Dr Md Maroof Azam, Research Associate, School of Environmental Sciences, Jawaharlal Nehru University.



Quiz



Test Your Environmental Awareness

1. Which crocodile is sometimes called 'kangaroo croc' because it can jump up to two metres vertically?
2. In 1992, I made it to the *Guinness Book of World Records* by swimming at a speed of 35.28 kilometres per hour in water. Who am I?
3. The film King Kong, made in 1933 was inspired by an extensive expedition to study which animal?
4. Which is considered the most destructive hurricane in American history?
5. A smog caused by volcanic eruptions is known as?
6. The Gulmohar tree is native to which place?
7. Late Sunderlal Bahuguna's Chipko Movement was inspired by Mahatma Gandhi's which famous movement?
8. Name the scale that is used to rate hurricanes.
9. Which decade was declared the 'International Decade for Natural Disaster Reduction' by the United Nations?
10. The World Meteorological Organization is headquartered in which city?

Answers
1. Cuban crocodile; 2. Leatherback sea turtle; 3. Komodo dragon; 4. Hurricane Katrina; 5. Vog;
6. Madagascar and the islands of Mauritius; 7. Satyagraha; 8. Saffir-Simpson scale; 9. 1990s; 10. Geneva.

Good Samaritans Trust

A Ray of Hope Amidst Pandemic

In a society where elderly people are considered a burden, Mr A I George Rakesh Babu, Founder, Good Samaritans Trust, is an inspiration for everyone. Being abandoned and left alone to die, some elderly people don't have any food and shelter. Good Samaritans Trust is a team with compassion for the needy and neglected people. They are a medically-trained small group of personnel who take care of these abandoned people, also called destitute, provide them with food, shelter, and respect in their last years of life.

Good Samaritans Trust was started in March 2011. It is a formal trust with co-founders Sunita George and Yesukala. It is the first trust in Hyderabad to rehabilitate the abandoned elderly people to home.

They also provide them free medical assistance and take care of all their needs. 'Besides providing food, shelter and care, the Good Samaritans Trust also plays an inevitable role in reuniting migrants with their families. More than 2000 migrants have been reunited with their families to date,' says Mr George. The untimely death of a Tamilian priest Late Mr Ganesh Prabhu changed Mr George's perspective towards life. Despite numerous challenges and absolutely no support from family or relatives, he strived to give over 60 orphans a quality life. Dedicating his entire life for the cause of orphans, Mr Ganesh Prabhu was humiliated in the last years of his life and even failed to get a dignified burial. This incident had a significant impact on George's life. He thought that every person has the

right to live their lives to the fullest and everybody has the right to a dignified death. This led to the emergence of Good Samaritans Trust.

According to Mr A I George Rakesh Babu, 'The abandoned or destitute included elderly people suffering from serious medical conditions such as cancer. They are a burden on their children due to heavy medical expenses. Further adding to this, Mr George shares the incident of an elderly woman named Shanta suffering from cancer who was neglected by her only son. Our team rescued the woman during the ongoing pandemic and gave her food and shelter. The woman had serious medical issues, and it was difficult to communicate with her due to linguistic barriers. After one month of search, the trust was able to locate Ms Shanta's brother, but before he could take her home, Ms Shanta passed away. The woman cried and longed for her son but was unable to meet him even in her last days of life.'

The Trust offers various rehabilitation programmes depending on the need of people. Some of these programmes include occupational rehabilitation, physical rehabilitation, aquatic rehabilitation, and cognitive rehabilitation. They have rescued around 4000 destitute people to date from the roads. The trust also works hard to take care of migrants in government hospitals and tries to reunite them with their families. They have three destitute homes, one in Hyderabad, the other two in Jangaon and Warangal, Telangana. ■



Sultanpur National Park

A Paradise for Birds and Birdwatchers

In this series of articles, **Amarjeetsingh Bishnoi** and **Shakti Bishnoi** share their wonderful experiences with their family in the lap of nature in Sultanpur National Park in Haryana. Last month, you read that they went to visit the sanctuary from their home in Delhi during the winter season.

Now, read more about their vivid experiences there from winter to summer season...

Early morning, we headed towards the designated watch tower point as per the route map. We were three families on this excursion. It was a chilly morning and all of us were wearing thick winter clothing. Watching the arrowhead formations of gargeny (amongst the first ducks to arrive here) and then the way they tumble tipsy-turvy into the lake was a delight. Other species that follow

include shovellers, pin-tails, common teals, mallards, and wigeons. And if the water is deep enough, then common pochards are also seen as these are the 'diving' rather than 'dabbling' ducks. If you are lucky, you can also spot the ferruginous ducks, also called fudge-ducks. The sanctuary also attracts both the species of geese—greylag and bar-headed—which are often spotted

wandering the national park all night, and then enjoying the morning sun by the lake. Big battalions of cranes and great white pelicans were sitting near the lake by late afternoon. You may spot them departing just before dawn.

Little stints, chirp near the lake shores and enjoy the company of common red-shanks (which have reedy red legs), sandpipers, and white-tailed plovers. Large flocks of ruff (boasting brown and beige feathers) seem to use the water body only as a transit halt on their way further south, and then on their way back north in spring. We went towards grasslands, south of the National Park, which is usually abound with larks and wagtails, scuttling after insects. The acacia woodlands of Sultanpur National Park also play host to black redstarts and canary-flycatchers. If the rainfall is good, the sanctuary has recorded a headcount of around 20,000 birds from October–March, while in those years with scanty rainfall (such as 2000–2003), the figure did not even cross 3000.

Onset of Return Migration

We took a plunge to explore more of Sultanpur and so we headed again to the National Park to witness the



preparedness of return journey of our esteemed guests. Once winter ends, the guests start preparing for their journey back home. The atmosphere in the park changes considerably in spring (March–April). There are songs which reverberate with melancholy and nostalgic feelings. The return journey of gypies starts, it looks like the interaction amongst them increases manifold—it maybe possible that they are discussing the route map and plans ahead. The frequency of meetings increases and so is the duration as there are many heated discussions regarding departure plan or any deviation to be taken. Also, they seem to be taking feedback from the last batch of migrants. Migrants express profound heartfelt gratitude towards the resident birds for sharing their land, water and food. With a firm promise to come back again and share lots of stories of their land, they depart. The birds start dividing themselves in groups like troops preparing for war for the final assault (onward journey). The waterfowls practice sorties overhead, preparing for their journey back north. On the lake bed, the red-wattled lapwings and black-necked stilts (both residents of the park) start showing signs of paranoia,

for now they have to brace themselves for the upcoming summers as the scorching heat of this region is truly uncomfortable. Also in the woodlands, other residents start looking for partners and accommodation. Pied mynahs, brown-faced barbets and coppersmiths busily excavate nesting holes, tailorbirds shout from the bush-tops as if they are electioneering, and even the deadly grey shrike, with its bandit mask warble love numbers!

Summer Commences

Summer commences in April and lasts till the end of June. The time for song and dance is over, and the stern business of raising families is on. They had enough good time interacting with foreigners and looking after them (they seem to follow our Indian custom of *Atithi Devo Bhava*) and after bidding them farewell, the life of resident birds returns to normalcy. Foreigners leave this soil with a strong promise to come back, while residents start preparing for their daily routine and brace harsh summer with smile. The woodlands may see a sudden influx of red-turtle doves, which construct their skimpy nests in the



acacias. The lapwings and stilts become neurotic—get close and you can be subjected to a dive-bombing attack. July to September are the most crucial months for Sultanpur National Park, for the amount of rainfall determines the extent to which the lake will remain filled in winter. (It has been sought that this dependency be reduced by bringing water from a nearby canal via a pipeline. However, even this supply is erratic.) ■

To be continued in the next issue...





Which Animals Will Survive Climate Change?

Climate change is exacerbating problems such as habitat loss and temperatures swings that have already pushed many animal species to the brink. But can scientists predict which animals will be able to adapt and survive? Using genome sequencing, researchers from McGill University show that some fish, like the three-spined stickleback, can adapt very rapidly to extreme seasonal changes. Their findings could help scientists forecast the evolutionary future of these populations. To study natural selection in action, the researchers tracked six populations of three-spined stickleback fish before and after seasonal changes to their environment, using genome sequencing. Stickleback found in different estuaries along coastal California provide a rare opportunity to study natural selection in real-time. Seasonal changes driven by wet winters and dry summers result in drastic shifts in habitat structure and balance of salt versus freshwater and only those fish able to tolerate these rapid changes survive into the next season.

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

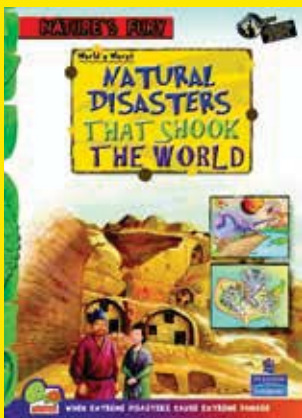
Mammals Can Use Their Intestines to Breathe

Rodents and pigs share with certain aquatic organisms the ability to use their intestines for respiration, finds a study published in the journal *Med*. The researchers demonstrated that the delivery of oxygen gas or oxygenated liquid through the rectum provided vital rescue to two mammalian models of respiratory failure. 'Artificial respiratory support plays a vital role in the clinical management of respiratory failure due to severe illnesses such as pneumonia or acute respiratory distress syndrome,' says senior study author Takanori Takebe of the Tokyo Medical and Dental University. 'Although the side effects and safety need to be thoroughly evaluated in humans, our approach may offer a new paradigm to support critically ill patients with respiratory failure.'

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



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Who Killed Assam's 18 Asiatic Elephants?

Thunderbolt or Man-Animal Conflict?

Can a herd of wild Asiatic elephants be killed by a thunderbolt? What would be its impact on the soil and trees if such a massive lightning strike at all hit the planet? Why the surrounding villages could not experience the sound of thunder along with bright rays of light? In this article, **Nava Thakuria** tries to find answers to these questions.

Quite a few questions have been raised by the environmentally conscious citizens of India as they found breaking news from Nagaon in central Assam where it was described that 18 Asiatic elephants died of some mysterious reasons. The State Environment and Forest Minister made an early assumption that all the bulky

animals died due to electrocution by lightening. The unfortunate incident took place on a hillock in Nagaon-Karbi Anglong border locality on the night of May 12, 2021 as claimed by the authority, which spread sensations among the people as elephants are adored as a symbol of Lord Ganesha in Hinduism. The state government, led by the Chief

Minister has already ordered a high-level probe into it to trace the reason behind the entire herd's shocking death. After visiting the site, the Forest Minister again hinted that the pachyderms were killed by a thunderbolt. A probe committee comprising forest officials, wildlife specialists, veterinarians, etc., is expected to complete its detailed investigations by a fortnight. But the post-mortem reports of those elephants are yet to be made public (after ten days of the incident/at the time of writing this article). Various conservation and wildlife protection bodies are rigorously demanding to get access to the reports in vain. Northeast India's well-known nature conservationist Soumyadeep Datta suspects a foul play with the animals. The Director of Nature's Beckon instantly termed the thunderbolt theory as unacceptable.

However, the first sharp and methodological reaction came from All Assam Engineer's Association (AAEA), a forum of engineering graduates over the theory of lighting that was projected as the primary reason of death of the 18 wild elephants at one go. 'It is absurd,' said Er Kailash Sarma, president of AAEA adding that if at all it happened (such a massive thunderbolt had stricken on Earth that night) gloomy days are ahead



of the wildlife and human population. 'We must consider it as a matter of serious concern and the caveat to all of us, as it may repeat in future anywhere on the planet (if not in India),' added Er Sarma.

The province government and initial findings of a probe committee hinted that all the animals were killed by the thunderbolt within a second. 'Even it is assumed that all the victim animals were very close to each other during the incident, their carcasses could have been found together, argued AAEA secretary Er Inamul Hye adding, 'in reality it was not like that and their bodies were seen scattered.'

The engineer's forum analysed, if the animals faced the thunderstrike as they were found scattered, it needed a massive strike covering over 150 sq. m area on the hillock. Then, burns on the trees and even the topsoil could have been visible. 'But the concerned site was enriched with its greenery. Residents of the adjacent areas could not remember such a lightning thunder 2-3 days prior to the recovery of elephant carcasses,' asserted the AAEA statement.

A lightning strike, created by the electrical discharges due to imbalances caused between the Earth and storm clouds (or within the clouds), can produce an intense sound (up to 200 dB). A lightning bolt (from cloud to ground) may generate around 1,000,000,000 Watt (around one billion volts of electricity) on the spot and it can heat the surrounding air up to 53,000 °F. When the cloud-to-ground lightning hit an animal, it creates sudden disturbance to the internal electric signals of a living being, which is otherwise essential for operating organs, such as heart, lungs along with the nervous system. Normally, the animal faces a cardiac arrest, brain injuries, spinal cord damages or severe burns and subsequently it collapses within a short time.

AAEA demands a high-level scientific probe into the incident that took place on the night of May 12 to unearth the

mystery of jumbos' death. It may be a case of poisoning (or other means) as these kind of incidents often take place in different parts of Northeast India, said environmentalist Datta, adding 'that is why the demand to make the post-mortem report (of each dead animal) public has been raised.' Speaking to this writer the experienced activist opined, the unusual delay in revealing post-mortem reports indicates there may be something wrong in it.

Assam gives shelter to around 6000 wild Asiatic elephants (India as a whole to nearly 30,000 bulky animals) and often they enter human colonies in search of food. Datta expresses anger that the urbanization has caused severe damages to the forest and wildlife which finally creates the series of man-elephant conflicts across the region. Haricharan Das from the environment protection group Aranya Surakhya Samity, expressed dismay over the unusual deaths of elephants including many calves. In a strong video message, Das demanded a Central Bureau of Investigation probe to resolve the mystery of their deaths and stringent punishments to the culprits if it is proved a man-made disaster.

Site of the incident, which is near the Burha Pahar area under the world famous (one-horned rhino habitat) Kaziranga National Park on the south bank of the mighty Brahmaputra River, often gets elephant visitors (around 200 individuals). Moreover, Bamuni hillock inside Kundali proposed reserve forest under Kothiatoli forest range in central Assam is a known elephant habitat. But there is a giant solar power plant with a capacity of 15 MW at the foothills of Karbi Pahar that surfaced as a matter of prime suspect. Hundreds of marginal farmers in Mikir Bamuni grant village (under Samaguri revenue circle in Nagaon) continue protesting against the grabbing of their fertile land, cultivated by them for generations, by a particular solar power company for the project. For over a year, a group of Karbi and Adivasi villagers are fighting



for their land rights and many of the protesters were even put behind the bars by the administration. Lately, the matter reached Gauhati High Court, where the highest court in the State ordered status quo on the matter on March 1. Now the construction works of the power plant, put up in a campus of over 276 bighas of land, has been ceased. 'We opposed the project as it is planned to erect in an elephant habitat. It is shocking how the project got the no-objection certificate from the forest department. We also do not subscribe to the lightning theory as a killer of 18 elephants,' said a local activist belonging to Asom Jatiyatibadi Yuba Chatra Parishad (AJYCP), an influential civil society group of Assam. The activist, while talking to local news channels, claimed that powerful people engaged with illegal tree felling and stone quarries are involved with the planned murder of elephants, which must be probed thoroughly. The organization has demanded to return the farmer's land and stop constructing the power plant in the eco-sensitive zone. ■

Disclaimer: The views expressed by the author in this article are his own and do not reflect TERI's views.

Nava Thakuria is an Assam-based environment journalist and he contributes articles for various publications inside and outside India.



Vegan Leather

Prevents Pollution and Animal Cruelty

The leather industry is not only death for animals but also extremely dangerous for us as the rivers are polluted with toxic chemicals. The industry is a major contributor to global warming. **Maneka Sanjay Gandhi** writes about plant-based leather or vegan leather, the ethical and cruelty-free alternative to traditional leather.

I am hopeful that, in my lifetime I am going to see a disruptive change in the eating and wearing of animal flesh. It is coming fast: the largest slaughter companies and the largest investors in the world have invested in laboratory created real meat (called clean meat) and milk. These meats are already in the market in countries such as Singapore. Perfect Day which makes milk cells is on the market with yoghurt (under the label Smitten) that is made of animal-free dairy. Indeed, if clean meat would replace intensive farming as an industry standard, the benefits for the environment would be immense. As consumers, we would also have 'cleaner' meat, meaning a product that does not have the antibiotic residues and bacterial contamination that come with slaughtered meat.

Vegetarians and vegans finally have meat eaters on the run. But the wearing of meat in the form of leather—has it gone down? Not yet. But it will. Apart from the millions of animals that it kills every year, especially young calves, the leather industry is extremely dangerous

for the Earth's survival. The rivers are polluted with the toxic chemicals used in leather; leather polish alone kills millions of fish. A 2018 global impact study by Quantis stated that 700 million metric tonnes of carbon dioxide are emitted by the leather footwear industry annually—a major reason for global warming. The New Zealand shoe company Allbirds which is in partnership with the giant Adidas has just announced that it is investing millions in plant-based leather. Allbirds has been going this way for a long time: shoes made of eucalyptus and cotton fibre, for instance, insoles made of castor bean oil, recycled plastic laces. This new material, plant leather is made from vegetable oil, natural rubber, and other bio inputs. The company announced their investment in a material innovation firm called Natural Fiber Welding, Inc. and says it will be adding 'the world's first 100 per cent natural plant-based leather' to its product line-up by December 2021. This material, which is called Mirum, is said to have 40 times less carbon impact than real leather and produces 17 per cent less



carbon than synthetic leather made from petroleum-based sources. Mirum will be constructed without any polyurethane, meaning that the material can biodegrade at the end of its life without leaving traces of plastic in the soil, or it can be reground into new Mirum.

Vegan leather, an oxymoron, is the ethical and cruelty-free alternative to traditional leather. It is meant to look and feel like traditional leather without the baggage of pollution and suffering. As more and more people grow aware of the leather industry's effects on the environment and on animals, the market for cruelty-free alternatives keeps growing.

British materials company Ananas Anam, set up in 2013, was among the first to come out with a plant-based leather alternative called Piñatex. The material uses fibres derived from pineapple leaves, sourced from the Philippines. These fibres are mixed with polylactic acid (PLA), a bioplastic derived from corn to create a flexible and durable material. Piñatex is being used by Hugo Boss and Canadian brand Native Shoes. Dutch designer Tjeerd Veenhoven has sourced his vegan leather from the leaves from the areca betel nut (*supari*). The Palmleather project was born as a low-cost plant-based replacement for animal leather, plastic and rubber and uses far fewer pollutants and water consumption than animal leather.

The company Desserto has introduced vegan leather made from nopal cactus leaves, which can be used to make furniture and car interiors, wallets, purses, and shoes. The nopal cactus grows in abundance across Mexico without requiring any water, making it a low-impact crop. Major luxury fashion houses including Stella McCartney, Adidas and Gucci parent company Kering have invested in a leather substitute product called Mylo, a soft leather-like material, created from mycelium, the branching filament

structure that mushrooms and other fungi use to grow. The material consumes substantially less water than is needed to produce animal leather while emitting fewer greenhouse gases. It takes just days to produce and is completely biodegradable and non-toxic.

MusKin is a leather-like material made from the caps of a mushroom called *Phellinus ellipsoideus*. The fungus is native to subtropical forests and feeds on tree trunks.

Will's Vegan Store is an online store that makes luxurious vegan leather shoes from cereal crops. The company's vegan leather is made from a mix of polyurethane and bio-oil made from cereal crops. The company is trying to move away from using polyurethane and recently rolled out a new product using viscose made from eucalyptus bark.

In 2017, the high-end vegan shoe company Veerah rolled out leather made from 50 per cent apple peels leftover from the apple juice industry, and 50 per cent polyurethane. The peels are dried and ground into a fine powder, which is then mixed with non-toxic pigment and polyurethane to become leather-like fabric.

Here are the Indian entrepreneurs that you should buy from or invest in: Malai Biomaterials Design Pvt. Ltd, a

Kerala-based initiative is the brainchild of Zuzana Gombosova and Susmith Suseelan. It produces a vegan alternative to leather using sustainable bacterial cellulose sourced from waste coconut, banana stem, sisal fibre, and hemp fibre. It is completely biodegradable, flexible, water resistant stretchy and has the same thickness as leather. The company collects coconuts from farmers in Kerala. The water is left undisturbed for bacterial culture to feed on. The end process results in jelly-like cellulose which is mixed with banana fibre or gum to create raw material in the form of sheets or three-dimensional shapes. To make the sheets colourful and glossy, the company uses natural dyes such as indigo, madder or cutch. The company's major clients are prestigious companies, such as Crafting Plastics, TON, Kazeto, etc., and the products are bags, wallets, backpacks. I do not know whether they have started making shoes as yet.

Aulive is an online Indian brand that has genuinely beautiful vegan, cruelty-free leather products. It labels itself as 'Genuinely Not Leather' and uses Pinatex. They have come out strongly against the cruelty and toxicity of the animal leather trade. Look up the site when you want to buy suitcases, briefcases, and bags.

Kanpur Flower Cycling owned by engineer Ankit Agarwal has created 'fleather'—a leather made of temple flowers. Even though it is not on the market yet, fleather has already won a UN Sustainability Award and a PETA award for best innovation. The company has already been making Florafoam—a compostable alternative to Styrofoam (non-biodegradable plastic) from moulding dried flowers with natural fungi. Brands, such as Bajaj and Havells are already using Florafoam packaging. Fashion houses such as Anita Dongre have also shown interest in this breathable and tensile material called 'fleather'. These companies can only be successful if you change your buying pattern. ■



Role of RWAs

In Coping Up with COVID-19 Pandemic

Since the start of the COVID-19 pandemic in early 2020, Resident Welfare Associations (RWAs) throughout India have been participating in many relief, reassuring, and rehabilitation programmes of the COVID-affected localities. Some of the major tasks taken up by them are discussed in this article.

It has been more than a year since the deadly coronavirus pandemic (COVID-19) struck the entire world, starting from Wuhan in China, towards the end of 2019. As per statistics from www.worldometers.info, 220 countries and territories around the world have reported a total of 168,011,339 confirmed cases of COVID-19 and a death toll of 3,488,194 (till May 25, 2021). In India, stringent measures including imposition of lockdown have been implemented in several states. A rapid vaccination programme is also going on at present throughout the world.

In the initial stages of the pandemic, particularly during the months of April to October, 2020, there was utter chaos with frequent lockdowns and blockades in virus-affected areas. Road, rail and air traffic came to a standstill, stranding millions of travellers. Hospitals were flooded with COVID-affected patients putting enormous pressure on healthcare professionals. Migration of workforce due to the closure of all constructional and agricultural activities was another major concern. We saw thousands of people belonging to the workforce travelling hundreds of kilometres on

foot to reach their native places. It was under these circumstances that wisdom prevailed over the resident communities, particularly the Resident Welfare Associations (RWAs) who kept cool, came together as an organized workforce and tried to bring normalcy in an otherwise panic-driven neighbourhood. From the month of April 2020 to this date, RWAs have participated in many of the relief, reassuring, and rehabilitation programmes of the COVID-affected localities. Some of the major tasks taken up by them are described here.



Awareness on the Virus and the Precautions to Be Taken

The first and foremost task was to create awareness on the virus and the precautions to be taken to control the spread of the virus. Pamphlets were distributed by RWAs and rallies were also organized with placards to carry message to the residents such as:

- Wash your hands regularly with soap or sanitizers
- Keep social distancing and don't move in crowds
- Wear gloves and masks when going out
- Don't touch your eyes or face with naked hands
- Avoid travel unless it is very essential
- Avoid non-vegetarian food and junk food.



RWAs helping people with food, water, and other essentials



These messages were displayed at prominent places. Frequent sanitization of public places was also taken up by RWAs.

Confidence-building Measures

RWAs helped residents to come out of the initial panic and mistrust among themselves. In the apartments, the initial denial to accept COVID victims in their premises, slowly transformed into accepting home quarantine and there were instances, where neighbours helped the affected families to overcome the disaster. COVID victims were no longer treated as untouchables and this no doubt raised the moral strength of the COVID-affected families.

Relief to Affected Victims, Particularly the Construction Labourers

Frequent phases of lockdowns, suspension of road, rail and other modes of transportation resulted in working labour travel mostly by foot for hundreds of kilometres, with no facilities to rest, eat, and sleep. We saw human chains moving from state to state facing difficult circumstances. RWAs helped them wherever they came across such people, particularly along the national highways.

They were provided with groceries, water, medicines, and other essentials.

Extending a Helping Hand to Sanitary and Civic Staff

The health, sanitary and security personnel were among the frontline workers who provided continuous services throughout the COVID period, even risking their lives. They deserve huge amount of encouragement and help for their selfless service. RWAs of the cities organized many felicitation programmes to honour them, which they richly deserve. Sanitary workers were provided with groceries and cash awards. Masks, PPE kits, gloves, and sanitizers were distributed to them.

Organization of Medical Awareness Camps

Organization of medical awareness programmes is another activity taken up by RWAs. For example, the Andhra Pradesh Federation of Residents Welfare Associations (APFERWAS) and Prajarogyavedika, Visakhapatnam had organized an interactive session with some of the eminent medical professions, in June 2020, with the main objective of soliciting their guidelines to control the spread of the coronavirus in the city.

The following suggestions were adopted at the end of the meeting for submission to the government as well as to the civic authorities:

- Government should undertake vigorous awareness campaigns among citizens on coronavirus infection and precautions, using all means of communication
- Government should ensure strict implementation of the three steps of S M S (Social Distancing – Mask – Sanitization) by the people
- Suitable campaign methods to be chosen as per the pandemic condition prevailing in the respective areas
- RWAs should take up special responsibility of campaigning about the precautions and ensuring their implementation in their colonies
- Three-tier hospital facility to be made available to the COVID patients as per their affordability
- Treatment for non-COVID patients to be made available at all levels uninterruptedly. Health network to be developed taking into confidence the civil society groups, NGOs, and other voluntary organizations
- Special emphasis to be made on campaign in slums where social distancing is difficult.

Collection of Donations for the Affected Victims

Many RWAs helped in raising the funds for countering this colossal economic loss. All over the world, economy was worst hit due to disruption of activities in all walks of life. RWAs within their limits helped in donating funds to cope up with this huge economic disaster.

The APFERWAS, Visakhapatnam donated ₹4.00 lakh to the AP Chief Minister Relief Fund towards COVID-19 relief activities. APFERWAS collected this amount from its constituent 130 RWAs in the six zones of the city of Visakhapatnam.

Activities of RWAs during the Second Wave of COVID-19

During the second wave of COVID-19 that commenced in March–April 2021, RWAs could not venture out directly in any on-field activities due to the very delicate situation prevailing in the country. However, they continued their services through other platforms, that is, through Internet-based communication. There was continuous sharing of information among the RWAs on the following points:



- List of dedicated hospitals for COVID treatment
- Availability of beds in each of these hospitals
- Vaccination centres both in public and private domain
- Location of vaccination centres as well as COVID test centres
- Location of quarantine hotels, government facilities, etc.
- Information on oxygen concentrators, ventilators, etc. Sharing of the addresses of distributors
- Information on donors of blood, plasma, blood banks, as obtained through different sources.

All this information was continuously updated every now and then based on authentic information received from different sources. In certain states, Federation of RWAs such as UFERWAS, Hyderabad, Telangana and APFERWAS, Visakhapatnam had coordinated with civic officials like municipal corporations to provide necessary advice and guidance for establishment of facilities for COVID vaccination as well as treatment. Online webinars were also organized once in a while among RWAs for mutual encouragement, guidance, and awareness about the situation. ■

Article contributed by Dr K S R Murthy, Secretary General, CoRWA; Associate President, APFERWAS; President, JR Nagar RWA; Former Emeritus Scientist, CSIR-NIO Goa/CSIR-NGRI, Hyderabad.



Green Warrior

Risking Life and Limb to Save Plants

Amid the chaos caused by the second wave of the COVID-19 pandemic, only a handful of 'unsung' green warriors such as **Dharmesh Barai** have risen to the occasion to ensure lives, beyond human, stay protected too. Read on to know more about his green endeavour...

Today, when millions across India are fighting for their lives struggling for oxygen in hospitals and nursing homes, Navi Mumbai's 32-year-old Dharmesh Barai risks his own to reach balconies on higher floors to 'save' plants abandoned by homeowners during the lockdown. 'After all, they too are struggling to survive in the heat and amid human apathy,' he says.

'Sadly, with the second wave of the COVID-19 infection, even as the government is bolstering efforts to ensure vaccination for all, a lot of people have left their homes for their native places as a knee-jerk reaction to the lockdown-like situation in Mumbai and surrounding areas,' says Mr Barai. 'But, in their hurry to leave their homes

before all got shut, they left back their plants in their balconies and outside their homes to fend only for themselves,' says the nature-lover, saddened by the callous attitude of homeowners and their families.

Amid the chaos where most individuals are busy protecting themselves or their loved ones only a handful of 'unsung' green warriors like Dharmesh Barai have risen to the occasion to ensure lives, beyond human, stay protected too. 'During the crisis of this magnitude, watering plants is the last thing on anyone's mind. Ironically, people tend to ignore 'oxygen-producing' plants even at a time when everyone is running around to secure 'oxygen' for COVID patients,' says Mr Barai, an



assistant manager of a sports venture.

So, this year, when the second COVID wave hit Maharashtra, Dharmesh swung into action to care for and water unattended plants and trees. During the ongoing lockdown-like restrictions imposed in the zone, Dharmesh has been tending to the greens in housing societies, residential complexes even along the roads in his area. His own residence is home to about 200 plants that bloom in all corners of his house and the balcony. His passion to care for plants has taken him to risky 'heights' literally often 'to reach out to the plants in a balcony or at a window-sill on a higher floor.' Dharmesh uses ladders to climb and 'doesn't involve the ever-so-eager children from the neighbourhood,' in the risk-laden activity.

Green warrior Dharmesh Barai watering plants abandoned during lockdown



'Interestingly, from the neighbourhood, it is mostly the kids who help me in the planting and watering activities. It is strange that COVID patients and their families are ready to pay lakhs of rupees to buy oxygen to survive yet even after surviving, do not realize how important plants are for life. They constantly release oxygen that is absolutely essential for human survival,' he adds, perplexed with the attitude.

After the first nationwide lockdown was announced in March 2020, Dharmesh had swiftly realized that the plants outside residential and commercial complexes, shops and along the roads and highways had been left completely unattended. During his first trip outside, a week into the lockdown, to a local grocery store, he noticed a withered plant a little distance from his home and immediately felt he needed to address the issue.

'It is actually very simple. Even one person can make a huge difference. If just a single person in a housing society takes up the responsibility of watering and taking care of plants in their area, it will make a big difference,' offers Dharmesh who has founded a volunteer group 'Environment Life' to address environmental issues with the help of young volunteers. Led by Dharmesh, Environment Life's members have been



Green warrior
Dharmesh Barai
watering to save
plants abandoned
during lockdown

active in cleaning and protecting the mangroves in and around Navi Mumbai. 'I kickstarted the Mangrove Clean-Up Drive in August 2020 after the phase-wise unlocking started. In the beginning, there were just three of us and now, in less than a year, we have more than 600 volunteers including college students, corporate professionals, and so on, pitching in. Why, even the local civic body has been extending help and support to us in every way possible to remove trash from the mangroves and help restore the delicate ecosystem.'

All it takes is a little initiative to make that change. In a lot of areas, shops were shut for months on end as they were not providing essential services. Those open would refuse to water another's plant owing to petty rivalry. 'All I had to tell them was that why take out your anger on a plant which depends entirely on you,' recalls the nature-lover. 'Ek bottle paani dalne se kya farak padega aapko...I would tell them and water them myself,' he says. And, when they see someone with little personal interest coming down to their neighbourhood to water someone else's plant, they feel ashamed and slowly take up the responsibility of watering them.

'Why, I have seen so many watchmen idling away at their chairs while shirking work but yet watering plants on request simply because, somewhere down the

line, it strikes a familiar chord with them,' he says. 'Aapke bharose pe hi tike hai...I tell them and watch them melt,' says a smiling Mr Barai. And, once you manage to evoke their empathy, things become a lot easier. 'Sometimes, I have to break it down for them and tell them that plants give oxygen for humans...which is now so costly and difficult to procure, and they understand...especially now when things are so bad for us,' he says.

The work done by Mr Barai and his group of young green warriors under the Environment Life banner is not restricted to plants in residential zones. The all-volunteer group members even plant trees along roads. And then, water them regularly as young plants need to be taken particular care of in the beginning. Now, they have been trained to keep an eye for plants withering in the scorching sun. 'It is heart-warming to see watchmen who did not care a fig earlier, now confronting vehicle-owners parking carelessly while damaging roadside potted plants too,' he says. Everyone needs to do just that little bit in helping nature survive in these trying times. 'After all, our own survival depends directly on the survival of nature,' as Dharmesh Barai says. ■

Article contributed by Ms Manu Shrivastava, who is a Media-Legal Researcher with think tank DraftCraft International. She writes widely on environment, climate change, women laws, and policy perception.

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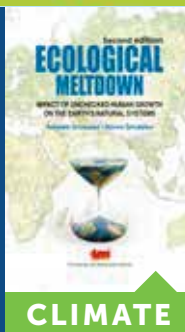
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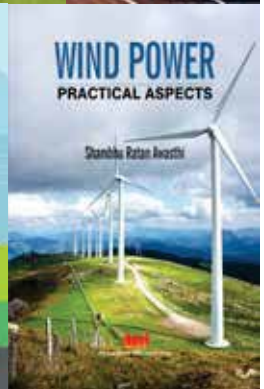
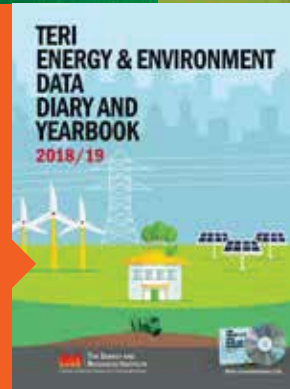


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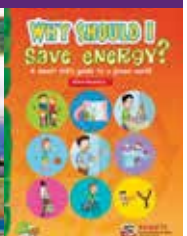
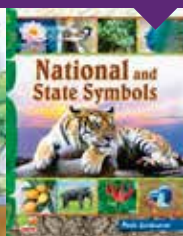


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