

TerraGreen

₹60



Subscriber's copy VOLUME 13 | ISSUE 04 | July 2020

Building Pandemic Resilient Cities in India

By Strengthening the WASH Sector

IN CONVERSATION

Ms Neha Sinha,
Conservation Biologist

TERRA YOUTH

Lockdown Diary
with Nature

SPECIAL HIGHLIGHTS

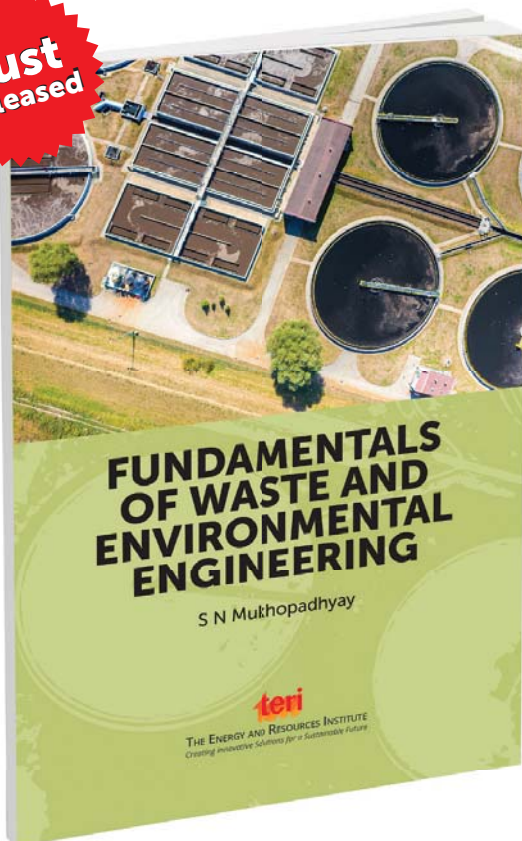
Realigning Sustainability in the
Post-pandemic World

Forests, Beyond Just Trees



ENVIRONMENTAL REMEDIATION THROUGH ENVIRONMENTAL ENGINEERING

**Just
Released**



Major topics covered

- Air Pollution and its Abatement
- Wastes to Value-added Products
- Water, Wastewater, and Non-aqueous Liquids
- Waste Heat Treatments and Utilizations
- Solid/Semisolid Waste Treatments/ Management for Business Developments
- Environmental Variance and Effects of Pollution on Humans.

ISBN: 9789386530103 • Price: ₹665.00

Fundamentals of Waste and Environmental Engineering deals with the global problem of waste generation. This book discusses the design and operation of engineering hardware and facilities for pollution control. It covers fundamentals of mesophilic and thermophilic bioprocessing of wastes. The book highlights the ways to control and minimize unwanted pollution and includes research-generated information and data. In order to make contents applicable, theoretical, multichoice, and practice tutorial numericals are also included in the book.

The Energy and Resources Institute
Attn: TERI Press
Darbari Seth Block
IHC Complex, Lodhi Road
New Delhi – 110 003/India

Tel. 2468 2100
Fax: 2468 2144
India +91 • Delhi (0)11
Email: teripress@teri.res.in
Web: <http://bookstore.teri.res.in>

To purchase the book, visit our online bookstore at <http://bookstore.teri.res.in> or send us your demand draft or cheque in favour of TERI, payable at New Delhi (outstation cheques are not accepted).

EDITORIAL



“ Governments are focusing more on the measures to tackle the strains on health care systems, and hence, social health and financial aspects are the pillars of sustainability in the immediate context. ”

Globally, most pandemics have severely affected crowded urban settlements which are often the hub of significant economic activities, but have inadequate housing and Water, Sanitation, Hygiene (WASH) infrastructure, especially for the poor. There are many factors that heighten the vulnerability of the people who live in these crowded urban settlements to pandemics, such as the current COVID-19 infection. The shortage of clean drinking water and sanitation facilities, inability to maintain personal hygiene, deprived living conditions and lack of access to quality health care exposes people in urban slums to significant risk of infectious diseases. Furthermore, overcrowding in slums makes social distancing and self-quarantine very tough, if not impossible, and place the slum dwellers at an increased risk of acquiring infection.

This month's cover story 'Building Pandemic Resilient Cities in India by Strengthening the WASH Sector' highlights that while washing hands and maintaining adequate hygiene has been advised as the need of the hour, COVID-19 also emphasizes the need to reassess the adequacy of the WASH infrastructure in slums and low economic settlements—not just in terms of its preparedness in handling pandemics in the future, but also in terms of its ability to be resilient in disasters and extreme events, considering that extreme events such as droughts, floods, and tropical cyclones are expected to increase on account of climate change.

In this month's feature article, 'Realigning Sustainability in the Post-pandemic World', we seek to ignite the discussion on sustainable futures, so to understand the various shapes sustainability can take in the 'new normal' times that we are going to witness in the future. In the immediate future, it is clear—and rightly so—that governments are focusing more on the measures to tackle the strains on health care systems, and hence, social health and financial aspects are the pillars of sustainability in the immediate context. As we move forward, we note that circular economy frameworks also need immediate attention on several fronts for economic growth, as well as for social inclusivity and environmental protection. We also envisage that with wider doors opened for international cooperation, the circular economy concept may accelerate and become a global sustainability programme. Global concerns, such as reduction of plastic on earth, use of sustainable materials, recycling, and waste management could give impetus to global cooperation so as to scale and accelerate actions by governments. The leadership roles of organizations, such as the WHO, UN, UNICEF, and others, will be important for this knowledge sharing and enabling their design so that they are seen as being the most cost-effective interventions. These organizations will need to orient themselves in identifying the segments to be prioritized during the transition.

I hope that you enjoy reading this issue of TerraGreen while staying healthy and safe. All of us are facing a humanitarian crisis at the moment but should come out of it with flying colours with our resilience and grit.

A handwritten signature in black ink, appearing to read 'Ajay Mathur'. The signature is fluid and cursive, with a long horizontal stroke at the end.

Ajay Mathur
Director General, TERI



The online issue of the June 2020 issue of *TerraGreen* has good reading material on the current humanitarian crisis. Adding to the already existing woes were Cyclone Amphan and Nisarga. I had read that the severe cyclonic Storm Nisarga was the strongest tropical cyclone to strike Maharashtra in the month of June 2020 since 1891. It was also the first cyclone impact to Mumbai since Cyclone Phyan of 2009. The third depression and second named cyclone of the annual cyclone season, Nisarga originated as a depression in the Arabian Sea and moved generally northward. Also, super Cyclonic Storm Amphan was a powerful and deadly tropical cyclone that caused widespread damage in Eastern India, specifically West Bengal, and also Bangladesh in May 2020.

Parthiv Desai
Gandhinagar, Gujarat

I enjoyed reading the June 2020 issue of *TerraGreen*. The TerraYouth section article on Olive Ridley turtles was such a joy to read for my 11-year-old kid. He has followed the author's advice of reading up as much as possible about the Olive Ridley turtle. Most of us never see an Olive Ridley turtle, so we often forget about them and their problems. To counter that, my son has pledged to spread the information that he has gathered, among his friends and other members of our family. We also enjoyed the comic strip (Babu and Bijili) where Bijili gave many useful tips to prevent the spread of COVID-19.

Rani Juneja
New Delhi

Smt. Maneka Gandhi's article on bovine tuberculosis is a real eye-opener. Bovine tuberculosis (bTB) is a disease of cattle that is a major public health threat. It is transmitted within herds by inhalation of infected aerosol droplets from infected cattle. The author is correct when she says that any attempt to eradicate the disease from humans without eradicating it from cattle is futile. Dr Agrawal's article on reaching out to the distressed in Dehradun is also very apt as he highlights that in such distressing times of coronavirus pandemic, individuals and members of many groups in Dehradun decided to form Doon Nagrik Rahat Samuh to extend help to all those people who were not getting any relief in this lockout, especially casual labourers.

John M Babu
Bengaluru, Karnataka

Printed and published by Dr Ajay Mathur on behalf of The Energy and Resources Institute, Darbari Seth Block, IHC Complex, Lodhi Road, New Delhi – 110 003. Editor-in-chief Dr Ajay Mathur

© The Energy and Resources Institute. All rights reserved.

Editor-in-chief
Ajay Mathur

Editorial Board
K Ramanathan
S K Sarkar
Suneel Pandey
Annapurna Vancheswaran

Publishing Head
Anupama Jauhry

Editorial Team
Abhas Mukherjee
Ipshita Mitra
Sachin Bhardwaj
Sushmita Ghosh

Design & Illustration
Santosh Gautam

Production
Aman Sachdeva

Marketing, Sales & Distribution
Sanjeev Sharma

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

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

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

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

Affiliate institutes
TERI North America
1152 15th Street NW Suite 300
Washington, DC 20005
Email: terina@teri.res.in

TERI Europe
27 Albert Grove, London SW20 8PZ, UK
Email: ritukumar@aol.com

Overseas representation
TERI Japan
C/o IGES
Nippon Press Centre Building (8th Floor)
2-2-1, Uchisaiwai-cho, Chiyodi-ku
Tokyo, Japan - 100-0011, E-mail: teris@iges.or.jp

TERI South-East Asia
Unit 503, 5th Floor
Menara Mutiara Majestic
15 Jalan Othman, Seksyen 3, 4600 Petaling Jaya,
Selagor Darul Ehsan, Malaysia
Email: nimtech@tm.net.my

TERI Gulf Centre
Flat No. 105, Dalal Building, Al Qusais,
Dubai, UAE



<http://www.terragreen.teriin.org>

Contents

VOLUME 13 • ISSUE 04 • JULY 2020

4	NEWS	30	SPECIAL REPORT
8	TERI ANALYSIS		Forests, Beyond Just Trees
	Water and Sanitation Stress of Rural India	34	GREEN CHALLENGES
10	ENVIRONMENTAL RESEARCH		Impact of COVID-19: on the Solar Industry in India
	Ambitious Vision for Man-made Cellulosic Fibres	37	TERRA YOUTH
12	FEATURE	46	WILDLIFE
	Realigning Sustainability in the Post-pandemic World		Community Solar Microgrids in Sundarbans
18	IN CONVERSATION	48	MANEKA SPEAKS
	Ms Neha Sinha, Conservation Biologist	50	PIONEER
22	COVER STORY	53	SPECIAL FEATURE
	Building Pandemic Resilient Cities in India	56	FIGHT CORONAVIRUS TOGETHER

12
FEATURE



30
SPECIAL REPORT



10 ENVIRONMENTAL RESEARCH



37 TERRA YOUTH



22 COVER STORY





Disposable Masks are Complicating Bengaluru's Waste Problem

Disposable masks are quickly piling up in Bengaluru, increasing its 'reject waste' burden, say activists and officials. Reject waste is non-recyclable and this will have a large-scale impact on the environment, which will be felt in about a year, they add. Odette Katrak, co-founder of Beautiful said, 'I have been talking to people on the streets wearing disposable masks to understand why they don't wear reusable cloth masks. What's worrying is that lower income groups are reusing disposable masks out of ignorance. For those who can afford them, it's about convenience and sadly, they don't think in terms of waste or chances of infection spread by improper disposal.'

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

29 Per Cent Rise in Asiatic Lion Population in Gir

The number of Asiatic lions in the Gir forest region has increased by 29 per cent to 674, the Gujarat forest department has said. The department carried out a 'population estimation exercise' on the night of June 5 and 6, 2020 when there was full moon. The exercise was undertaken as the five yearly census could not be carried out in May 2020 due to the coronavirus outbreak and lockdown. The 'population estimation exercise' showed that the lions' population had reached 674, a 28.87 per cent increase, the official release said. It was the highest growth rate recorded so far, it added.

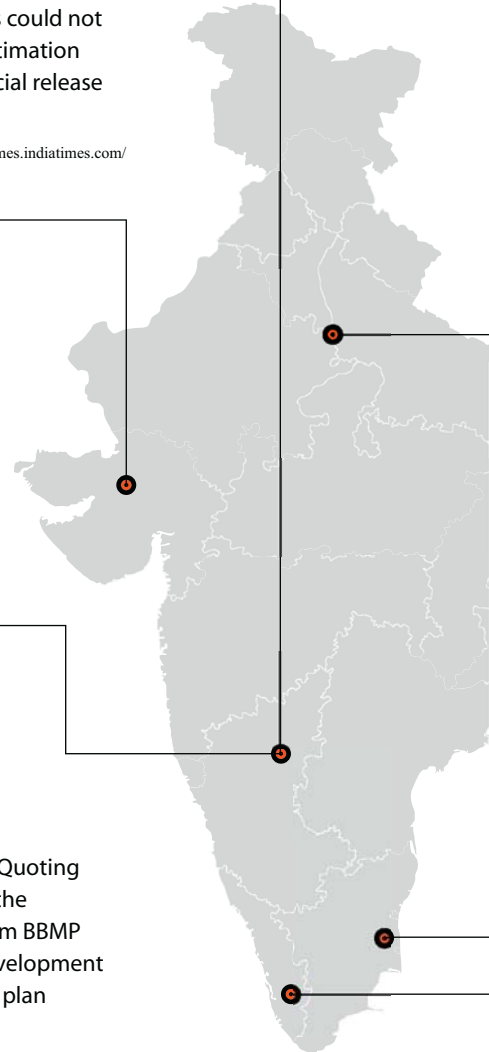
Source: <https://economictimes.indiatimes.com/>



No Construction near Lakes, Says BBMP

The Bruhat Bengaluru Mahanagara Palike (BBMP) has banned all constructions on the lakes in Bengaluru, saying water bodies cannot be used for any purposes other than for storing water. Quoting the 2014 and 2016 orders of the National Green Tribunal (NGT), the civic body has prohibited the construction of any structures in the lake area affecting the natural flow of water. A circular from BBMP Commissioner B H Anil Kumar invoked Section 12 of the Karnataka Lake Conservation and Development Authority Act, 2014, while issuing the direction. The circular also noted that the revised master plan 2015, while directing BBMP officials to ensure that the rules are not violated.

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





Reducing Travel Demand amid COVID-19

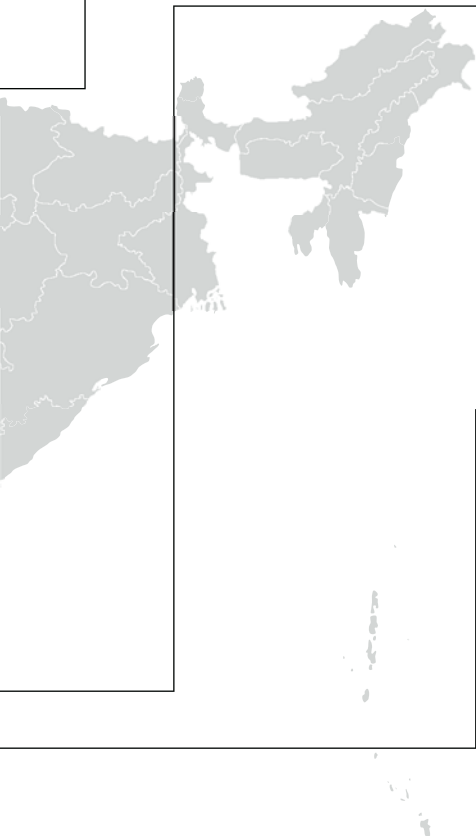
The COVID-19 pandemic has thrown the world out of gear, and with the lockdowns, the future of the urban transportation system is set for an overhaul. In a study conducted by TERI, 35 per cent of the respondents stated that they are likely to change their mode of transport from bus and metro services to private vehicles and intermediate public transport such as taxis and auto rickshaws. In another study conducted in Wuhan, China, it was concluded that an infected person in a bus can infect 13 others even from a distance of 4.5 m, though people wearing face masks were safe. In this scenario, suitable travel demand management (TDM) tools to reduce or redistribute travel demand in space or time can help.

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

Chennaiites Breathed Better During Lockdown: Study

In one way, the lockdown has been a boon for Chennai as air pollution levels saw a sizable reduction with residents of the city breathing better than their counterparts in the other southern metros of Bengaluru and Hyderabad. According to a study by Greenpeace India, using the Central Pollution Control Board data, in April 2020, $PM_{2.5}$ reduced in the city by 55.56 per cent and the concentration of NO_2 reduced by 23.86 per cent in comparison to last year. The city's $PM_{2.5}$ levels were $17.79 \mu g/m^3$, while the NO_2 levels were $8.52 \mu g/m^3$. Chennai's pollution levels were much less than in Bengaluru, whose $PM_{2.5}$ levels were $24.72 \mu g/m^3$ and NO_2 concentration was $12 \mu g/m^3$, and Hyderabad, whose $PM_{2.5}$ levels were $30.38 \mu g/m^3$ and NO_2 levels were $12 \mu g/m^3$ during the same period.

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



Kerala Elephant Death Symptom of Failed Conservation

Though it was quite gut-wrenching, the death of a pregnant elephant from eating food crackers-laden pineapple laid out by locals in Manarkkad, a municipality in Kerala's Palakkad district, is a mere symptom of a larger problem: human-wildlife conflict, primarily because of habitat loss. The state has launched an investigation into the wildlife-crime, and has even offered a reward for information that can help identify 'perpetrators', but the preliminary investigation seems to suggest that the elephant's death was accidental, a collateral in an older fight between local farmers and boars that routinely destroy crops, foraging for food, even as forests continue to shrink.

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



Global CO₂ Levels in Atmosphere Hit New Highs in May Despite Lockdowns

The drop in worldwide emissions due to the coronavirus outbreak failed to cancel out the large natural variations in carbon emissions caused by how plants and soils react to temperature, humidity and other factors, scientists have said. A key measure of carbon dioxide emissions in the Earth's atmosphere hit a record in May 2020 even as a global pandemic brought the world's economies to a virtual standstill this year, according to US government data published recently.

Carbon dioxide recorded at the Mauna Loa Observatory in Hawaii reached 417 parts per million (ppm) in May 2020, higher than the record of 414.8 ppm set last year.

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



Artificial Night Sky Poses Serious Threat to Coastal Species

The artificial lighting which lines the world's coastlines could be having a significant impact on species that rely on the moon and stars to find food, new research suggests. Creatures such as the sand hopper (*Talitrus saltator*) orient their nightly migrations based on the moon's position and brightness of the natural night sky. However, a study by Bangor University and the University of Plymouth shows the presence of artificial light originating from cities several kilometres away (also known as artificial skyglow) disrupts the lunar compass they use when covering long distances.

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

Plants can Also Absorb Plastic

Nanoplastics particles, as small as a protein or a virus, can accumulate in plants and have adverse ecological effects, according to a study published in *Nature Nanotechnology*. A group of researchers exposed *Arabidopsis thaliana*—a type of weed—to plastics smaller than 100 nanometres. The team then studied how far the plastic travelled into the plants, as well as its impact on the plant's biology and genetics. According to the researchers, 'Our findings provide direct evidence that nanoplastics can accumulate in plants, depending on their surface charge. Plant accumulation of nanoplastics can have both direct ecological effects and implications for agricultural sustainability and food safety.'

Source: <https://www.dailymail.co.uk/>

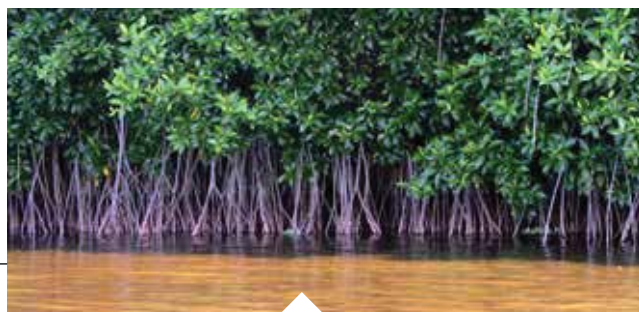




Protecting Natural Forest in Oil Palm Plantations Crucial for Conservation

Forest conservation areas in oil palm plantations play a vital role in storing carbon and boosting rainforest biodiversity, a new study on palm oil agriculture in Borneo has revealed. The study, led by the University of York, found that patches of protected forest play an important role in helping to conserve endangered species including hornbill birds and dipterocarp trees. The study revealed that plantations, where a tenth of the land is protected as natural forest, store up to 20 per cent more carbon than plantations with no protected forest. Oil palm agriculture is a key driver of deforestation, causing widespread biodiversity loss and carbon emissions—particularly in Indonesia and Malaysia, where 85 per cent of the world's palm oil is produced.

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



Mangrove Forests Could Be Wiped Out by Rising Sea Levels in 30 Years

Mangrove forests could disappear under rising sea levels by 2050 if the greenhouse gas emissions continue unabated, according to a new study. Examining sediment data from 78 mangrove ecosystems from the last 10,000 years, a team of researchers from Rutgers University found that if the sea level rises by more than six millimetres or 0.23 inches per year, the mangroves would be in danger of dying in just 30 years. They are more likely to survive when sea-level rise is less than 5 millimeters (about 0.2 inches) per year, which is projected for low-emissions scenarios this century.

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

More Investment in Clean Energy to Help APAC Recover from COVID-19 Crisis

A greater investment in clean energy will contribute to Asia-Pacific's recovery from the COVID-19 crisis and make economies more resilient against future shocks, the Asian Development Bank (ADB) observed in its virtual Asia Clean Energy Forum (ACEF) 2020. In view of the current scenario, ADB has invited proposals for digital solutions to improve waste management, reduce the amount of material sent to landfills, and increase sustainability in order to create more resilient communities.

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



Water and Sanitation Stress of Rural India

Highlighted by COVID-19

In this article, **Mayuri Phukan** and **Anagha Krishnan** say that inequitable water access and distribution calls for systematic water resource management so that disparities could be properly addressed. With high levels of water stress, rural India has to prioritize the use of water for meeting drinking, cooking and washing requirements and implementation of WASH practices. India will also need to look at managing its water resources more effectively and bring about technical and policy changes to ensure its equitable access to combat pandemic situations in future.

Since March 25, 2020, India has been under a nationwide lockdown, barring essential services. Frequent handwashing with soap and scrubbing for at least 20 seconds or using alcohol-based hand rub and social distancing has been advised by the World Health Organization (WHO) as measures to be taken up to combat the spread of COVID-19.

India has a population of around 1.3 billion; with a prevailing disparity and inequity in piped water supply and water access across the country.

Underprivileged communities, including the rural population and the economically weaker sections, are usually the most vulnerable during disease outbreaks. In areas where piped water supplies are not available, groundwater is the only source for addressing the water requirements. Excessive withdrawal of groundwater, over a period of time leads to the groundwater depletion. Coupled with this, is the issue of water quality and sanitation provision, which can negatively affect the health of the community. There is also the ongoing

climate change crisis, accelerated due to anthropogenic activities, which has affected the availability of water. This inequitable water access and distribution calls for systematic water resource management so that such disparities could be properly addressed.

The designation of red, orange and green zones throughout the country based on reported COVID-19 cases has brought about an interesting aspect. In May 2020, the 300 districts that were designated as green zones lie predominantly in rural India. While the reason for this could be manifold, one cannot ignore the fact that rural regions will be differently affected if there is spread of disease to these areas. There is disparity in household income levels, basic infrastructure and transportation facilities as compared to urban regions. Rural India also depends mostly on public healthcare facilities. As per the National Health Profile-2019, there is one government hospital bed available for an average of 3100 people in rural regions, while for urban regions, this number amounts to 800 people per bed.¹

Water, Sanitation and Hygiene (WASH)



¹ <https://www.indiatoday.in/diu/story/rural-population-in-india-defenceless-against-coronavirus-threat-1653210-2020-03-06>

measures are the main line of defence against the disease and rural regions are not well equipped to implement these actions. According to a report² by the Ministry of Jalshakti, Government of India, only 18.33 per cent of rural households have piped water supply as of March, 2019. About 163 million³ people do not have access to clean water near their homes. This number also includes people who would take more than half an hour to travel back and forth to fetch water. With the onset of summer season, the situation becomes worse due to increase in water demand.

It is to be noted that majority of Rural India is largely dependent on groundwater sources. The Central Ground Water Board (CGWB) reported in 2017, that out of 6881 groundwater assessment units in India, 1186 units falls in 'over-exploited' category and 100 units have 'saline' groundwater. About 50 per cent of assessment units have groundwater contaminated with arsenic, fluoride, nitrate or salinity.⁴ With such high levels of water stress, rural India has to prioritize the use of water for meeting drinking, cooking and washing requirements and implementation of WASH practices. For example, in Kaithi a village located in Bundelkhand, one tap is shared between five households. In many regions the need to collect water for daily use from a single source can become a barrier for social distancing as competition for the resource increases.

It has been estimated that frequent handwashing will increase water requirement by 20–40 litres⁴ per person. For Sadakwadi village in Palghar, Maharashtra, usage of this volume of water for handwashing has low priority as there is only one well to source water



for about six hamlets. Studies also reveal that sanitation facilities in many parts of rural areas is poor. A report⁵ by the National Family Health Survey (NFHS) in 2017, states that only 37 per cent of rural households use non-shared toilet facilities which means that a majority of rural households have a higher chance to potentially be infected due to higher contact between multiple households sharing a toilet. While about 96.3 per cent of rural households have designated places for washing hands but handwashing practices varied among these households. About 49.4 per cent households used soap and water, while 19.4 per cent households used only water for washing hands. This shows that the presence of infrastructure does not necessarily translate in to their designated usage. Hygiene practices were found to be better among the rich households compared to the poor and also better among the educated compared to uneducated population. Unavailability of soap and water clubbed with low information about good hygiene practices were among the reasons for poor hand hygiene in rural areas.

Response to the pandemic should consider the constraints present in rural areas for containing and responding to the disease spread. Rapid response

pathways⁶ may include provision of rapid water access points or kiosks with soaps to remote areas and packaged drinking water supply through supply tankers to rural areas and adequate water storage facilities for service operators. Communication about hygiene practices through local languages and interactive advertisements may prove to be beneficial.

The current situation reiterates the importance of investing in public health infrastructure and ensuring uniform coverage of water supply and sanitation services across rural and urban regions. Moreover, bringing about behavioural change is a complex process, which takes sustained efforts to convert awareness and knowledge into habit formation. The importance of good hygiene practices has to be delivered to local communities, by linking its importance to health. This will help in increasing their willingness to practice good hygiene. India will also need to look at managing its water resources more effectively and bring about technical and policy changes to ensure its equitable access to combat pandemic situations in future. ■

Mayuri Phukan, Senior Research Fellow, Water Resources Policy & Management (WRPM), TERI and Anagha Krishnan, Consultant, WRPM, TERI, New Delhi.

² https://jalshakti-ddws.gov.in/sites/default/files/JJM_Operational_Guidelines.pdf

³ <https://www.wateraidindia.in/media/the-water-gap-with-60-of-the-world-now-living-in-water-stressed-areas-wateraid-report-reveals>

⁴ <https://www.downtoearth.org.in/blog/water/covid-19-outbreak-more-hand-washing-can-increase-india-s-water-woes-69900>

⁵ <http://rchiips.org/nfhs/NFHS-4Reports/India.pdf>

⁶ <https://www.worldbank.org/en/topic/water/brief/wash-water-sanitation-hygiene-and-covid-19>

Ambitious Vision for Man-made Cellulosic Fibres

Promises Greater Resilience for Global Textile Industry

As COVID-19 continues to impact textile producers and buyers, a new report from international sustainability non-profits, Forum for the Future and Textile Exchange, highlights the huge potential of man-made cellulosic fibres (MMCF)—including viscose, modal and lyocell—to create a more sustainable future, and outlines an ambitious sector-wide vision that could revolutionize the textile and apparel industry, with implications for a wide variety of other industries from health to personal care.

With COVID-19 and climate change causing lasting disruption in the textile and apparel industry, the most significant industry players and stakeholders in the man-made cellulosic fibres (MMCF) value chain have revealed an ambitious shared vision for unleashing the fibres' huge untapped potential for building resilience in the global textile industry.

The MMCF 2030 Vision aims to provide a shared vision to drive the sector towards collectively putting more back into the environment and society than it takes out—from source to finished product. It was built by the sector through an extensive participative process engaging over 50 stakeholders from more than 40 organizations representing views from across the MMCF value chain. It is not intended as a formal commitment document or standard against which organizations will be measured. Instead, it seeks to serve as a set of guiding principles to inform how existing standards and practices must move at an accelerated pace, and towards which truly pioneering

organizations can lead the sector to go further, faster. The vision complements existing standards by challenging actors to look *beyond* what might be possible now—a call to action that seeks to stimulate new kinds of partnerships and forms of cross-sector collaboration to ensure that MMCF can reach its full potential as a sustainable fibre.

Man-made cellulosic fibres are the second biggest cellulosic fibre group after cotton and have the potential to contribute to realizing circular fashion, regenerating ecosystems, providing vital carbon sinks, and increasing community resilience and prosperity. Created with co-convenors, Forum for the Future and Textile Exchange, the vision outlines how the MMCF value chain can take the lead in transforming the textile and apparel sectors while building on existing standards and the progress already being driven by existing industry initiatives to address specific social and environmental issues. It calls on businesses and industry actors—from apparel and personal care brands to fibre producers—to align behind its goals and act collaboratively

to build a resilient industry that helps regenerate society and the planet at the same time.

The MMCF 2030 Vision sets out five interrelated areas for ambitious and collaborative action along the entire lifecycle—from raw material sourcing and fibre production right through to disposal and re-use—to help move the sector forward at the pace and scale needed and stimulate new kinds of partnerships and investment, as given below:

- **Regenerating ecosystems:** Restoring natural ecosystems, ensuring a carbon negative value chain, and taking regenerative landscape approaches
- **Producing with zero harm:** Managing chemicals and other inputs, zero emissions and closed-loop production systems
- **Enabling circular systems:** Designing, incentivizing and implementing circular value chains and zero waste
- **Creating prosperity:** Distributing economic value equitably, applying living wage and

equality, universal access to education and healthcare

- **Upholding rights:** Community empowerment and related access rights, protecting the rights of individuals, indigenous people, and other communities.

The vision sets out the activities required to deliver the ambition within each of the five areas, as well as commentary on where challenges need to be overcome. The vision also highlights the critical enabling factors needed for delivery, including collaboration across the value chain, positive voice and advocacy, full transparency and traceability, robust metric systems for impact measurement, sharing best practice and accelerating innovation, flows of finance, consumer education, affordability of solutions, self-regulation, and enabling policy.

The vision is launched at a time when COVID-19 is hitting the MMCF sector considerably. The shared vision, therefore, becomes even more important as a guiding star for the industry as it emerges from this crisis in a manner that will both build industry resilience and reduce the likelihood of future disruptions.

Dr Sally Uren, Chief Executive Officer at Forum for the Future, commented: 'The MMCF sector is facing significant social and environmental challenges, including deforestation, chemical use, and labour rights. The current COVID-19 crisis is intensifying these challenges. While progress is being made on traceability, innovation and sourcing practice, opportunities for deeper, systemic change are being lost in the absence of a holistic approach to addressing these interrelated challenges within the full value chain. By aligning behind a shared vision for a resilient and sustainable industry, the MMCF industry could lead the transformation of the apparel and textile sector, as well as make a positive contribution to other industries that source this versatile fibre. We now invite actors from across the industry to explore how they will work together to achieve this vision.'



The vision with its five components and enablers will be taken forward by the industry and facilitated through the Textile Exchange MMCF Round Table. Industry stakeholders will convene in early November 2020 when various initiatives will give updates on progress against the vision and participants will identify the critical innovation areas that need to be taken forward collectively beyond what is already happening.

LaRhea Pepper, Managing Director for Textile Exchange, said: 'Textile exchange has seen the industry make great strides in our nearly twenty years of operation, but we know it still has a long way to go. 2020 is kicking off a decade of change and the launch of the MMCF Vision is a big driver of the change that is needed! We must reduce carbon emissions from fibre and material production by 2030. Textile exchange has adopted a Climate+ Strategy to accomplish this and increasing the uptake of preferred man-made cellulosic fibres is part of the solution.'

Mr Eisaku Maeda, Senior General Manager, Bemberg Division at Asahi Kasei Corporation, said: 'Amid the demand for reforms toward the realization of a sustainable society on a global scale, as well as in the fashion industry, it is essential to accelerate the establishment of a circular economy through transparent production processes with low environmental impact and sustainable materials which have high traceability. MMCF is a material with various characteristics that can meet these needs and we are convinced that activities such as the MMCF Vision will be collectively taken forward by all those involved to ensure MMCF become a more sustainable material that is needed by the world. Asahi Kasei will continue to make even more efforts so that we can take this leap forward and we thank Textile Exchange, Forum for the Future, and all the stakeholders for creating this kind of opportunity.' ■

For more information, please visit www.forumforthefuture.org

Realigning Sustainability in the Post-pandemic World

Towards a Sustainable Planet

As the COVID-19 pandemic spreads into more regions, the national priorities are moving towards supporting the stretched health systems, hard-hit small business owners, and the labour force working in various sectors. National governments are working overtime to ensure the availability of basic necessities such as food, water and sanitation to their population. Redistributive actions, hence, have become the focus. With the general belief that the pandemic will continue for some time, though hopefully in a minor capacity, what will sustainability look like in the post COVID-19 world? In this article, **Anjula Gurtoo** and **Rahul Patil** attempt to ignite the discussion on sustainable future to understand the various shapes sustainability can take in the new future.







The nature of the world after the current coronavirus pandemic crisis remains to be fully understood. As the situation evolves rapidly, the predictions about economic, environmental, and social impact become highly dynamic.

COVID-19 Influencing the Current Sustainability Pillars

The coronavirus pandemic has triggered economic degrowth leading to a

reduction in greenhouse gas (GHG) emissions. But obviously, we did not want to reduce the footprints via such a heavily cascading economic systemic failure. Surely, these reductions in emissions are temporary and will regain in some form once systems try to get back to their own normal. However, that normal will be different from the pre-pandemic normal and, furthermore, the current degrowth does not reflect positive development for sustainability. The leading defenders of degrowth-based sustainability transition do not advocate for the same as well, as

this nature of degrowth expresses itself through extreme societal sufferings and hardships.

The production-consumption patterns, expectedly, are heavily disordered as well, evident through the lowering of crude oil prices due to a significant decrease in demand worldwide. We witness reduced production of crude oil through a tentative agreement between the Organization of the Petroleum Exporting Countries (OPEC), Russia and other countries recently.

The severity of the pandemic crisis has also brought forth the socially unsustainable growth in health care systems. Faster breakdowns and strains on the existing systems due to the sudden surge in a number of COVID-19 patients are shreds of evidence of the systemic unsustainability of the current health care system. The causal factors are several, including decreased prioritization of public health systems, lack of focus on good health and well-being (SDG 3)¹ and research focus on personalized medicine. The number of government hospital



¹ UN's SDG 3: Ensure healthy lives and promote well-being for all at all ages, available at <<https://www.un.org/sustainabledevelopment/health>>

beds² or percentage GDP spending on public health care across various economies before the pandemic eruption identifies vividly with the pre-pandemic focus in the health sector.

Post-pandemic commons are in disarray, and are leading to increased unemployment, salary cuts, unnatural resource diversion on social welfare, reduced spending on non-essential services, the involvement of government machinery in distributing food and essentials, corporations are pushed to manufacture non-core products such as medical equipment and health essentials, and these practices can be considered as a prelude to changing financial frameworks.

Sustainability During- and Post-pandemic

The current crisis has broken the process of a steady-state progressing sustainable growth. The outbreak brings forth newer global vulnerabilities as well. The question to ask, therefore, is, what will the new steady-state progress of sustainability be like?

Localization of economic activity

While emissions have fallen around the world due to reduced economic activity, investors still want the companies to have long-term plans that go beyond temporary reduction. The high fossil fuel utilizing industries will keep feeling the pressure to lower emissions. Along with the pressures of emissions reduction, the argument on linkages between the spread of endemics and globalization surface more frequently in the recent discussions. Localization of economic activity and serious international



considerations of restricted travel are being discussed in the light of poor global governance. Of course, a global health crisis is not the answer to reducing GHG emissions, but the phenomenon should give us a cause to reflect on the impact human activity has on the planet—including how we travel. The shift of focus towards a larger discussion on climate change, through localization of the economic systems and more controlled global supply chains, seems a nearer possibility.

Stronger focus on SDG 3

In the wake of the COVID-19 pandemic, the time taken to develop the vaccine or medicine becomes an important milestone in the prospects of sustainability. Unless COVID-19 gets mitigated just like smallpox, poliomyelitis, and others, and pandemic escalation and virus resurgence are carefully monitored, the economic degrowth will put unwanted, unsustainable burdens on the economies. For the continuation of economic recovery, the dominance of public health system growth and health system policies may take precedence over other SDGs. A stronger focus on SDG 3, that is, health systems and well-

being, in the short and medium-term, therefore, becomes a strong possibility.

Emergence of new socio-economic models

Transition to sustainable development through the coronavirus caused tunnel-like situation offers unique and best chance to equate the importance of sustainable economics. The pandemic provides an opportunity to adapt innovatively designed solutions in recovering the economic routines followed before the crisis and the lockdown period. Rebuilding the prior economic models and recreating the old worsened environmental situation makes little sense. For example, the economic efficiency logic of global supply and value chains, have led to more fossil fuel use through transportation.

Guidance from the hybridity concept³ can address careful redesigning of

² Number of beds per 1000 people: China- 4.2 (2012); France- 6.5 (2013); Germany- 8.3 (2013); India- 0.3 (2011); Italy- 3.4 (2012); South Korea- 11.5 (2015); Spain- 3 (2013); Switzerland- 4.7 (2013); United Kingdom- 2.8 (2013); and United States- 2.9 (2013); Source: Data at World Bank, available at <<https://data.worldbank.org/indicator/sh.med.beds.zs>>

³ A hybrid system mixes elements, value systems and action logics (e.g., social impact and profit generation) of various sectors of society, i.e., the public, the private and the voluntary, within its structure, roles and processes (Borys and Jemison, 1989). Hybrid Arrangements as Strategic Alliances: Theoretical Issues in Organizational Combinations. The Academy of Management Review, Vol. 14, No. 2 (April, 1989), pp. 234-249



approaches to handle new sustainability priorities due to the pandemic crisis. Incorporation of hybrid models and economic principles has tremendous potential, however, these measures are interwoven with a higher degree of complexity. The market-based economic fundamentals of value extraction and efficiency will have to be amalgamated with the mechanisms of economic justice. For example, designating some months of the year as no travel months, flexible production capacity, equitable distribution of goods and services (anti-hoarding laws and price control of essential goods), and work from home options (community costs) for employees can promote models of efficiency as well as sustainability. Systemic reforms to address market-based economic imbalances and building more economically sustainable policies aimed at the common good, should emerge as a significant economic discussion.

Global cooperation, collaboration, and partnership

Global information sharing and various spontaneous initiatives in trying to manage the crisis has widened the doors of international collaborations. The development of COVID-19 diagnostic kits merely in a matter of weeks after the outbreak,⁴ uniformity in guidelines globally to contain the propagation of the virus, international cooperation in sharing medicine, vaccine development, and informatics on casualties are some of the examples of sustainable global cooperation. These kinds of sustainable practices may extend to the social and economic domain as well. For example, global employment systems, better accounting of unorganized sector, and

common renewable resources norms may emerge as part of the global exchange of knowledge and desire for global uniformity of response. Similarly, health care technologies and broader health issues such as obesity and immunity, and so on, will face more investor interest in the face of the virus, making pharmaceutical firms to work collaboratively on larger social health areas.

Circular economy as a global sustainability programme

Such conscious human stewardship can be brought in reality through the practice of circular economy.⁵ With wider doors opened for international cooperation, the circular economy concept may accelerate and become a

⁴ Rebecca Tan, COVID-19 Diagnostics Explained, Asian Scientist Magazine, available at: <<https://www.asianscientist.com/2020/04/features/covid-19-diagnostics-explained/>>, April 8, 2020

⁵ <https://kenniskaarten.hetgroenebrein.nl/en/knowledge-map-circular-economy/what-is-the-definition-a-circular-economy/>

global sustainability programme. Global concerns, such as plastic reduction, use of sustainable materials, recycling, and waste management could push governments to support companies towards global cooperation. For example, corporate renewable energy initiatives could become more important through solar installations, through a shift from household single solar installations to large building and factory-level installations.

Circular economy frameworks, thus, need immediate attention on several fronts as a sustainability transition progression. The new regime phase demands shifts across various dimensions. Such dimensions include policies, technologies, infrastructure, user practices, industrial networks, and cultural aspects. National regimes may,



therefore, redesign and coevolve taking sustainability to a coordinated global scale.

Conclusions

Everyone on the planet seeks a safer exit from COVID-19 catastrophe, from nationwide lockdowns, and disrupted

daily lives. But these actualities somewhere deep in our thoughts have triggered the sense of vulnerability and dependence on the ecosystem among societies. Here's the ray of hope for sustainability, it is the sign of solidarity among the brotherhood.

Global cooperation, advocated by 17th UN-SDG, has revitalized the nature of our COVID-19 tackling approaches worldwide. The leadership roles of supranational organizations, such as WHO, UN, UNICEF, and others, will be important as most world economies are facing financial breakdowns. These organizations require to orient themselves in identifying the segments to be prioritized during the transition and should not wait for the crisis to rest in peace.

In the immediate future, governments would be focusing more on the measures to tackle the strains on health care systems and hence, prioritized segments might belong to social health and financial aspects which further represent important pillars of sustainability namely, social and economic. Whereas, in the long run, world sustainability might share spaces on top priority list along with others. ■

Acknowledgment: The authors gratefully acknowledge the discussions under the IPACST project.

Anjula Gurtoo, Professor, Indian Institute of Science, Bangalore and Rahul Patil, Research Associate, Centre for Society and Policy, Indian Institute of Science, Bangalore. The article is also available at: <https://csp.iisc.ac.in/01C-04-2020/>.



“Conservation is About Knowing Our Place in the World”

In a freewheeling video chat, the multi-faceted conservation biologist **Neha Sinha** opens up to Meghaa Aggarwal for *TerraGreen*.



How do childhood experiences nurture a conservation mindset in children and what is the role of environment education in school?

Children need to be exposed to nature, to walk on a variety of surfaces like sand and grass, to touch a variety of surfaces like soil, leaves, and rocks. They need to be within that unsanitized environment.

I find many parents are reluctant to let their children do this. But it helps to build immunity. It helps them to understand that we are all part of nature.

Even if they are growing up in cities, they are not far from nature. Cities are not just about people or about buildings. They are also home to many other creatures. For example, Delhi has at least 300 different species. In Kolkata, you can find dolphins in the Hooghly. Leopards stray into the areas around the Sanjay Gandhi National Park in Mumbai. They have all adapted to live here. For example, the dolphins in the Hooghly are blind because there is so much silt in the river that they cannot see. So, instead of vision, they use advanced echolocation and hearing to navigate. Conservation is about knowing our place in the world with all its biodiversity.

Environmental education should not just be about books and classes. Children need to be taken outdoors where they can find a hundred things to observe about nature. I started observing nature as a child. There used to be a big nest of a white-backed vulture near my school in Delhi. I was fascinated by the birds. I was a small girl and these big birds appeared like mythical creatures to me. But one day they were suddenly gone. Many such creatures have vanished from nature, from our lives.

What prompted you to switch from journalism to conservation and how easy was the switch?

I got a job in journalism right out of college. It taught me a lot about investigation and analysis in a short span of time. I learnt to think for myself, question and have an inquiring mind. I did a number of stories, including many on the environment. But I found that most of the environmental stories were negative and depressing—about deforestation, air and water pollution. I wanted to make a difference from inside. So, I pursued the MSc in Biodiversity, Conservation and Management at the University of Oxford. It was a steep learning curve, especially since I was not from a science background. After completing the course, I returned to India.

Conservation is not an easy career. It is difficult to get a job, the pay is not very high and career progression can be a problem. It is also challenging, with a lot of fieldwork. But I had made up my mind and did not want to live in fear. I spent three months without work. But ultimately, I got a job and made my own way.

Can someone without a professional degree be called a conservationist?

No amount of professionalism can replace public-mindedness when it

comes to issues of development, be it environmental conservation, woman and child health or justice for minorities. For example, local communities seeking to protect a sacred grove or people protesting against the chopping of trees may not be professionally qualified but they are taking out the time and making the effort to conserve what is dear to them.

A lot of your work is focused in the North East and in Andhra Pradesh and conservation of the Amur Falcon in

Nagaland has been one of your most successful projects. Could you share something from your experiences?

These are relatively less-explored geographies. The culture and pride of people from the north east is deeply distinct. I have been part of the Amur Falcon project, but it would not have been possible without Bano Haralu, a former television journalist turned conservationist. The Eastern Ghats in Andhra Pradesh have a lot to explore. I was drawn to the wetlands there. These are such incredible places with so much

life, yet they are being neglected and taken over for commercial fishery. So I got in touch with the forest department there and am working on a project.

You have often spoken of the struggles of being a woman in conservation...

Our society is awash in biases and it is the same in this field. When people look at me, even before they think of me as a conservationist or a biologist, they think of me as an entitled, upper-caste woman riding in cars and living in an air-conditioned home. They wonder if I will



be able to do the job. They want to know where I studied. Even after spending so many years in this field, I continue to hear the snide remarks and get mansplained. No one asks the same things of men. No one cares what a man in this field looks like.

To get a full picture of issues in conservation, whether it is human-wildlife conflict or rights over forest produce, you need inclusion. You need the female perspective as also the perspective of various other minorities. When you speak to people in the field, you realize that men and women often have different priorities and different ways of looking at a situation. A woman will be deeply concerned about the needs of her household and her children. But many times one skips this perspective because male conservationists may not be allowed into this private life of women. There are various challenges that women may face.

For example, getting safely to a remote place. In many places, the locals may also find it odd to see a woman outside the house. But organizations that are keen on comprehensive research and inclusivity will arrange for appropriate logistics. As a woman, I too do my bit by actively mentoring women working in this field and encouraging them.

What would you say to people who call conservation anti-development?

The problem is that we usually have only one vision of development and do not explore all options. For example, what is the carrying capacity of a river and how many dams can it have before it ceases to be a river. What about the habitat of the animals living within and around it. What about the people who depend on it for their livelihood. Who will it benefit? Often the electricity produced by a dam in one state is sold to other states instead of benefitting the people sacrificing

for it. Also, is the dam the only way to generate electricity? Conservation is not anti-development. It is about exploring all options before exploiting a natural resource.

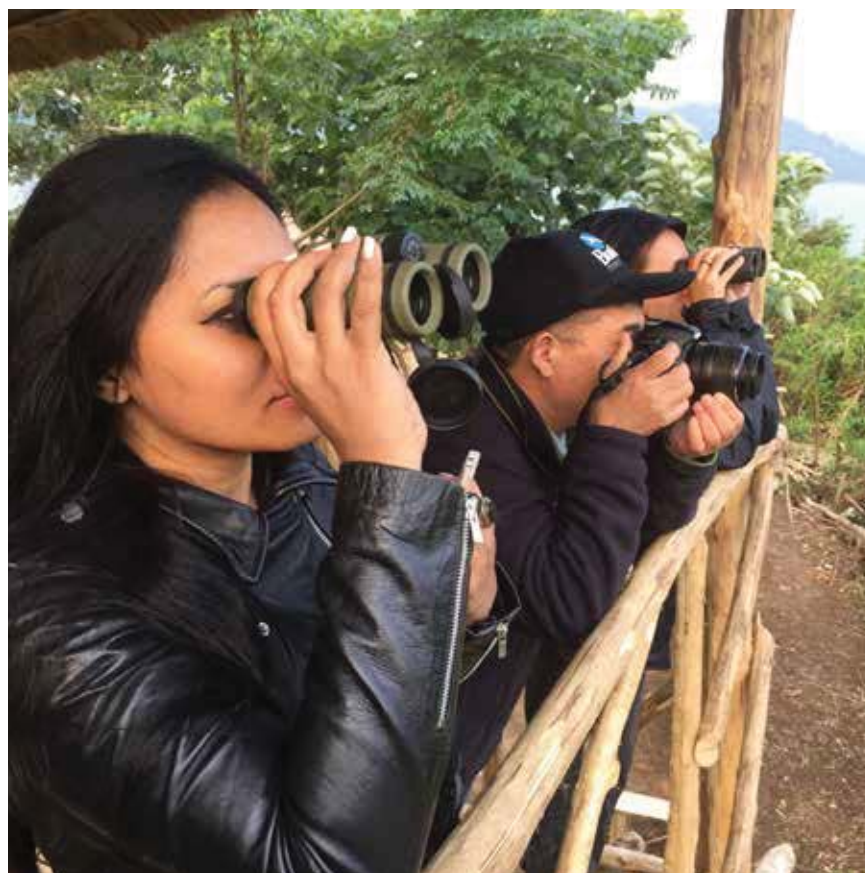
A lot of people have been talking of how the lockdown has been good for nature. What are your views?

Such a short period—a few months—is not going to make a big difference. During the lockdown many decisions have been taken by governments around the world that adversely impact the environment. Many people are blaming bats for the outbreak and killing them because the virus is believed to have originated in bats. They forget that the virus would not have spread without an intermediate species that transmitted it to humans. It is because of human interference in nature that novel interfaces open up and such things happen. We capture wild animals and keep them under stressful conditions, forcing them to shed the microbes they carry.

What will matter is what we do in the long-term. Change needs to be institutionalized for it to make a difference. A low hanging fruit would be actively encouraging work from home, so we can cut down pollution caused by transport.

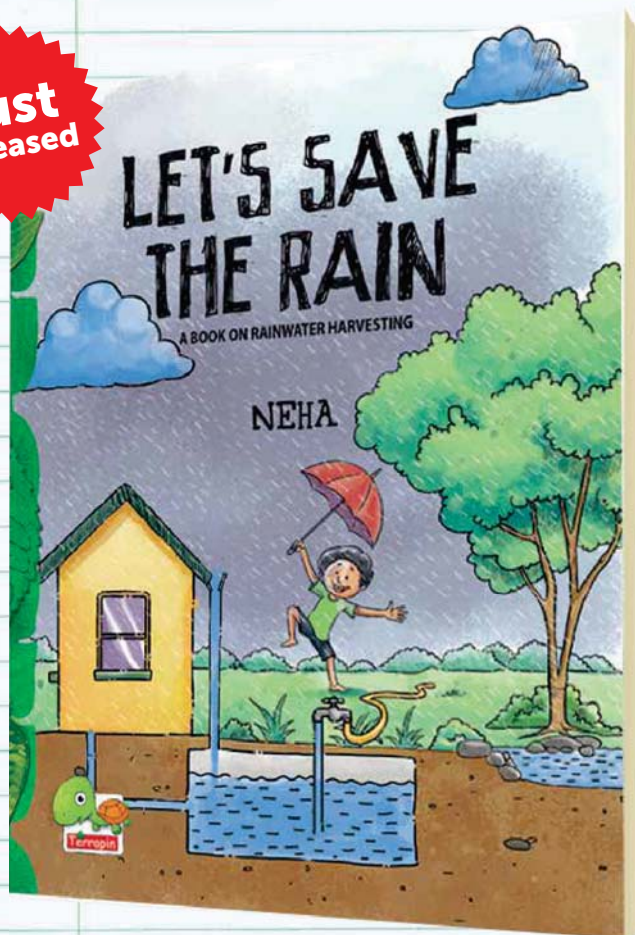
Recently, there was a lot of buzz around the locust attack in cities. Could you demystify this phenomenon?

We need to put our trust in science and facts. Locusts are like grasshoppers. They do not eat or bite humans. At most, they will damage trees and gardens. Unlike farmers, they will not ruin our livelihood. The decision to use insecticides to get rid of them is more dangerous for our health. In our neighbouring country, they are catching locusts and using them as chicken feed. This is something even I would do. Use them as chicken or fish feed instead of spraying poison. ■



Rain Is Gain When We Harvest Rainwater

**Just
Released**



Ages: 12-14 years • ISBN: 9789386530073 • Price: ₹150

- Introduces children to the importance of conservation
- Talks about the traditional and modern rainwater harvesting systems
- Showcases how rooftop rainwater harvesting is beneficial for the socio-economic condition
- Explains the technique and various types of rainwater harvesting systems
- Beautifully elucidated with experiments, DIYs, and easy calculations

The Energy and Resources Institute
Attn: TERI Press
Darbari Seth Block
IHC Complex, Lodhi Road
New Delhi – 110 003/India

Tel. 2468 2100 or 4150 4900
Fax: 2468 2144 or 2468 2145
India +91 • Delhi (0)11
Email: teripress@teri.res.in
Web: <http://bookstore.teri.res.in>

To purchase the book, visit our online bookstore at <http://bookstore.teri.res.in> or send us your demand draft or cheque in favour of TERI, payable at New Delhi (outstation cheques are not accepted).



Building Pandemic Resilient Cities in India

By Strengthening the WASH Sector

It is well established that globally most pandemics have severely affected crowded urban settlements which are often the hub of significant economic activities, but yet they suffer from poor housing and basic Water, Sanitation, Hygiene (WASH) infrastructure. In this article, **Mary Abraham** and **Nathaniel B Dkhar** highlight that while washing hands and maintaining adequate hygiene has been advocated as the need of the hour, COVID-19 exerts the need to reassess the adequacy of the WASH infrastructure in slums and low-economic settlements. They rightly emphasize on the need for WASH infrastructure improvement to face pandemics in urban areas.





India is one of the fastest urbanizing nations with around 459 million people living in the urban areas. As per the Census of India, about 28.53 per cent of the population in 2001 resided in urban areas which grew to 31.16 per cent by 2011 and estimated at around 34.3 per cent in 2018.¹ By the year 2050, around 52.8 per cent of Indians are estimated to live in urban areas.² Despite considerable progress in the urban Water, Sanitation and Hygiene (WASH) sector, the inequity of WASH infrastructure persists as a serious challenge especially in the context of the COVID-19 outbreak. Almost all the states in India are affected with coronavirus with urban areas being on high risk. Several measures are being taken by the Central and State Governments for containment of the pandemic, including a phased-out lockdown and strengthening of health infrastructure.

The World Health Organization (WHO) recommends hand hygiene or washing of hands with soap to prevent the spread of COVID-19 virus transmitted through respiratory droplets or direct contact. Good WASH and waste management practices in communities, workplaces, markets and institutions including health

care facilities serve as barriers in the spread of the virus.

Although there has not been any clear connection of the virus spreading through drinking water, the safe management of drinking water and sanitation services is necessary for maintaining good health. The prevalence of gastrointestinal symptoms of the infected COVID-19 patients,³ further demands access to adequate sanitation facilities. The faecal oral transmission of the SARS-CoV-2 virus is yet to be clearly established. However, several studies point out the presence of SARS-CoV-2 virus in faeces and there is concern that untreated sewage waste could be a potential source of infection.⁴ An examination of WASH infrastructure in urban areas especially urban slums is imperative to mitigate large-scale outbreaks of infectious disease.

While the consequences of the pandemic is still being understood and yet to be fully assessed, urban areas have already witnessed severe socio-economic consequences. In view of the fact that there is no vaccine yet, and recent reports from WHO indicating the possibility of COVID-19 being an endemic is unsettling. This is especially precarious for urban areas

¹ <https://data.worldbank.org/indicator/SP.URB.TOTL.IN.ZS?locations=IN>

² United Nations, Department of Economic and Social Affairs, Population Division (2018). World Urbanization Prospects: The 2018 Revision, Online Edition

³ Rothan and Byrareddy, 2020; D'Amico, *et al.*, 2020

⁴ Chen, *et al.*, 2020; Medema, *et al.*, 2020; Carvalho, *et al.*, 2020; Ahmed, *et al.*, 2020

in developing countries where people face higher vulnerability for several reasons. The current scenario raises concern especially for 24 per cent of India's urban population living in slums under dense habitations often lacking adequate WASH facilities. It is thus pertinent to assess the urban WASH sector in view of the current pandemic.

Urban Poor and WASH

Around 26–37 (33–47 per cent) million households⁵ are reported to live in slums and informal housing facilities, often lacking adequate basic amenities challenging the maintenance of required hygiene during this pandemic. NSS, 2019 suggests only around 40 per cent of urban population have access to piped drinking water in their dwelling units, 16 per cent draw it from their yards, 7 per cent used public taps and 12.2 per cent use bottled water. Almost 50 per cent of the households treat water for drinking. A study by WaterAid in 2018⁶ suggests that 74 per cent slums use tap water generally accessed through community stand posts. Several studies also indicate the inequalities in terms of quantity and quality of water supplied to urban slums. Another report suggests that slums receive less than one-third of the urban water supply which are mostly from informal sources such as local bore-wells, etc., and suffer with issues in terms of both quantity and quality as compared to other urban households.⁷ Around 66 per cent of slum households have individual toilets and 15 per cent have access to public toilets, though several of them lack water for use and are poorly maintained.

Hand washing is also a concern due to poor water availability and lack of necessary infrastructure. NSS, 2019 suggests 44 per cent of the total urban population do not wash hands with soap before meals and around 12 per cent do not wash hands with soap after defaecation, studies indicate the population washing hands with soap are much lower among slum and poorer communities. Most of these slums also have poor living conditions, with more than half the slums being affected by water logging and almost a quarter located near drains and waste dumping yards.⁸ With projections



indicating rise in urbanization, the urban slums are expected to further grow at a much larger pace. The pandemic exposes the risks posed to the urban poor living in slums due to their workplace exposure, inability to maintain social distancing and isolation while living in cramped habitations and poor basic facilities including WASH infrastructure.

Impact of COVID-19 on Urban Poor in India

Severe socio-economic consequences under the current lockdown for containing the SARS-CoV-2 virus have increased the vulnerability for poor. A recent study by the Azim Premji University, suggests around 67 per cent workers have lost employment during the lockdown with more than 80 per cent of urban workers losing their jobs. The plight of migrant urban population returning to their places of origin, others depending on government and civil societies for food and basic requirements indicates high prospects of a large majority of the community slipping back into extreme poverty.

The health of the urban poor communities who lack basic amenities is further threatened by poor quality of water for consumption. An existing inadequate WASH infrastructure coupled with deterioration in economic condition of the vast majority of urban poor throw a grim scenario in terms of meeting the requirements to deal with COVID-19. The significant amount of people living in close quarters, using community toilets and water access points increases the chances for community transmission.

Frequent and proper hand washing preferably under running water is critical under the current pandemic. The current scenario demands washing hands more often than normal times, in all probability twice as often as it had to be in the absence of the pandemic,

⁵ Jain, *et al.*, 2016 (accessed from <https://www.fsg.org/sites/default/files/publications/Informal%20Housing%20Inadequate%20Property%20Rights.pdf>)

⁶ <https://www.wateraidindia.in/sites/g/files/jkxoo336/files/state-of-urban-water-supply.pdf>

⁷ <https://swasti.org/water-quality-in-urban-slums-life-saving-or-life-threatening/>

⁸ USAID, 2015, Water, Sanitation and Hygiene of the Poor in Urban India, A photo journey into issues, challenges and opportunities



directly posing an increased demand in usage of water by around 20–40 litres per household as projected in a recent analysis by the Centre for Science and Environment. While on the other hand most cities are glaring at an acute water crisis. The NITI Aayog in 2018 had projected that 21 cities including Chennai, Delhi and Bengaluru would run out of groundwater by 2020.⁹ Several reports highlight that most urban households cope with the water shortages especially during the lean period by purchasing more water for meeting their basic needs.¹⁰ High water demand due to scarcity in urban areas provides significant scope for private water market in reducing it. The higher price puts an additional strain on the finances of the urban poor and poor quality of the water delivered by these private vendors are serious concerns.

The water supplied is at times contaminated with *Escherichia coli*, which indicates faecal contamination. Lack of access to clean water can lead to diarrhoeal illness especially in children. Additionally, recurrent diarrhoeal illness can result in increased child mortality and poor nutritional status. Recent reports by the World Resources Institute (WRI) have pointed out that even during the lockdown slum dwellers in cities such as Mumbai queue up for water delivered by tankers and access water way lesser than the WHO recommendation of 50 litres per day.¹¹

⁹ NITI Aayog (2018), Composite Water Management Index

¹⁰ Subbaraman, R., Nolan, L., Sawant, K., Shitole, S., Shitole, T., Nanarkar, M., Bloom, D. E. 2015. Multidimensional measurement of household water poverty in a Mumbai slum: Looking beyond water quality. PLoS One 10(7), e0133241 & Bharti, N., Khandekar, N., Sengupta, P., Bhadwal, S., Kochhar, I. Dynamics of urban water supply management of two Himalayan towns in India. Water Policy 2019

¹¹ <https://www.wri.org/blog/2020/04/coronavirus-inequality-cities>

The rise in demand for water in the COVID-19 era and deterioration of economic conditions leads to a major hindrance in the requirements of basic hygiene, where most often cooking and drinking is the first priority for water use. The current pandemic thus worsens the situation in most urban slums, thereby, highlighting the inequity and scarcity of water availability for washing hands, maintaining personal hygiene and drinking.

While, washing hands will be a challenge to those lacking piped water supply within their dwelling and the areas facing acute water shortage, the availability of soaps, and sanitizers may seem a luxury and certainly beyond the reach of the vast majority of the urban poor.

On the sanitation front, the success of the Swachh Bharat Mission-Urban (SBM-U) has made headlines. Out of the 4372 urban local bodies (ULBs) in India 4324 (98.9%) have self-declared to be open defaecation-free (ODF).¹² An assessment of 4258 self-declared ULBs shows that 4053 (95.19%) are certified as ODF while 205 (4.81%) have not fulfilled the criteria for ODF cities.¹³ Since the announcement of SBM, about 6,160,812 individual toilets and 593,338 community/public toilets have been constructed in the urban areas.¹⁴ The NSS data indicated that around 77.6 per cent urban India has the privilege of exclusive access to household toilets and 15.6 per cent have access to common toilets and only around 2.7 per cent depend on the access to community toilets. These statistics highlight phenomenal achievements in terms of toilet coverage and access to urban population. However,

¹² <http://swachhodurban.org/?id=eyo10wqvjkwm373h>

¹³ <http://sbmodf.in/>

¹⁴ <http://swachhbharaturban.gov.in/dashboard/>

this needs to be complimented with improved faecal sludge and septage management. While the statistics of 593,338 community/public toilets constructed till date under the SBM seem impressive, there are serious concerns on the adequate management and social distancing for use of these toilets during the lockdown period especially in crowded slums. There are reports of heightened fears on the use of public toilets under a pandemic despite the fact that the health hazards caused by not having access to toilets are greater than the threat posed by sharing toilets. The need for use of such community/public toilets had risen under a lockdown scenario since several informal workers who had access to toilets at their workplace were faced with options of using community/public toilets or defaecate in the open. Rising urbanization, especially with the rise of growth of Tier II and Tier III cities where majority of the migrant population live in slums and informal settlements located around drains or low-lying areas underlines the need for equity and improved planning of peri-urban areas.

Another serious issue of concern on the sanitation front is that only 81 cities in the country have at least 80



per cent of all constructed toilets attached to sewerage systems or have septic tanks. Most urban areas still lack adequate septage management programmes or treatment facilities. Of the 62,000 million litres per day (MLD) (approx.) of sewage generated, the treatment capacity in the country is as low as 23,277 MLD with 816 sewerage treatment plants (STPs). The overpopulated metropolitan cities also do not have adequate sewage treatment capacity, only 51 per cent of sewage treatment capacity exists in 35 metropolitan cities generating around 15,644 MLD of sewage. Also, most of the sewage treatment plants are either non-operational



or poorly managed.¹⁵

It is well documented that the poor sewage management infrastructure has a direct impact on the outbreak of communicable diseases and can have worse impacts under the current pandemic scenario. For instance, an outbreak of cholera reported in early March 2020 in several parts of Bengaluru (though contained at an early stage) was an alarm for the public health infrastructure which if left uncontrolled may cause further stress on the existing health systems. Untreated sewage from wastewater can pollute water bodies, although there are no established studies yet that indicate sewage being a transmission path for COVID-19, there are extensive studies that point towards the prevalence of the virus from infected or carrier individuals flowing into water bodies and catchments. All of these demands for monitoring of the entire faecal sludge management chain is to be strengthened during these times. These issues need to be adequately assessed and addressed under the ODF++, of SBM phase II which focusses on safe collection, conveyance, treatment and disposal of all faecal sludge and sewage.

Recommendations in WASH Sector

The current pandemic reiterates the need for improvement of WASH infrastructure in urban slums and low economic settlements. It is imperative to do so to build the resilience of cities to pandemics and improve their disaster preparedness. Some specific recommendations under the heads of management, institutional and financial that need to be considered are detailed below:

¹⁵ CPCB Annual Progress Report 2017-18

Management

- Disaster management plans to include specific strategies for improvement of WASH infrastructure in slums for the urban poor.
- Regular monitoring and maintenance of WASH infrastructure in urban slums. Address specific WASH needs for slums and low income group (LIG) settlements such as mobile hand washing and mobile sanitation facilities as provided by some State Governments during circumstances of a pandemic or disasters.
- Awareness creation and IEC specifically for population residing in slums and lower economic zones.
- Improve Faecal Sludge and Septage Management (FSSM) strategies in cities and address wastewater management effectively to contain the spread of communicable diseases.
- Building resilience to pandemics such as the COVID-19 and other disasters through ongoing Government programmes such as SBM, AMRUT and Smart City Mission (intended towards improvement of water, sanitation and sewerage infrastructure and provision of improved housing to urban poor) to address large inadequacies that continue to exist.

Institutional

- Participation of stakeholders and inclusion of urban slum dwellers in planning, implementation and management of WASH interventions.
- Institutional strengthening and capacity building of ULBs towards pandemic proofing and improving the WASH infrastructure for the urban poor.
- Informed/fact-based decision making for institutional and infrastructural strengthening.

Financial

- Economic support, financial guarantees and micro-credit schemes to urban poor for strengthening operation and maintenance of WASH infrastructure and interventions.



- Leveraging funds from corporate and private institutions for promotion of WASH infrastructure and behavioural change in urban slums.
- Development of state-specific action plan to liquidated unspent balances meant for improving WASH interventions.

The Need for WASH Infrastructure Improvement to Face Pandemics

It is well established that globally most pandemics such as Ebola, the 1918 Spanish Flu, and so on, have severely affected crowded urban settlements which are often the hub of significant economic activities, but yet they suffer from poor housing and basic WASH infrastructure.¹⁶ While washing hands and maintaining adequate hygiene has been advocated as the need of the hour, COVID-19 exerts the need to reassess the adequacy of the WASH infrastructure in slums and low economic settlements not just in terms of its preparedness in handling pandemics in the future but also towards disasters and extreme events considering that extreme events such as droughts, floods, wind-storms and tropical cyclones that are expected to rise on account of climate change.

These call for an improvement of the following:

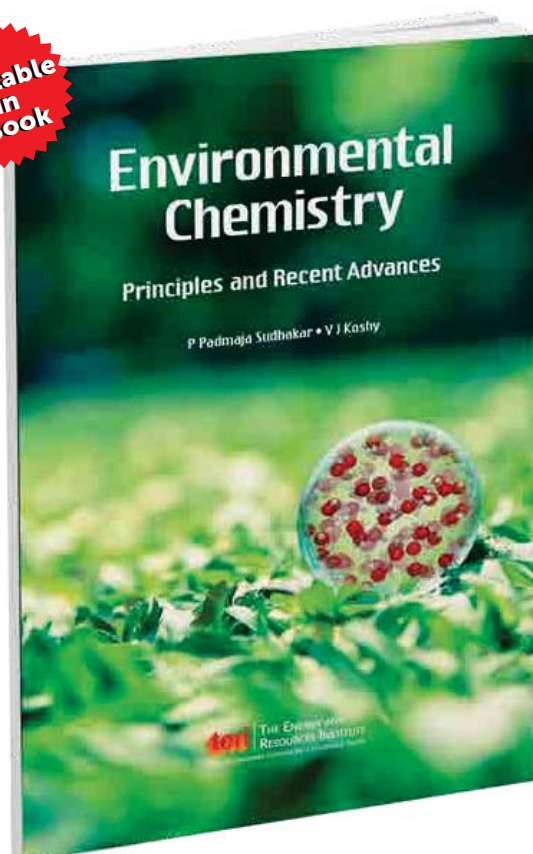
- WASH infrastructure in slums, schools and health centres catering to the low-income populations.
- Resilient housing and infrastructure as good quality housing is one of the prerequisites of addressing any pandemic or disaster.
- Slum improvements, including construction of stormwater drains, sanitation infrastructure, embankments and roads, are key to reducing vulnerability.
- Safe management of wastewater and solid waste.
- Sustainable and effective behavioural change programmes to incorporate educating the vulnerable communities (on subjects such as the importance of WASH, health and hygiene, and benefits of hand washing) through educational and behavioural tools and awareness generation campaigns. ■

Mary Abraham, Fellow, Water Resource Policy and Management (WRPM), TERI, Bangalore, and Nathaniel B Dkhar, Associate Fellow, WRPM, TERI, New Delhi.

¹⁶ Neiderud, C. J. 2015. "How Urbanization Affects the Epidemiology of Emerging Infectious Diseases." *Infection Ecology and Epidemiology* 5: 27060. doi:10.3402/iee.v5.27060

A STUDY OF THE CHEMICAL PHENOMENA IN THE ENVIRONMENT

Available
in
eBook



Major topics covered

- Fundamentals of chemical thermodynamics
- Atmospheric chemistry
- Hydrospheric chemistry
- Soil and soil pollution
- Solid and hazardous waste management
- Environmental toxicology
- Radiation pollution
- Global environmental disasters

ISBN: 9788179935224 • Price: ₹650.00

Environmental Chemistry: principles and recent advances discusses the various pollutants present in the atmosphere, including persistent and bioaccumulative chemicals, pesticides, nanoparticles, and chiral pollutants. Advances in treatment techniques and analysis and monitoring of pollutants are the other topics covered in detail. A chapter has been dedicated for a comprehensive discussion on green chemistry. The book also talks about the Best Available Techniques (BAT) adapted by industries for Preventing and Controlling Pollution and also provides information on the application of analytical techniques, such as GC, LC, IR, and MS for analysing and measuring aqueous, solid and atmospheric samples and for monitoring environmental pollutants.

The Energy and Resources Institute
Attn: TERI Press
Darbari Seth Block
IHC Complex, Lodhi Road
New Delhi – 110 003/India

Tel. 2468 2100
Fax: 2468 2144
India +91 • Delhi (0)11
Email: teripress@teri.res.in
Web: <http://bookstore.teri.res.in>

To purchase the book, visit our online bookstore at <http://bookstore.teri.res.in> or send us your demand draft or cheque in favour of TERI, payable at New Delhi (outstation cheques are not accepted).

Forests, Beyond Just Trees

We have been taught to look at forests through the glasses of revenue generation; to frame policies which are just tree centric, since exploitation of trees is quite easy. Understanding that forest is a natural self-sustaining system and trees are just a component of it has now become a must. If the sustainability of the forest is disturbed we don't have enough of knowledge to redeem it, writes **Rajshekhar Pant**.

A late evening in the somnolent winters of Nainital; beneath the gloomy shade of an oak tree stands before me Vinod Pande—a retired forest officer. He has challenged before the law an office order of the Uttarakhand Government. Besides defining the 'forest', this order, sets parameters for the 'deemed forest.' Following a ruling by the apex court in the year 1996 the right to define their forests rests with the states. On the

recommendation of the Forest Advisory Committee the Ministry of Environment, Forest and Climate Change (MoEFCC), Government of India, had asked the states and UTs to identify their 'own forests' as 'having well established forest departments they are in a better position rather than the MoEFCC to understand their own forests and needs.' Though for the criterion thus finalized the states were not supposed to seek any approval from the MoEFCC, yet in a

communication the states and UTs were asked to exercise due diligence taking into account the spirit of the order of the apex court, national forest policy and the rationale of having adequate forests, site quality of naturally occurring forest species, etc., for supporting a healthy environment.

In this background, the Government of Uttarakhand issued the said order which defines unclassified or deemed forest as a minimum expanse of 10 hectares



of area of forest having 75 per cent of native trees along with a canopy density of more than 60 per cent. Vinod Pande along with other environment activists condemns this as an arbitrary move in utter violation of Forest Conservation Act, 1980. In a famous case of the late 1990s, the apex court holds that the provisions made in the Forest Conservation Act, 1980 must apply to any area recorded as forest irrespective of the nature of ownership or classification. It is clear here that all unclassified forests automatically fall under the purview of the Forest Conservation Act, 1980 and the state government on its own is not supposed to alter the definition of the forest. Environmentalists further term this order as a violation of public trust doctrine that violates the right to a wholesome environment which is a facet of the right to life guaranteed under Article 21.

Besides bringing to the forefront the big question that what the forests are, this move of the government has also shown that how the market forces are being given a free play in defining forests at policy level. Forests can't be confined to trees alone. In hills even a growing child does know it well that the forest gives them water, fodder for their cattle, is an inexhaustible source of uncultivated vegetables and fruits, provides them and



their cattle medicines to treat common ailments and so on. It actually is a great bestower and constitutes the very basis of their triple basket economy. Gautam Buddha defines forest as 'a peculiar organism of unlimited kindness and benevolence.' This simple definition enunciated millennia ago along with what is intuitively known even to every growing adolescent from hills has always been overlooked. Of course a forest is something more than just

the perceptible trees, and protecting environment is not simplistic enough an exercise to be understood in terms of planting more trees and protecting them. *This myopic perception related to forests imported from the west, says Vinod Pande, 'has enabled us but to forge narratives ranging from Stockholm and Chipko to Rio, Kyoto and so on, which in turn mould us to look at the environment from the point of view of a consumer.'*

Right from the time of the Indian Forest Act, 1927, which is considered to be the mother law on forest governance, forest has been looked upon as a revenue generating entity and not as a bedrock whereon rests life and livelihood. The draft Indian Forest Amendment, 2019 that has sidelined all the progressive steps taken so far (including Forest Act, 2006) bears corroborative evidence to the above stated approach of the forest governance. It is quite relevant to understand here that unlike the concluding years of the century bygone, forests now in most of the states in India have become liabilities. The revenue they earn is far less than the expenditure on their maintenance. The idea of 'production forest' first spoken about in the amendment draft of the year 2019



betrays it clearly. Of the 38,000 sq. km of total forest (better read forest land) in the state of Uttarakhand as stated in the report of the Forest Survey of India (FSI) the area of unclassified or deemed forest is around 4.13 per cent. In the hilly districts of the state (which is 86 per cent of the total area, that is, 53,483 sq. km) small patches of unclassified forests are in abundance. Those familiar with the wilderness in mountainous region know it well that 10 hectares (now the forest department has offered to reduce it to 5 hectares) is an enormously vast swath of land in the given topography. The land measurement unit prevalent in hills is 'nali' which corresponds to 200 sq. m approximately. One hectare is roughly around 50 'nali' and this expanse of land is rarest of the rare an asset for an average cultivator in hills to hold. Apprehensive of the intentions of the forest department the environmentalists allege that this tweaked version of the 'deemed forest' is made up to suit the builder lobby and to promote the non-forest activities in the forest area in utter violation of the Forest Act of 1980. Incidentally, following the construction spree unleashed in the late 1980s, a number of resorts, shops, kiosks and even sprawling ashrams have sprung all over the forested regions in hills. A 50-km drive around the Nainital-Bhimtal

region, so close to the foothills, is good enough to reveal that how indifferent and complacent the forest department must have been over the years to allow the encroachments.

Vinod Pande has substantial reasons to apprehend that the patches of unclassified forest acting as buffers to their reserve counterpart are destined to become the hotspots of non-forest activities if the 'quixotic orders' of the state government are implemented. He also puts it emphatically that 10 hectare or even 5 hectare (as per the recent offer of the state government) has no logical backing. Research conducted for determining the definitions of forest and its interpretation by the organizations from the field of environment has defined the forest in a rather less 'liberal' manner than the department of forest is alleged to have done.

The Food and Agriculture Organization (FAO) of the United Nations sets a limit of 10 per cent canopy with 0.5 hectare of area for it. The United Nations Framework Convention on Climate Change (UNFCCC) is for 0.05 hectare and 10–30 per cent of canopy. The Convention on Biological Diversity (CBD), which is an outcome of the Earth Summit 1992 at Rio, to which India is a signatory, calls for 10 per cent of canopy density and 0.5 hectare of land. Incidentally,

India's Biological Diversity Act of the year 2002 is fallout of this convention. The International Union of Forest Research Organization (IUFRO) pleads for 10 per cent canopy. Even the India State of Forest Report (2017) released by the FSI considers an expanse of 1 hectare with 10 per cent of canopy density as forest. For informing the international agencies, the Government of India invariably uses the FSI data. Interestingly, even this definition when forwarded to the UNFCCC was questioned by the same organization as to how this conclusion had been arrived at. The state of Uttar Pradesh brought an amendment way back in 1960 to add chapter V-A to the Forest Act, 1927. It is still applicable as such in the state of Uttarakhand. Section 38A in it gives an extremely wide definition of forest covering 'land covered with trees, shrubs, bushes or woody vegetation.' In this background it becomes quite difficult to justify the need and intent of the new definition of forest given by the state government. The International Union for Conservation of Nature and Natural Resources (IUCN) also states that views and definitions of forest need to adapt the changing circumstances imposed by climate change and any change in the definition of forest must state the purpose of management behind it. The orders fail at this criterion also. Undoubtedly, it is not easy to justify the 10 hectares of expanse.

The government's approach becomes clear when the canopy part of the given order is judged against the accepted norms. The canopy based classification of forest by the FSI states that above 70 per cent it is very dense forest; from 40–70 per cent is what they call the moderate forest and from 10–40 per cent it is termed as open forest. Below 10 per cent is defined as the scrub forest, however, forest it still is. Obviously for the forest department of Uttarakhand none other than the very dense forest qualifies for the status mentioned in the referred order.

The southern slopes of mountains





in the Central Himalayan hills have less soil formation and obviously trees are scattered and much of the landscape is covered with grass, shrub, and even xerophytes. Besides, in the higher Himalayan reaches, beyond the tree line, unclassified patches of alpine meadows are there where not even a single tree grows. These meadows however, have been the biodiversity hotspots. The office order appears to be a deliberate attempt to exclude such wildernesses from the definition of forest. Certain ecological reasons like the sudden spurt of some invasive species, parasites, fire or biotic pressure may also reduce the canopy density. Such degraded forests need proper care so that they may be upgraded. The forest policy of India issued in the year 1952 and 1988, respectively, states its objectives as: 'maintenance of environment stability through preservation and, where necessary, restoration of the ecological balance that has been adversely disrupted by serious depletion of the forests of the country. Conserving the natural heritage of the country by preserving the remaining natural forest with the vast variety of flora and fauna, which represents the remarkable

biological diversity and genetic resource of the country.' The said order of the state government covertly excludes all unclassified forest areas having an expanse of less than 10 hectares and canopy density of 60 per cent from the purview of the deemed forest. This cherry picking attitude of the state government is bound to give a field day to land grabbers and other bigwigs who have for long been eyeing these expanses for non-forestry uses.

The latest Indian State of Forest Report reveals that while 49 sq. km forest cover in the recorded forest area in the state of Uttarakhand is gone completely in the couple of years, outside the forest area an increase of 23 sq. km of green cover has been noticed. The credit obviously goes to the commoners of the state though the possibility of the advancement of wilderness into the once cultivated areas of the deserted villages can also not be ruled out. This compels me to think wishfully—if the department of forest could involve the local farmers in growing trees in the unclassified forest land with lesser canopy and limited expanse. The forest policy of the 1988 does also emphasize this strategy. A report by the Centre for

Science and Environment (CSE) speaks of the yield of wood getting dramatically improved in the hands of the farmers. Instead of 6–10 tonnes per hectare that the forest department would cut, farmers could reap up to 200 tonnes of wood from each hectare of land. Even in the unirrigated lands, the yield jacked up to 50–70 tonnes. Such an initiative will not only be of help in curtailing the mass migration of hill youth from the interior hill hamlets but will also go a long way in breaking the myth that throwing a ring of protection around the forest is the only way of protecting it.

While concluding this write-up, I am reminded of a line from Pablo Neruda's poem—'Keeping Quiet'. So speaks he—

Perhaps the earth can teach us
As when everything seems dead
And later proves to be alive.
Now I'll count up to twelve
And you keep quiet and I will go.

Pablo Neruda underlines here the sustainability of the wilderness, where the process of regeneration and rejuvenation has always been an ongoing phenomenon. We have been taught to look at the forest through the glasses of revenue generation; to frame policies which are just tree centric, since exploitation of trees is easiest. Understanding that forest is a natural self-sustaining system and trees are just a component of it, has now become a must. If the sustainability of the forest is disturbed we do not have enough knowledge to redeem it... Vinod Pande actually sounds prophetic when he says, 'we should better do away with the obsessive preoccupation that we know the nature, understand the wilderness in its totality. We have yet to learn, unlearn, and relearn *quite a lot*.' ■

Disclaimer: The views expressed by the author in this article are his own and do not necessarily reflect TERI's views. Mr Rajshekhar Pant is an amateur filmmaker, a photographer, and a writer, who has written over a thousand write-ups, reports, etc., published in the leading newspapers and magazines of the country. He can be reached at pant.rajshekhar@gmail.com.

Impact of COVID-19

on the Solar Industry in India

India's solar power sector, like other sectors, is struggling in the wake of the COVID-19 pandemic.

In this article, **Anita Khuller** discusses the challenges that the nationwide lockdown, as a consequence of the coronavirus outbreak, has imposed on the operations of the country's solar market, power distribution companies, and the overall economy.

India installed 7.3 gigawatt (GW) of solar power in 2019 (CY19), consolidating its position as the third largest solar market in the world, according to a study by Mercom Communications India. The report further stated that the country also had a strong pipeline of utility-scale under-development projects of 23.7 GW capacity by end-CY19, with 31.5 GW capacity tenders pending under auctions. Out of this, 7.3 GW, as per the Government of India's Ministry of New and Renewable Energy (MNRE), about 5.7 GW of new utility-scale solar capacity was added in the financial year (FY) 2019–20, which was 24 per cent less than the 7.5 GW target set for the year. Compared to the previous year's installations, FY20

installations are also marginally lesser—by about 1 per cent.

To top this slow achievement, the imposition of a nationwide lockdown by the Government of India to control the COVID-19 outbreak, has had a negative impact on the whole economy. There has been an estimated 30 per cent fall in Indian electricity demand during the period from mid-April to May, due to the lockdown of industrial and commercial establishments. Consequently, this has also adversely impacted the revenues and cash collections of the power distribution companies (DISCOMs). Further downside risks may arise from any extension in the lockdown period and any delay in issuance of tariff orders,

or inadequate tariffs approved by the state electricity regulatory commissions. This would aggravate the payment delays from DISCOMs to power generation companies (including solar-based projects), which are already reeling under large payment dues of more than ₹920 billion as of February 2020.

Given that the lockdown would also impact project implementation in quarter one (Q1) of FY2021, and assuming normalcy thereafter, the capacity addition in the wind and solar segments together is likely to lower by about 25 per cent to 8 GW against the earlier estimates of 11 GW for FY2021 as per reports.

Far-reaching Effects

Some of the adverse effects faced by all renewable energy, including solar, businesses are—non-availability of resources at the sites, depreciating rupee value (particularly for companies that import components), and banks not operating in many regions, to name a few. The under-construction projects are facing delays in execution because of disruption in the supply chain in India



and labour availability, following the lockdown.

The COVID-19 crisis is also impacting the global manufacturing space. Among the various sectors that are bearing the brunt, India's solar power industry, in particular, is looking at months of delays due to disruption in the supply chain.

China is the largest producer of solar raw material in the world and supplies 85 per cent of this raw material to the solar industry globally. China virtually controls the entire value chain from silicon to ingots, wafers, cells, and modules. Southeast Asian module manufacturers mostly rely on Chinese suppliers for solar cells, glass, backsheets, frames, junction boxes, etc. Currently, the Chinese companies dominate the Indian solar components' market due to their competitive pricing, where they supply 80 per cent of solar cells and modules. Due to the lockdown, there was a long hold on these items in China, so the module assembly capacity of these module manufacturers was being affected.

Also, the government has been promoting LFP (lithium-iron-phosphate) chemistry from China rather than the NMC (nickel-manganese-cobalt oxide), which is provided by brands such

as Samsung and LG. This dependence on China and a prolonged shutdown will have a severe impact on government-based projects. COVID-19 may also lead to a rise in solar module prices in the near term as manufacturers have already begun experiencing wafer, cell, and solar glass shortages. Production rates were also affected by the extended Chinese New Year holiday introduced by the Chinese authorities as a measure to deal with the pandemic, in addition to the requirement for workers from infected areas to quarantine themselves for two weeks. The prices of components such as solar modules will go up in the short term with cheaper supplies from China drying up. This hike will be reflected in an increase in project costs as well, with modules making up for roughly 60 per cent of the cost of a solar project.

The timing of this pandemic could not have been worse. Says Puneet Goyal, co-founder, SunAlpha Energy—a solar company providing turnkey engineering, procurement and construction (EPC) services along with comprehensive maintenance contracts (CMC) services to industrial, commercial, and residential consumers across India and abroad, 'Everyone, especially the private sector, wanted to commission projects in the

last quarter of the financial year of 2019–20, to take advantage of the tax benefits. Already the demand is high and historically, the price is usually high in this quarter.'

The soft increase in prices due to delayed panel shipments has added to the 'stress' margin of EPC players who are at the end of the value chain. All the variable factors across the value chain from the procurement of the bills of material of the panels, to the manufacturing and the supply chain, are borne by the EPC players. They have to bear the brunt of the increasing prices as contracts have already been signed with their end-customers.

Projects that had to be commissioned by June were particularly affected. The rating agency CRISIL (formerly Credit Rating Information Services of India Limited) has estimated that about 3 GW solar projects worth ₹16,000 crore will bear the brunt of the COVID-19 pandemic. Since most of these projects are connected with the interstate transmission system, any inordinate delay in their commissioning may invite transmission/point-of-connection charges from the Power Grid Corporation of India under their long-term open access (LTOA) rules.





Solutions/Light at the End of the Tunnel

Industry bodies feel that even now, all is not lost. The pandemic provides an opportunity to bring the best technologies and quality to government-funded projects in India. In case of solar PV, India has the option of turning to domestic manufacturers for PV modules. This will boost the morale of domestic manufacturers and minimize the damage caused to the sector.

The government is trying to take steps to relieve the sector. The MNRE has assured some relief by notifying that a time extension of the lockdown period plus 30 days can be provided for all renewable energy projects, under the force majeure clause. In another government reprieve, in April 2020, the Central Electricity Regulatory Commission (CERC) passed an order extending the validity of renewable energy certificates (RECs) to October 31, 2020 to avoid demand-supply imbalances in the REC market.

The extension provided by the MNRE is appreciated. The latter should also focus on making financial solutions available. Timely and adequate liquidity support from the respective state governments, including the payment of regular subsidies, remains extremely crucial.

The industries are also hopeful that the government will begin promoting alternatives to the solar cells such as

thin-film and other technologies, which are not dependent on China. Also, the government should focus on battery cells developed in India, while promoting the NMC technology from branded manufacturers.

Some companies suggest that the government should remove the Safeguard Duty with immediate effect, and should not implement the Basic Customs Duty. Additionally, moratorium should be given to local manufacturers' loans for one year. Another form of assistance could be in the area of working capital loans being offered at 10 per cent interest rates without collaterals in these difficult times.

The MNRE has stated that all renewable energy projects are operating on a must-run basis during the current public health crisis. To keep up the pace with near-term targets, India continues to allocate projects even during these testing times. For instance, Vikram Solar, one of India's leading module manufacturers and an EPC, and rooftop solar solutions provider, recently bagged a 300-MW solar project from state-owned utility major National Thermal Power Corporation Limited (NTPC) under the Central Public Sector Undertaking (CPSU)-II scheme. Tata Power Solar Systems too won a contract to construct a 300-MW solar PV plant for NTPC.

Conclusion

India's solar industry is suspected to see more challenges ahead due to the

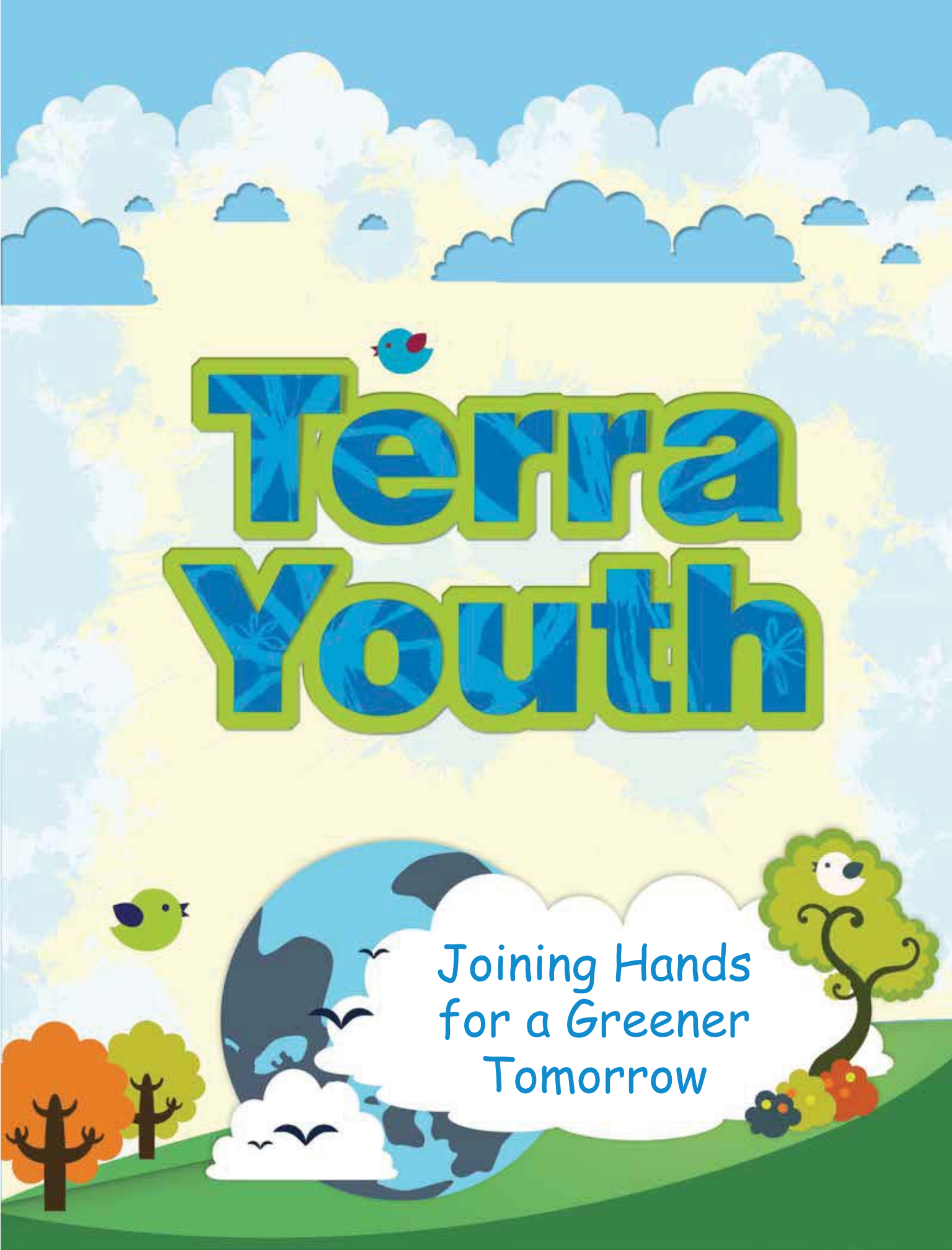
coronavirus outbreak. Supply disruptions, delays in production, quality checks and transport of components due are already visible in China, which are compelling Indian developers to declare force majeure.

The COVID-19 outbreak has highlighted the fact that several countries, including India, are heavily dependent on China for solar component manufacturing and do not have a diversified manufacturing base that can cater to the demand in the light of any kind of crisis. Considering all these factors, the Indian solar industry experts believe that India could benefit from COVID-19 by investing in solar component manufacturing.

Not to be disheartened, as per R Jayaraman, National Sales Head, Canadian Solar Energy Private Limited, 'We expect the market to revive in three months, and this financial year Q3/Q4 will have very huge requirements. We have launched high-efficiency modules of over 500-Wp per module, and improved module efficiency over 20 per cent for Poly (polycrystalline), to offer lower leveled cost of energy (LCOE).'

Other companies are also adapting to the situation to avoid going bankrupt and to cater to the surging demand for ICU ventilators during this period. Central Electronics Limited (CEL) is following in the footsteps of its solar-sector counterpart – Bharat Heavy Electricals Limited (BHEL). These solar cell manufacturers are collaborating with ventilator manufacturers to work on the setting up of facilities to manufacture the required medical equipment. The CEL joins a growing list of solar companies, like Tesla Solar, that is now venturing into the development of ventilators to help fight the pandemic. ■

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



Terra Youth

Joining Hands
for a Greener
Tomorrow

Coronavirus

Delving into the Basics

In this article, **Dr Pradeep Kumar Mukherjee** discusses some interesting features of coronavirus and throws light on its extremely infectious and deadly nature, while being optimistic that eventually it will be tamed.

The deadly coronavirus is being viewed as a very formidable virus all over the world. So much is the scare about this virus that it is circulated through electronic and social media that this virus has been created artificially in a Chinese laboratory. However, before making any such assertion, we should not lose sight of the scientific temper, which in essence teaches to accept a fact on the basis of evidence, after proper verification only.

The Backgrounder

The first case of infection from coronavirus came from the Wuhan city of China. The infected person was a seller in the 'sea foods' market of Wuhan. In this market, live wild animals and sea creatures are sold for human consumption. Soon, many more persons

infected by the virus were admitted to hospitals. No doubt was now left. It became amply clear that an epidemic had swept the Wuhan city. On January 9, 2020, World Health Organization (WHO) announced that the cases of infection in the Wuhan city were due to a new form of coronavirus. Death of the first patient of coronavirus on January 11, 2020 made it clear beyond doubt that the virus can indeed prove to be fatal.

This new coronavirus was first named '2019 novel coronavirus.' But, on February 11, 2020, the International Committee on Taxonomy of Virus named this virus 'Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2).' On the same day (February 11), the WHO named the disease caused by coronavirus as COVID-19 (Coronavirus disease-19).

But, why is it considered so infectious and deadly the world over? Why are

people so scared of this virus? It is because till date there is no treatment for this disease although active attempts are being made to develop effective drugs for its treatment. The medical scientists are also trying to make clinical vaccine that can prevent the onset of infection in the first place. Antibiotics just prove ineffective for the treatment of this disease because they are only effective against infections caused by bacteria. However, it is learnt that some medical practitioners abroad are using antiviral drugs for its treatment. Some doctors belonging to countries other than India are also using the age-old malarial drug—hydroxychloroquine—for the treatment of the disease.

What is Coronavirus?

Coronavirus belongs to the family of ribonucleic acid (RNA) type of viruses which carry RNA in their genome. These viruses are fundamentally different from DNA type of viruses. Compared to other RNA viruses, coronaviruses have genome of bigger size (26–32 kilobase). In fact, a virus is even tinier than a bacterium. Therefore, coronavirus cannot be observed with the help of an optical microscope. A special kind of microscope, called electron microscope, is needed for viewing the virus. Coronavirus has spike-like structures protruding from its outer cover. When viewed with an electron



microscope, it gives the appearance of a crown. In Latin, 'corona' means 'crown', hence the name coronavirus. However, not all coronaviruses are able to infect humans; those which can infect humans are called human coronavirus. So far, we have been able to identify seven distinct forms of human coronaviruses. Starting from common cold and influenza, human coronaviruses can notoriously spread even deadly diseases. It may be noted that 15–30 per cent cases of common cold are due to the coronaviruses. In fact, first coronavirus was isolated in 1960 from the nasal swabs of patients suffering from common cold.

Although the new form of coronavirus is being considered as the most infectious and deadly of all known coronaviruses, in the past also coronaviruses were responsible for spreading deadly diseases which finally took the form of pandemics.

The Past Pandemics

In 2002, cases of infection started spreading in China due to Severe Acute Respiratory Syndrome Coronavirus (SARS-CoV). Next year (2003), it assumed the form of a pandemic. At first, it was thought that this disease was spread through the wild animal musk palm civet, which is found in abundance throughout Asia. So, these poor creatures were killed in large numbers in China. However, later it was found that a kind of bats, called Horse Shoe bats, found in the



Uttarakhand province of China were actually responsible for spreading the infection. SARS-CoV, which started as epidemic in 2003, affected about 28 countries till 2004. Nearly 8000 people were infected by the virus, leading to fatalities of nearly 774 people.

After SARS-CoV, Middle East Respiratory Syndrome Coronavirus (MERS-CoV) spread its tentacles in Saudi Arabia. The genetic analysis of the virus, which spread through camels, revealed that it was a new form of coronavirus. By 2014, it assumed the form of a pandemic, spreading to more than 20 countries of the world. Till December 2019, 2488 people had been infected by the virus, leading to the death of nearly 884 people.

Mutations in the Spike Protein of SARS-CoV-2

According to scientists, two mutations in the spike-like structures protruding from the outer cover of the new coronavirus made it very infectious and deadly for humans. The scientists carried out the genetic analysis of the spike-like structures, called spike glycoprotein or spike (S) protein. The analysis revealed that two specific mutations occurred in the spike protein. One of these mutations occurred at a site, called receptor-binding domain. As a result of this mutation, a grappling hook kind of structure was created. This altered

structure allowed the virus to latch onto a protein, called angiotensin converting enzyme 2, which lines the respiratory tract of humans.

The second key mutation allowed the coronavirus to grow a dagger-like structure, made of furin protein. The site where the mutation took place is called 'cleavage site'. This furin protein acts like a molecular 'can opener', allowing the virus to slice through other proteins to make it bind tightly to throat and lung cells of humans. According to scientists, the furin protein is what made the coronavirus so infectious and deadly to humans.

While the threat of coronavirus is looming large, we are taking all precautions to combat it. There is no gainsaying the fact that we have to fight the virus with courage and need not at all be scared by it. We should not forget that the human race had faced the wrath of many pandemics in the past also, but at the end of the day we always emerged victorious. Therefore, there is no reason to worry. We only need to take all possible and necessary precautions to avoid getting infected by it. There definitely is a silver lining. The message is writ large on the walls: 'We Shall Overcome'. Rest assured, coronavirus will be tamed. ■

Dr Pradeep Kumar Mukherjee is an ex-Associate Professor of Physics, University of Delhi. He is an active science communicator and has been writing on science, environment, and other issues of general interest since the last 40 years, or so.

Bizarre Facts

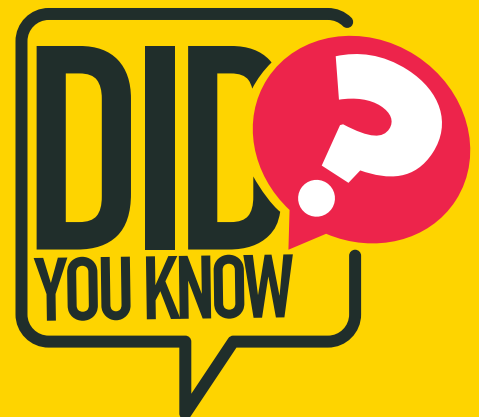


1. Blue whale tongues can weigh as much as an elephant.
2. The world's smallest wasp is smaller than an amoeba.
3. A cloud can weigh more than a million pounds.
4. Spider webs were used as bandages in ancient times.
5. One-quarter of all your bones are located in your feet.
6. Australia has pink and purple lakes.
7. Bubble wrap was originally intended to be wallpaper.
8. The human nose can remember 50,000 different scents.
9. Sunsets on Mars are blue.
10. People do not sneeze in their sleep due to their brain shutting down the reflex.



Did You Know?

- More than 90 per cent of the freshwater the world needs is found in the Antarctic region but it is not available for our use.
- Scientists estimate that it takes nearly 10,000 litres of water to manufacture a pair of jeans.
- Fish droppings in the water makes it good for the plants underwater.
- Fruits and vegetables can also quench your thirst. Next time you are thirsty, try eating some of these.
- Flamingos bend their legs at the ankle, not the knee.
- Sloths can hold their breath longer than dolphins can.
- It is impossible to hum while holding your nose.
- A giant tortoise thought to be extinct for 100 years was discovered in the Galápagos in 2019.
- Squirrels are behind most power outages in the US.
- A 'moonbow' is a rainbow that happens at night.



Helping Brainz

An Innovative Way to Reach Out to the Neediest!

Helping Brainz is a registered weekend volunteer group which aims to help build democracy by creating self-reliant citizens, developing respect for the experience of others and encouraging dialogue. The conceptualizers and event orchestrators at Helping Brainz are either working IT professionals, homemakers or students who do not have any social work or disaster management background. However, they are definitely keen learners, innovators, thinkers and know how to manage a situation with the help of all available resources during distress. Be it, the disaster during the floods in Kerala and Assam or the present COVID-19 pandemic, Team Helping Brainz has used simple WhatsApp groups, Social Media integrations and Google Spreadsheets with the help of few workaholic volunteers and at the same time innovative and motivated team members to deliver the goal that is helping the needy. During the

lockdown, they initially started helping the needy families. Given that the migrant population started moving homewards, the common man lost his source of daily income and the tensions started increasing. This is where Helping Brainz devised their 'Linking Shopkeeper-Needy Model', all thanks to Yedhu Krishna Menon, Swaminathan Lakshminarayanan and Sneha Harsh from Helping Brainz who connected the dots in a layman's idea. Today, Helping Brainz has helped more than 4000 people get 7 days ration from more than 60 cities in India with the help of 50+ shopkeepers. This innovative model of work also aimed at helping the local shopkeepers who are in stress by giving them an opportunity to serve the community.

Helping Brainz Lockdown Support Team is a 25-member WhatsApp group which functions from 10 a.m. to 7 p.m. in two different shifts. The team receives inputs about the needy families and migrant labourers from various social media platforms, (especially the Migrant Transport Network groups). These inputs are entered into the Google Spreadsheets by the data entry team, followed by the validations by the due diligence team, post which the data quality is checked and the same appears on a closed Google Spreadsheet's Dashboard—which indirectly becomes the input for the ground team to handle each location as queued in the dashboard. Emergency cases are given priority. The ground team uses Google Maps, local contacts, to locate a shopkeeper. Shopkeepers are assured that they will be paid first using any e-wallet and then they may deliver the kits. They ensure that not more than four people would be visiting the shops

in an interval of 10 minutes to buy the goods, thereby ensuring social and time distancing. Shopkeeper delivers the goods after the family member verifies himself/herself using his/her Aadhar card number. Along with this fact, they have established multiple checkpoints to ensure due diligence. All photographs are taken following the social distancing norms, after taking appropriate consents from the families. Faces in the photographs are blurred before they are shared with their social media channels and the donors, ensuring their privacy. Food kits are again given to families after a gap of seven days.

Additional counselling was given to labourers and migrants, along with the travel support to a few of them. All the grateful messages and calls from the beneficiaries were the primary source of motivation for the volunteers who were working continuously from different cities of India and abroad for one cause, that is, 'no matter what, no one should stay hungry.'

The upcoming project of Helping Brainz is being scheduled on providing employment opportunities for the needy and the team is actively working on the data, research, and integration. Also as part of the improved health and sanitation programmes, Helping Brainz plans to distribute sanitary napkins in the rural townships of Karnataka and Jharkhand, and to conduct health care awareness drives in these cities/towns. ■

Article contributed by: Sneha Harsh – Communications and Public Relations – Practice Head, Helping Brainz; and Kirti Kumari Tikyani – Environmental Sustainability and Media Information Literacy Projects Head, Helping Brainz.



Lockdown Diary with Nature

In this article, **Dr Surya Prakash** shares the wonderful experience he had with nature at the JNU campus during the complete lockdown period in Delhi-NCR.

The COVID-19 pandemic has forced many countries around the globe to impose complete or partial lockdowns in their respective nations as the infectious disease still continues to spread like a wildfire in many parts of the world, including India.

Although many offices chose to adapt the new mode of functioning, that is, 'work from home' but a lot of us still felt confined at home. Although it is essential to 'stay at home' and maintain social distancing to avoid the spread of the current pandemic—some amount of frustration and restlessness started precipitating within the urbanized modern societies because of restricted

movement.

Being a nature lover, I tried to utilize my time during the lockdown period by observing the nature all around our residential neighbourhood within the Jawaharlal Nehru University (JNU) during this unprecedented silence when the sky looked absolutely clear because of no air pollution. The JNU campus is spread in 13.8 sq. km and is also a part of the Southern ridge forest hosting wonderful faunal and floral biodiversity in the national capital. I have already documented 210 species of resident and migratory birds, more than 80 species of butterflies, dozens of lizards, more than two dozen snake species, and more

than dozen mammals along with many varieties of insects. During the lockdown, some of my friends and I were able to document many new species of birds which were not even included in the JNU list of documented birds. These include greater flamingos, barheaded geese, ultramarine flycatcher, Baillon's crane, and many more. All this was possible because of the clear and pollution-free blue sky and complete silence due to which the faintest sound was audible. We started recording the songs and calls of birds from our surrounding areas during the spring–summer season of the year which is also interestingly the breeding season of many birds. We heard these songsters

Greater flamingos



throughout the day especially during mornings (dawn chorus) and evenings (dusk chorus). I started recording and sharing these 'dawn chorus' of birds everyday with a friend at the All India Radio (AIR) and she, along with her entire team, started broadcasting them on 102.6 FM Rainbow. The initiative was wholeheartedly appreciated by all nature lovers and other citizens of the country. Looking at the overwhelming response of the 'National Dawn Chorus' AIR decided to make it international but it was difficult to accomplish it this year as a live show because of the COVID-19 pandemic but AIR still made it possible by compiling all the recordings from national and international participants and finally on May 3, 2020, 'International Dawn Chorus' was aired for 2 hours.

Also, all the factories and the industries remained non-functional during the lockdown in April which was a blessing in disguise. The river water became crystal clear as no industrial waste was being siphoned into these rivers. The spring-summer is the time when all cold blooded creatures like insects and reptiles come out of their dormancy phase and start propagating their next generation. Also, a lot of summer migratory birds such as Indian golden oriole and Indian pitta come to breed in the plains. Co-incidentally, this is also a time when the migratory avian friends after spending their

winters in India, start their journey back to their respective countries to breed. Interestingly, many such species have to stop and feed at different stop-over joints. JNU was also one of them and so we were lucky to see, click and hear the mesmerizing melodious songs of many of them including rosy starlings in thousands this time around not only within the JNU campus but also everywhere in Delhi-NCR.

Due to no anthropogenic activity, natural vegetation also flourished and bloomed to its peak which otherwise used to be either pruned or removed and sometimes pesticides are sprayed by men during the fruiting season to protect them as this natural vegetation is considered useless for human use, kitchen gardens, and other ornamental man-made gardens. Many lovely seasonal trees such as flame of the forest, red silk cotton tree, bottle brush tree, rohida, and many others flourished and helped many insects and butterflies to breed. It sounds unbelievable but it is true that common Jezebel, the painted lady, the dark cerulean, the tropical fritillary and many more butterflies were not only seen but photographed laying eggs on their respective host plants in large numbers by many of my friends and myself, not only in JNU but outside also. The larvae of many such breeding insects also served as rich protein supplements to the growing chicks of many insectivorous birds.

In the evening, when the sun starts settling down in the west, painting the entire sky in pink, I could not help but admire nature's beauty. When birds return to their roosting sites with their dusk chorus, in the background of pink sky, it is such a magnificent sight. I have captured these moments in my mind and soul for the rest of my life. I would always cherish and remember these priceless moments with Mother Nature during the lockdown.

As the night falls, and bright milky moon starts peeping from the window of clouds in the company of twinkling stars,



Indian thick knee

I gasped as not only the days were clear but the nights were no less. My family and I have seen constellations, and pole star including Big Dipper during this lockdown. The night is the time for the nocturnal creatures like Indian thick-knee, also known as goggle-eyed waders (due to the enlarged size of their eyes). Its screeching mating and territorial calls are quite loud in the silence of the night. Flying foxes, alternatively called fruit bats, can also be seen assembling around the red silk cotton trees and gular trees for the nectar and the fruits. The common palm civets, spotted owlets have also been very vocal at night, perched on the streetlight's pole to communicate with their soul mates and family. Intermittently, the Indian golden jackals were also heard howling and marking their respective territories inside our campus.

We shared our 'wonderful experience' during the lockdown period with a small group of friends within the JNU campus. I would like to sum up this snippet with a message. This message is also a personal experience that if we extend our help to conserve Mother Nature, I am sure Mother Nature in turn will heal and restore its natural beauty. ■

Dr Surya Prakash, Member—BNHS, IBCN, WWF, School of Life Sciences, Jawaharlal Nehru University, New Delhi, India.



Painted lady



Wildfire Smoke has Immediate Harmful Health Effects

Exposure to wildfire smoke affects the body's respiratory and cardiovascular systems almost immediately, according to new research from the University of British Columbia's School of Population and Public Health. In a study published recently in *Environmental Health Perspectives*, researchers found that exposure to elevated levels of fine particulate matter during wildfire seasons in British Columbia was associated with increased odds of ambulance dispatches related to respiratory and cardiovascular conditions, with increased ambulance dispatches occurring within only one hour after exposure. Among people with diabetes, the researchers found that the odds of health complications increased within 48 hours following exposure to wildfire smoke.

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

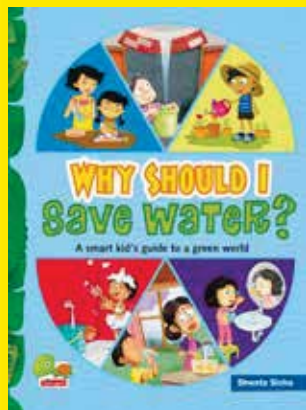
Antioxidant-Rich Diet Reduces Stress Response during Bird Migration

A research team led by a University of Rhode Island ornithologist had birds fly in a wind tunnel to simulate migration and found that birds that consume dietary antioxidants before and during fall migration can reduce the endocrine stress response triggered by long-duration flights. The results, published recently in the *Proceedings of the Royal Society B*, emphasize the importance of protecting habitat with an abundance of available berries containing antioxidants at migratory stopover sites. 'This reduction in the endocrine stress response may be a major benefit birds gain in fall by eating fruits at stopover sites during migration,' said Scott McWilliams, URI professor of natural resources science, noting that many species of birds select berries containing anthocyanins, a type of dietary antioxidant present in purple-coloured berries.

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



To know more... Read



ISBN: 9788179933695

WHY SHOULD I SAVE WATER? A SMART KID'S GUIDE TO A GREEN WORLD

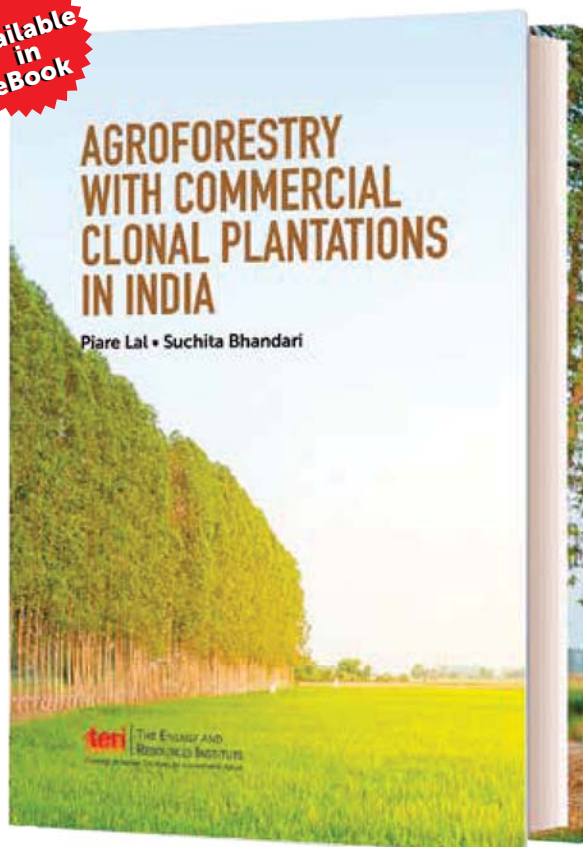
Shweta Sinha

Trash, oil spills, and climate change – these are only few of water's troubles. Our drinking water supplies are shrinking, even as we continue to use more and more. We waste water and dump our garbage into rivers and oceans without giving it a thought. Do you know India may run out of drinking water in 25 years? Are you ready to take action? Every small step you take makes a difference. *Why Should I Save Water?* helps you understand the miracles of water. It teaches you the importance of saving water and helps you with ideas to do your bit towards conserving our precious resource – Water

Available at: [amazon.in](https://www.amazon.in) [flipkart](https://www.flipkart.com) [amazonkindle](https://www.amazon.in/kindle) [Google play](https://www.google.com/search?q=buy+book+online&rlz=1C1GCE9Z_C901469_1000117287_1600000000_1000000000) [teri bookstore](https://www.teribookstore.com)

**"A COMPREHENSIVE GUIDE TO UTILIZATION OF
SCIENTIFICALLY PROVEN TOOLS AND METHODS FOR
CLONAL PROPAGATION OF TREES AND THEIR ROLE IN
ACHIEVING SUSTAINABLE AGROFORESTRY"**

**Available
in
eBook**



Major topics covered

- Status of Forest Resources in India
- Soils and Management of Soil Fertility
- Understanding Extension
- Cloning of Eucalyptus
- Clonal Plant Production Nurseries: Eucalyptus
- Clonal Casuarina Plantations
- Improving Productivity of Plantations

ISBN: 9789386530936 • Price: ₹650.00

Rapid deforestation and depletion of genetic resources have made it essential that avenues be found whereby short-duration trees can be propagated and massed produced. Clonal agroforestry plantations provide this alternative to the use of natural forests. *Agroforestry with Commercial Clonal Plantations in India* provides complete scientific information on clonal technology applications for selection and cloning of candidate plus trees, development, field testing, final selection and deployment of genetically superior, high yielding and fast-growing clones of important tree species grown under agroforestry system.

The Energy and Resources Institute
Attn: TERI Press
Darbari Seth Block
IHC Complex, Lodhi Road
New Delhi – 110 003/India

Tel: 2468 2100 or 4150 4900
Fax: 2468 2144 or 2468 2145
India +91 • Delhi (0)11
Email: teripress@teri.res.in
Web: <http://bookstore.teri.res.in>

To purchase the book, visit our online bookstore at <http://bookstore.teri.res.in> or send us your demand draft or cheque in favour of TERI, payable at New Delhi (outstation cheques are not accepted).

Community Solar Microgrids in Sundarbans

Provide a Ray of Hope after Cyclone Amphan

When one of the fiercest cyclones ever produced in decades, Amphan ripped through the Indian state of West Bengal and Bangladesh, it left a trail of massive destruction behind. Amphan's major impact was witnessed in the eco-fragile area of the Indian Sundarbans delta, which is home to one of the largest mangrove forests in the world with a population of over 4.5 million people. Read how community solar microgrids in Sundarbans provided a ray of hope in the aftermath of Cyclone Amphan.

Cyclone Amphan rocked the coastal areas in West Bengal and Bangladesh—breaching embankments, uprooting trees, and decimating homes, forcing people to take refuge in disaster relief shelters despite the fear of COVID-19. With hundreds of electric poles uprooted and wires snapped at several locations, a major part of Sundarbans plunged in darkness

even after two weeks of the disaster. The Satjelia Island in the Sundarbans stood out as an exception where the community solar microgrids set up by WWF-India held the fort and continued to serve communities in an important life-supporting way.

A community solar microgrid is a small energy system planned, designed and installed to provide reliable and

clean energy for vital community facilities and assets within a defined area. Being a cluster of low-lying islands in the Bay of Bengal, the Sundarbans is highly vulnerable to extreme weather events. Such weather incidents pose an enormous challenge to traditional infrastructure such as the conventional utility grids. Decentralized energy systems such as solar can successfully fill up this gap in geographically challenging vulnerable landscapes like the Sundarbans.

Since its inception in 2011, WWF-India, in partnership and consultation with local communities and other stakeholders, has so far installed six solar DC microgrids and one solar AC microgrid in the Satjelia and Kumirmari islands of the Sundarbans region. Post-Amphan, the local communities have been able to successfully repair and operationalize all functional solar microgrids in these islands.

'Cyclone Amphan uprooted trees, electric poles and snapped wires but together we made the solar microgrids up and running within days,' says Amal





Mondol, Secretary of one of the Village Energy Committees set up by WWF-India. The solar microgrids stood strong as a testament to their robustness and established themselves as places of emergency electricity sanctuaries within the Satjelia and Kumirmari Islands.

Satjelia and Kumirmari islands' journey from the struggle for basic electricity to community-owned, managed and operated solar energy systems inspires many villages in the Sundarbans region and beyond. Falling under the gambit of the project 'Sahasra Jyoti', this microgrid set up by WWF-India is the largest non-governmental renewable energy initiative of its kind in the Sundarbans.

These solar microgrids with a combined installed capacity of 84.12 kW electrify around 700 rural forest fringe households, benefitting over 3000 men, women, and children. Out of the electrified houses, 60 per cent fall below the poverty line. Besides, these microgrids provide round-the-clock grid-quality electricity at an affordable price to some small businesses and rural institutions such as schools, disaster relief shelters, etc. This project has also made it possible to install 90 solar-powered street lights, significantly reducing the risk of negative human-wildlife interactions.

An interesting aspect of this project is that these microgrids have been planned,

designed and installed in consultation with local Gram Panchayats, who now own the systems and Village Energy Committees, which manage and operate them.

WWF's Project Sahasra Jyoti in the Sundarbans has been supported by multiple corporates and individuals. Some of the partners include Bank of America, Schneider Electric India Foundation, IndusInd Bank, Bain Capability Center, Tata Trent, and H&M. Also, knowledge partners like Center for Advanced Technologies (CAT-International), Australia and Schneider Electric India Foundation (SEIF) partnered with WWF-India to support the design and installation of these solar microgrids.

The solar microgrids in the Sundarbans landscape have created an enormous impact by presenting a technology option of decentralized clean energy generation which could be owned, operated, and managed by the community itself. This solution has eased the lives of the people while opening up socio-economic development opportunities and delivering safe, reliable, affordable, and environment-friendly electricity to the communities. ■

Article Courtesy: <https://www.wwfindia.org/>





Cows

Benevolent and Intelligent Beings

Maneka Sanjay Gandhi says that cows are highly intelligent, social, and compassionate creatures who can be friends for life with human beings. Every animal needs the congenial company of its own species and a cow needs to be allowed to enjoy her 'rights' in her own way and not according to a human timetable.

Rosamund Young has written a book called *The Secret Life of Cows* which, surprisingly for a book on animals, has shot to the Top Ten bestseller list of *The Sunday Times*. It is a very sweet small book about the animals she has brought up and interacted with, especially

cows, in her Kitt's Nest farm in England. She has treated them with kindness and consideration, and kept them in as natural conditions as possible. And she has been rewarded with watching an entire other world of innocence and love, play, and happiness. She knows all

of them by name and describes their personalities.

Rosamund describes her relationship with each cow. 'Cows are as varied as people,' she writes. 'They can be highly intelligent or slow to understand, vain, considerate, proud, shy or inventive. Although much of a cow's day is spent eating, they always find time for activities such as baby sitting, playing hide and seek, looking for berries.' They look for happiness in the warmth of their own families. Grandmothers step in when mothers need a break from feeding, calves make best friends and share treats, cows literally jump in the air—all four feet—when happy and excited. Rosamund describes how cows in trouble come to her or her brother at their house and tell them when they are about to calve or when they are not feeling well so that they can be helped. They know their own names and come from far when called. They stare when they want something, looking from you to the object they want you to see till you understand.

Cows have different kinds of moos—voices like ours. Mooing in a loud



agitated way could mean that the mother is looking for her calf. Fear, disbelief, anger, hunger or distress—all of them have different sounds and a low quiet moo means she is asking you a question. Cows tell the difference between people, remember people who have been kind to them and nurse grudges. They are easily offended and will ignore you forever until you try very hard to make friends again. But ultimately they are forgiving. They make friends for life. They can be obstinate, gentle or aggressive. Above all they are wise. If you choose to see a cow the way you see your dog, she can be very good company.

They love each other, have friends and enemies. They communicate with people—if you are willing to listen. They like music. They are problem solvers—which means a high degree of intelligence. The cows in my hospital, Sanjay Gandhi Animal Care Centre, find out how to open the gates of their pens and come out when they feel like. They have food preferences—are you listening gaushala or dairy people who feed them the same awful food day after day? When I was sending some cows to a really good gaushala on the outskirts of Delhi so that they would have more freedom, Radhibai, our most beloved cow inmate, attacked all of us several times so that her friends would not go.

They are good mothers. They will lick their children all over as a calming grooming gestures. One cow who came to us had given birth and suffered a prolapse—when the uterus falls out because of the pressure of birthing. She was in dreadful pain having been lying on the road for two days with the newborn calf. But her eyes never left her baby even while she was being stitched up and the baby was being bottle fed. When she recovered she went back to feeding her daughter.

Bovine needs are in many respects the same as human ones: freedom from stress, adequate shelter, pure food and water, liberty to exercise, to wander about, to go for a walk or just to stand



and stare. Every animal needs the congenial company of its own species and a cow needs to be allowed to enjoy her 'rights' in her own way, in her own time, and not according to a human timetable. The number of ways a calf may be treated is no fewer than the number of ways a child may be treated. A badly treated calf is simply a neglected, ill nourished, lonely frightened child.

If any sense of fear is aroused, then none of the cows will sleep. If the source of fear is remote, cows will communicate to the calves that they can sleep while the older animals keep guard.

We are the only country in the world that treats cows as special, invests them with a religious significance and makes special shelters called gaushalas for them. But, because we do not recognize the cow as a thinking individual, even the gaushalas become simply prisons for cows where they stand in an indiscriminate herd. They have no names and no individual recognition. I have, in collaboration, written the only manual

in India on gaushalas and we have a chapter on what cows like and what they fear, how to approach them, and how to recognize their moods.

Even the people who keep a few cows in their homes, who should know better about their personalities, do not bother to be nice to them or even understand them. They are kept tied most of the day, milked, their children separated at birth and tied a few unattainable feet away from their mothers. 'It' is simply an animal tied to a post whose only thought presumably is of fodder. It is easier to assume that an animal has no feelings. They can then be treated as generators of profit without any thought to their needs. And yet, the same person will go into his house and worship the small idol of the cow he keeps on his *puja* table.

This book should serve as a good reading material, especially for people who have the compassion to run gaushalas. If animals are to survive, people must realize that these are us, just in another form. ■

Move towards Zero Waste

The last few years have witnessed a heightened awareness about the ill-effects of plastic and how they have been piling up in landfills. Even as the government announced a ban on single-use plastic in India, the challenge lies in implementation. In such a scenario, stores that encourage customers to bring their own wares could eliminate the use of plastic to a large extent. **Sapna Gopal** speaks to **Pankaj Sancheti**, on his store in Secunderabad, Telangana—one that aims to nullify the use of plastic.

Plates made from arecanut waste



For Pankaj Sancheti, a chartered accountant working in Chennai, visiting a zero-waste store in the city stemmed from his own thought process of eliminating the use of plastic to the best possible extent. 'Of late, the harmful effects of plastic are known. Two or three years ago, when I heard so much about the issue and read several articles, I realized that plastic waste is a huge burden on the planet. From then on, I have been trying to reduce the use of plastic and have managed to do it by 50 per cent to 60 per cent, compared to a normal individual. This has been possible by cutting down on various things that are a part of the packaged industry.'

Originally from Hyderabad, Pankaj, a chartered accountant, moved to Chennai for work. It was in Chennai that he came across a zero-waste store. After a while, when he moved back to Hyderabad



A form of dried cow dung used to ward off mosquitoes in villages, is sold at the store

and was scouting for a zero-waste store where he could shop for groceries and other essentials, he was unable to find one. 'Every time I bought at a supermarket I would feel guilty. At the same time, I had taken a break from my job and was planning to do something on my own. That is when the thought of starting a zero-waste store struck me,' he recollects as to how the idea of the store he currently operates, began. He was also clear that there was no need for any kind of branding and hence the store is called 'zero waste'.

On how he handled the risk factor, considering that there was uncertainty with regards to the economics, he admits that it was initiated more as a passion than anything else. 'I was not at all confident and saw this as a risk venture. In fact, when I spoke to some of my



acquaintances, they were taken aback as to why I was giving up a lucrative job and taking this up.'

However, he made some calculations and realized that the investment was not a large sum and he was not spending anything substantial on the interiors. 'I felt that even if the shop does not do business, the loss would hardly be ₹5 lakh. Also, the idea was that if residents in the nearby area buy things from us and even 50 families bought their groceries here, the shop would break even,' he adds.

The risk paid off and just a few months into the venture (that was started on September 8, 2018), the response was tremendous. Unlike most new stores that open amidst much fanfare, this was started in the bylanes of Secunderabad and not in a prime area. 'It was a conscious choice, since we were starting new and did not want to commit mistakes on a large scale,' confesses Pankaj.

Emphasis on Quality

For his store, Pankaj procures in bulk, since the idea is to buy plastic free groceries—'We sell basic stuff, which is required daily.' 'When the store was set up, there were many organic stores alongside, but the issue is that they are worried about the ingredients and not about the packaging. I approached some people in the organic stores for grocery supply, but they said they would not sell them loose, since theirs is a brand. That is another thing we want to target, that people buy it for the quality and not for the brand,' he states, candidly.

Queried on how he ensures quality products, Pankaj explains he does not sell anything that he or his family do not use at home. 'These are products that we have been using since the last few years. We are aware of what is sold, and we focus on good quality—I don't believe in keeping something which is very exotic and pricey, something a customer is unable to use or I as a consumer would

Pulses on sale



not buy.' 'The intent is also to promote local talent,' he adds. All the powders, pickles and ready-to-eat mixes have been made by women at home, thereby promoting employment. If they sell the same thing online, packaging becomes an issue.

The Way Forward

Pankaj suggests that people must start buying local instead of shopping at large stores. The government, he adds, should also have a policy for bulk stores that follow certain rules. In fact, it is the

government that promotes packaging, and this is an area that needs to be re-looked, he stresses. Thirty years back, when supermarkets were not there, stores were small, and people used to go with their cotton bags and utensils, and this is what we wanted to revive. The idea is to try and go back to those times and operate the stores like how the ones in a bygone era would ply. ■

Sapna Gopal is an independent writer on environmental concerns and renewable energy. She can be reached on sapnagopalmd@gmail.com.

Is Lockdown a Potential Solution for Pollution Abatement?

In the wake of havoc created by the novel coronavirus, there is sudden drop in the air pollution levels in India and across the globe. With lockdown enforced in several countries, one of the eclectic advantages was to see the sights of clear blue skies from all over the world. The COVID-19 pandemic, which has claimed millions of lives and has threatened our way of living, has drawn attention of people towards the signs of changing environment. But a global crisis like this, feeding on the atrocities of the world, was never imagined or thought to bring an environmental change.

After the first phase of nationwide lockdown on March 25, there is an observable drop in concentrations of $PM_{2.5}$ and NO_x . Although a decrease in concentrations of particulate matter was always expected due to less industrial, commercial and construction activities, a drastic reduction in the NO_x emissions have also been observed as a result of restricted movement of traffic on roads. Delhi has shown dramatic reduction in concentrations. From $248 \mu g/m^3$ mid-March to $107 \mu g/m^3$ mid-April, NO_x saw 56 per cent reduction in its levels at Central Pollution Control Board (CPCB) station. Similarly, $PM_{2.5}$ concentration came down from $113.9 \mu g/m^3$ to as low as $39.4 \mu g/m^3$ as on March 28 and altogether a drop of 39.2 per cent was observed from 32 real time monitoring stations in Delhi. A noticeable drop in concentrations in other cities such as Patna and Faridabad

has also been observed. Patna observed 38 per cent drop in both $PM_{2.5}$ and NO_x concentrations before and after the lockdown whereas Ludhiana observed a drop in 53 per cent and 48 per cent in its $PM_{2.5}$ and NO_x concentrations before and after lockdown, respectively.

Comparing these concentrations with the concentrations of 2019 for the March and April, Delhi has seen a difference of 30 per cent and 25 per cent lower concentrations for $PM_{2.5}$ and NO_x measured at 30 stations while Lucknow has shown a tremendous drop of 41 per cent in its $PM_{2.5}$ values and 47 per cent reduction in its NO_x concentrations and nearly same drop has been seen for both Patna and Ludhiana cities. This is likely due to the fact that the entire lockdown has resulted in least number

of vehicles plying on roads with minimal congestion and idling of vehicles which contributed to low NO_x concentrations, followed by less industrial, commercial and construction activities all of which contributes majorly to particulate matter.

Satellite images from the National Aeronautics and Space Administration (NASA) show a surprising dip in the NO_x concentration over Wuhan and the rest of China. The NO_2 levels from January to February, 2020 were 10 per cent to 30 per cent lower than usual average concentrations, and they did not rise back till late February, 2020 attributing to the mitigation measures like closing of industries for some time, travel bans, and work from home measures that have been implemented in view of the outbreak. Similarly, data from the



European Environment Agency (EEA) showed a similar trend over March 16–22. In Madrid, average NO_2 levels decreased by 56 per cent after the government banned non-essential travel on March 14. This was a journey that did not take long to travel but took only few days to achieve the so-called ambitious air pollutant levels.

The reduction in particulate matter emissions is largely due to reduced industrial activity, which contributes carbon emissions on a comparable scale to transport. What we planned as slow process of environmental transformation and transition in the years to come was attained in a matter of few months and this has changed our entire course and perspective for life and ecosystem. But how long these changes would last?

When these emissions will increase again depends on how long the lockdown/restrictions due to the current pandemic last in the country—which is difficult to predict at this moment. If some of the lockdown measures continue in the coming months, it would bring fuel use for daily commutation, either by trains, public or private vehicles to nearly down by 70 per cent. Other factors, such as meteorological conditions, may also significantly

contribute to the weekly reductions seen in pollutant concentrations.

Another major question which needs to be pondered upon is whether lockdown is a potential solution for pollution abatement and control. Undoubtedly yes, effective lockdown has the potential to bring down the pollution levels in emergency situations such as crop residue burning, specifically October and November when the air quality index (AQI) reaches hazardous levels. Suggesting a lockdown during peak air pollution episodes might sound a bit fallible and tend to debilitate the economic structure, but it builds up strong rationale about current scenario that the lockdown has proved to be efficient and imprudent in reducing the pollution levels.

Certainly, a lockdown to mitigate air pollution is least likely to be acceptable by anyone, except in a dire emergency such as the COVID-19 pandemic. However, some aspects of the lockdown may have benefits on their own, and may be practiced voluntarily even after the lockdown among which the most prominent would be: work from home, study from home and online medical, legal, and so on, consultations. Their benefits in terms of work productivity,

and learning, as well as youth and female participation, seem to be established, and on that account, they may be widely practiced even after the lockdown ends. These will, have a major impact on road/metro transport and consequent $\text{PM}_{2.5}$ and NO_x/SO_x emissions, besides greenhouse gases (GHGs).

In 122 non-attainment cities under the National Clean Air Programme (NCAP), the lockdown measure would considerably bring down the emissions if lockdown is ordered during air pollution crisis. However, lockdowns will have its repercussions as it will not go in accordance with the daily wagers and labourers but it is still a worth as spending loads on detrimental health impacts. This calls for sagacious judgments from authorities, stakeholders and civil society for a collaborative effort and mutual decision making.

To combat global crisis like air pollution or climate change, a systemic change is possible only when the government and public at large join hands. Positive behavioural changes among citizens by proper awareness and capacity building will help as well.

The lockdown measures during COVID-19 outbreak have definitely given us clean air but not at the cost the world has incurred. What is to be learned from this pandemic is the difference that communities can make when they look out for each other—and it should be replicated in dealing with climate change. As individuals, we are the most vulnerable but as a society we are unbreakable. The situation demands coherent efforts as a community. Lessons have been learnt, working patterns have been assessed, now is the time that we take full responsibility of our actions and play an important role in the sustainable development or else face yet another challenge of climate change. ■

Article contributed by Mrinal Alexander Emmanuel, Research Associate and Suresh R, Fellow & Area Convenor, Centre for Environmental Studies, TERI, New Delhi.



SUBSCRIBE

TerraGreen

INDIA'S LEADING MONTHLY ENVIRONMENTAL MAGAZINE

<http://terragreen.teriin.org>



TerraGreen promotes the concept of sustainable development. Launched in June 2004, this magazine from TERI is an effort to bring forth information and knowledge in the fields of energy, environment, and sustainable development. The magazine is in keeping with our mission to expand the base of environmentally conscious readers and popularize sustainability issues at the local level. *TerraGreen* aims to provide the readers with the necessary inputs to enable them to be a part of the process of change. The magazine stays away from all jargon, so that the educated, informed, yet lay readers are updated on all that happens around them everyday.

Tick one	Term (yrs)	No. of issues	Cover price	You pay	You save
			₹ US\$	₹ US\$	₹ US\$
	1	12	720 122	680 116	40 6
	2	24	1440 234	1300 211	140 21
	3*	36	2160 302	1950 272	210 30

* Free online access to those subscribing for 3 years

*Name of the Customer (IN BLOCK LETTERS).....

Designation..... Company / Organization.....

City..... State..... PIN..... Country.....

Email.....

PAYMENT PROCEDURE

Enclosed a Cheque/Draft number.....drawn in favour of **'TERI'** payable at New Delhi for

₹/.....for 1/2/3/ year subscription of *TerraGreen*.

To SUBSCRIBE or make online payment, visit: <http://bookstore.teri.res.in/TerraGreen>

For subscription related queries,
contact: +91 11 2468 2100 / 7110 2100
Email: teripress@teri.res.in

THE ENERGY AND RESOURCES INSTITUTE
Darbari Seth Block, IHC Complex, Lodhi Road, New Delhi – 110 003
Tel. 2468 2100 or 7110 2100, Fax 2468 2144 or 2468 2145, India +91 • Delhi (0) 11
<http://terragreen.teriin.org>



Fight Coronavirus Together

We all can fight coronavirus together by following these measures:

- Wash your hands with soap and water frequently for 20 seconds or use alcohol-based hand rub. Do not touch your eyes, nose, or mouth if your hands are not clean.
- Cover your nose and mouth with a disposable tissue or flexed elbow when you cough or sneeze.
- Practice social distancing and avoid close contact with people who are unwell.
- Follow the government lockdown guidelines. Stay home and self-isolate from others in the household if you feel unwell.



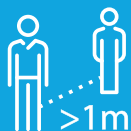
Stay at Home



No Contact



Wash More



Keep Distance



Don't Panic



Call Doctor



FEEDBACK FORM

PLEASE TICK YOUR CHOICE.

1. Which section(s) did you find the most interesting?

- ☐ TERI Analysis ☐ Environmental Research ☐ Feature
☐ In Conversation (Interview) ☐ Cover Story ☐ Special Report
☐ Green Challenges ☐ Terra Youth ☐ Review

2. In your opinion, which section(s) need(s) improvement?

- ☐ TERI Analysis ☐ Environmental Research ☐ Feature
☐ In Conversation (interview) ☐ Cover Story ☐ Special Report
☐ Green Challenges ☐ Terra Youth ☐ Review

3. What do you think about the look and feel of TerraGreen?

- ☐ Brilliant ☐ Design is not a priority, content is
☐ Average ☐ Needs improvement

4. In your opinion, what aspect(s) of TerraGreen need(s) improvement?

- ☐ Choice of stories ☐ Handling of issues ☐ Language
☐ Design ☐ Presentation

5. Please rate TerraGreen on a scale of 1–5 (5 being the best).

- ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

6. What issues would you like TerraGreen to cover?

.....
.....

7. Which other environmental magazine(s) do you read?

..... ☐ None

8. Any further suggestions?

.....
.....

YOUR DETAILS

Name:

Profession:

Tel.:

E-mail:

The most innovative suggestion will get a surprise gift.

The Energy and Resources Institute
Attn: TERI Press
Darbari Seth Block
IHC Complex, Lodhi Road
New Delhi – 110 003/India

Tel. 2468 2100 or 7110 2100
Fax: 2468 2144 or 2468 2145
India +91 • Delhi (0)11
Email: teripress@teri.res.in
Submit online: <http://bookstore.teri.res.in/terragreen>



ADVERTISE IN...

TERRAGREEN

Circulation information

Industries, Ministries, PSUs, Corporates,
Multi and Bilateral Agencies, Universities,
Educational Institutions, and Research professionals.
Readership of 40,000

General information

- Monthly
- All colour
- Matte paper
- Number of pages: 56



Technical specifications

Finished size: 20.5 cm × 26.5 cm
Non-bleed ad size: 17.5 cm × 23.5 cm
Half page ad size: 17.5 cm × 11.75 cm
Bleed size (3 mm bleed on all sides): 21 cm × 27.5 cm
Artwork preference: Print ready, minimum 300 dpi (tiff, eps, pdf, or cdr) files with all fonts with high quality print proofs and progressives for colour reference.

Advertisement tariffs (₹)

Position	Card rate for single issue(INR)	quarter contract (3 issues) (INR)	bi-annual contract (6 issues) (INR)	annual contract (12 issues) (INR)
Advertorial (per page)	100,000	255,000	480,000	900,000
Back Cover	100,000	255,000	480,000	900,000
Inside Back Cover	75,000	191,250	360,000	675,000
Inside Front cover	75,000	191,250	360,000	675,000
Inside Full Page	50,000	127,500	240,000	450,000
Inside Half page	30,000	76,500	144,000	270,000

GST & taxes additional as applicable

Subscription

One year ₹720 / \$122 • Two years ₹1440 / \$234 • Three years ₹2160 / \$302 (Free online access for those subscribing for three years)

ENERGY FUTURE

Circulation information

Industries, Ministries, PSUs,
Corporates, Multi and Bilateral Agencies,
Universities, Educational Institutions,
and Research professionals.
Readership of 25,000.

General information

- Quarterly
- All colour
- Matte paper
- Number of pages: 96



Technical specifications

Finished size: 20.5 cm × 26.5 cm
Non-bleed ad size: 17.5 cm × 23.5 cm
Half page ad size: 17.5 cm × 11.75 cm
Bleed size (3 mm bleed on all sides): 21 cm × 27.5 cm
Artwork preference: Print ready, minimum 300 dpi (tiff, eps, pdf, or cdr) files with all fonts with high quality print proofs and progressives for colour reference.

Advertisement tariffs (₹)*

Ad location	Back cover	Inside back cover	Inside front cover	Inside full page	Inside half page	Inside quarter page	One-sixth page
Single issue	60,000	50,000	50,000	40,000	20,000	12,000	7,000
Two issues	114,000	95,000	95,000	76,000	38,000	22,800	13,300
Three issues	171,000	142,500	142,500	114,000	57,000	34,200	19,950
Four issues	228,000	190,000	190,000	151,000	76,000	45,600	26,600

Subscription

One year ₹800 / \$80 • Two years ₹1600 / \$160 • Three years ₹2400 / \$240

Contact details

Gitesh Sinha

Email: gitesh.sinha@teri.res.in
<Extn 2710>

Payment mode

Please send your advertisement material along with the accompanying advertisement release form and the payment in the form of cheque/DD favouring **TERI, payable at New Delhi** (no outstation cheques will be accepted)
Website: <http://bookstore.teri.res.in/TerraGreen>



The Energy and Resources Institute

Darbari Seth Block, IHC Complex
Lodhi Road, New Delhi – 110 003
Tel: 011 2468 2100 / 7110 2100
Fax: 011 2468 2144 / 2468 2145
Website: <http://bookstore.teri.res.in>

No. of Pages 56 without Cover

OPEN YOURSELF TO A WHOLE NEW WORLD OF ENVIRONMENT INTELLIGENCE!

PRESERVE • CONSERVE
INSPIRE • LEARN

ORDER
YOUR COPY
TODAY

ENVIRONMENT STUDIES AND SUSTAINABLE DEVELOPMENT

SUSTAINABILITY OF BUSINESS IN THE CONTEXT OF ENVIRONMENTAL MANAGEMENT
Kamlesh Prabhu

EIGHTEEN TIDES AND A TIGER
Anjana Bose

ENVIRONMENT CHRONICLES II
The Best of Teri/Times
Bahar Dutt

ECOLOGY, ENVIRONMENT, AND FORESTRY

Redefining Forestry for Effective Livelihoods
Pradyot Bhattacharya

SUSTAINABLE ARCHITECTURE

Sustainable Building Design Manual
Volume 3
Sustainable Building

ENVIRONMENTAL ENGINEERING SERIES

Air Pollution Control
S.P. Mahajan

ENVIRONMENTAL ENGINEERING

CLIMATE CHANGE AND ENVIRONMENTAL ISSUES
EDITORS: Anoop Singh and Anil Kumar Thakur

CLIMATE

ENERGY

TERI ENERGY & ENVIRONMENT DATA DIARY AND YEARBOOK 2017/18
The Director and Research Associates

WIND POWER PRACTICAL ASPECTS
Shambhu Ratan Awasthi

CHILDREN BOOKS

LET'S SAVE THE RAIN
NEERA

National and State Symbols
Anita Sundaram

WHY SHOULD I PROTECT NATURE?
A smart kid's guide to a green world
Rishi Prasad

LIFE SCIENCES

GOLDEN GREENS
The Amazing World of Plants
Bharati Bhattacharya

Environmental Engineering Series

Air Pollution Control
S.P. Mahajan

EDITOR: T.V. Ramachandra
Commonwealth of Learning, Canada
Centre for Ecological Sciences, Indian Institute of Science
Karnataka Environment Research Foundation

TERI publications also available at

amazon.in

flipkart.com

GET IT ON
Google play

LEARNERLIBRARY

mintbook
Experience Reading

amazonkindle

ShopClues.com

infi beam.com

paytm

kopykitab
Same textbooks, click away

For more information, log on to <http://bookstore.teri.res.in>