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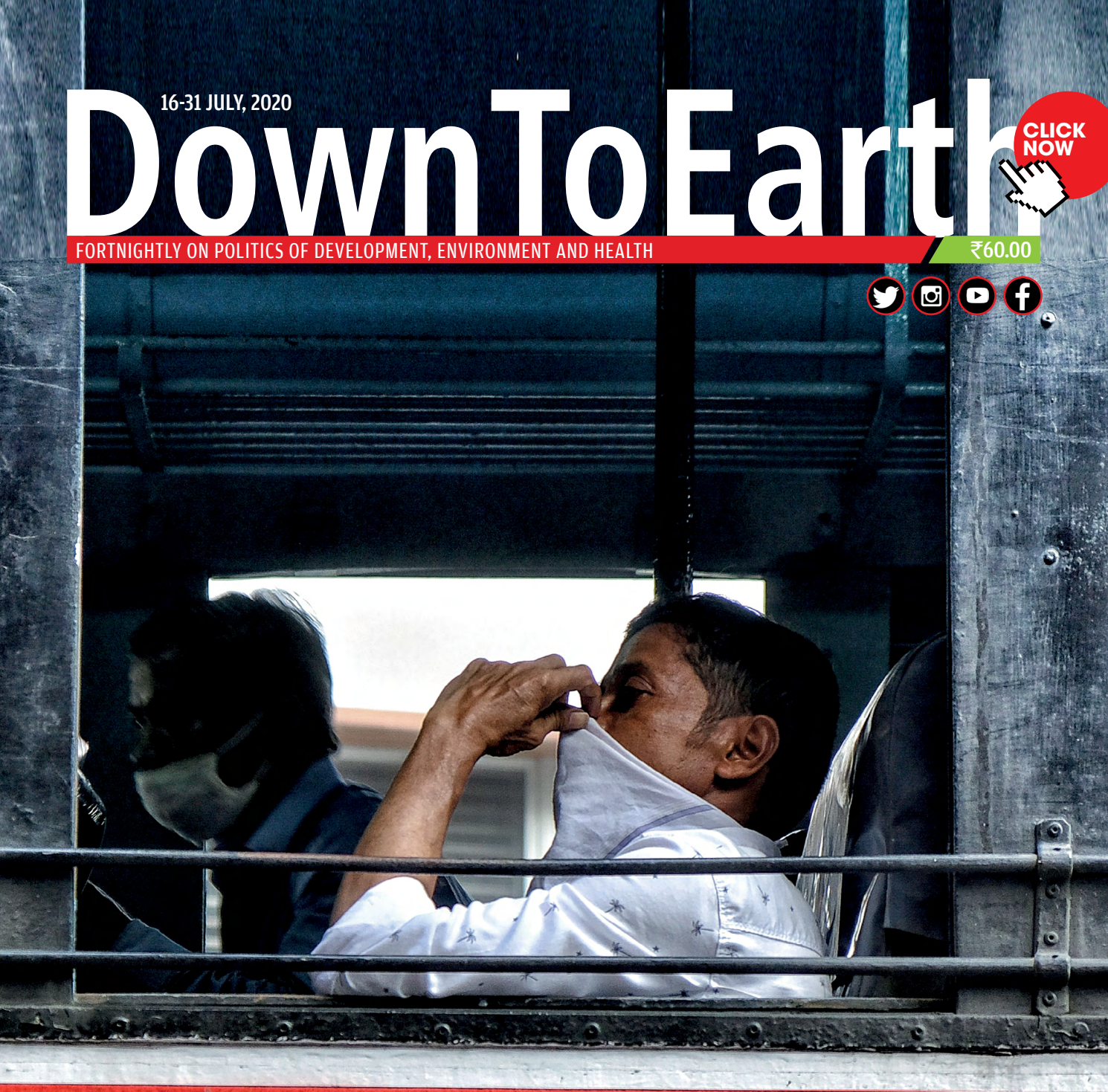

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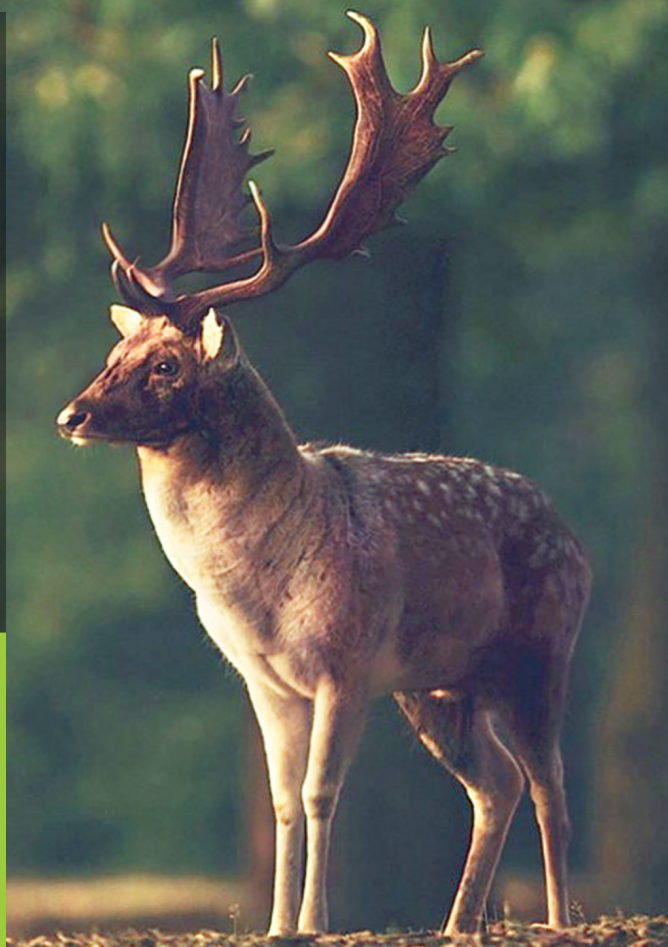

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Politics of recycling plastic

COVID-19 IS all-subsuming; it makes it difficult to think or act on issues that made up our world yesterday and would stay in our world of tomorrow. One such issue is that of plastic—the most ubiquitous substance in our lives that fills up our land and oceans, polluting it and adding to our health stress. The current health emergency has normalised the use of plastic as we use more and more of it for protection measures against the virus. The plastic protection gear—from gloves, masks to body suits—so critical in this "war" against COVID-19, will also contribute to the mountains of trash in our cities—if it is not incinerated in properly-controlled and -managed medical waste disposal facilities.

The politics of plastic is embroiled in a benign word called "recycling". The global industry has successfully argued that we can continue to use this highly durable substance because once we throw it, it will be recycled. Never mind that nobody knows what this means. When China came up with its 2018 National Sword policy to stop imports of plastic waste for "re-processing", the rich nations woke up to some harsh realities. Ships of plastic waste cargo were turned away from many other countries as well, including Malaysia and Indonesia. Nobody wanted this waste. They had enough of their own to deal with.

It is reported that prior to the 2018 ban, 95 per cent of European Union's and 70 per cent of USA's plastic waste collected for recycling was sold and shipped to China. The dependence on China meant that recycling standards had become slack—food waste was mixed with plastic and the industry had excelled in creating new products, design and colours of the waste. All this meant that waste was more contaminated making recycling difficult. So much so that even China—which can create business from nothing—found it unprofitable to reprocess it.

India's plastic waste problem is not as huge as the rich world, but it is growing. The latest annual report of the Central Pollution Control Board on plastic waste tells it all—while rich states like Goa produce as much as 60 grams of plastic per capita per day; Delhi is catching up with 37 grams per capita per day. The national average is around 8 grams per capita per day. In other words, as societies become more affluent, they will become more wasteful. This is the ladder of wealth we must not aspire to climb.

It is nearly impossible to segregate, collect and transport soiled multilayered plastic or sachets for recycling

However, given the huge litter of plastic we can already see in our cities, it is clear we cannot get sanguine about the fact that we will catch up—collect more; recycle more. This will not work, unless we can think differently and act decisively. Something that is sorely missing today.

Prime Minister Narendra Modi made a powerful statement on Independence Day in 2019 calling us to give up the habit of plastic and promising that his government would announce significant plans for reduction. But his government is doing pretty much the reverse.

And again, the politics is about recycling. The industry has, once again, managed to convince policymakers that plastic waste is not a problem as we can recycle virtually everything. It's a bit like tobacco—if we stop smoking, farmers will be affected. If we stop using plastic, the recycling industry—run by small industry; working often in the informal sector; and, using poorest people who work in the most abysmal conditions—will collapse. Jobs will be lost.

Let's first discuss as to what happens to the waste that cannot be recycled? All studies (limited as they are) show that the plastic waste in drains or in landfills comprises the least recyclable material—this is multi-layered packaging (food stuff of all kinds), sachets (gutkha or shampoo) and plastic bags. The 2016 Plastic Management Rules recognised this and said that sachets would be banned and all multi-layered plastic use would be phased out in two years. In 2018, this was fatally amended—now only waste that is non-recyclable, and if there is any of this at all, needs to be phased out. This is not to say that theoretically multilayered plastic or sachets cannot be recycled—they can be sent to cement plants for energy recovery or used in road construction. But everyone knows that it is nearly impossible to first segregate, collect and then transport these empty, soiled packages. So, business continues as usual. Our garbage problem does not go away. The second issue is what do we really mean by recycling? The fact is that recycling of plastic needs careful segregation at the household level; this puts the onus on us and the local bodies. So, it's time we dismembered and took apart the world of recycling. I will discuss this further with you in the coming weeks.. DTE

@sunitanar

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Engage

PHOTOGRAPH: JAYANTA BASU

Time to redeem

This is in reference to "Multiple crises: the cost of wasted time" (1-15 June 2020). India has been a developing country for many years now. But the only ones who seem to have developed are those in whom we had entrusted the protection of our common resources and hoped would work for the common good. In India, Kerala is particularly touted as a model for development, scoring high on all human development indices. But the report by the Western Ghats Ecology Expert Panel, popularly called the Gadgil Commission, has been comprehensively subverted by this fully literate and politically conscious state. Globally, we have the US, a "developed" nation and the leading economic power, whose president is in a total denial mode as far as climate change is considered. Is it merely Donald Trump's folly? To answer in the affirmative would be to question the US' democratic credentials.

Our country, Bharat, had a great tradition of living with nature. Love and respect for nature was woven into our daily lives through religion and culture. Will we be able to redeem that culture and belief system and save the world from the looming disaster?

P M RAVINDRAN
VIA EMAIL

Patanjali case shows regulatory lapses

This is in reference to the article, "Many links missing in Patanjali's claims of COVID-19 drugs", published online on June 23, 2020. This incident has exposed the real status of our drug control authorities. If Ramdev, Balkrishna and party are not put behind the bars, it will expose how the government promoted such quacks to play with the lives of people. Shame on our corrupt system and politicians who allow such criminals to play with the lives of citizens.

SHIKSHIT
VIA EMAIL

↘ The best way to validate this is to give the virus to Ramdev and have him prove he is cured. That will address the issue.

RAVI
VIA EMAIL

Can returning workers rejoin traditional jobs?

This is in reference to "Rural options for Odisha's returnee migrants", published online on June 18, 2020. The question raised is quite pertinent because the returnee workforce is attuned to a certain work culture and has a certain skill set. The government's focus to engage it into traditional labour-intensive works may not be a best fit. Adapting to the new paradigm could be difficult for them.

ANUP
VIA EMAIL

↘ Intriguing article. Undoubtedly, the times call for the migrants of Odisha to be engaged in occupations they are acquainted with.

SRISTI
VIA EMAIL

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DTE TV

Protocols flouted

Did Patanjali Ayurved flout test protocols before launching its anti-COVID-19 drugs—Coronil and Swasari Vati? The government thinks so,

because it banned the publicity of both the drugs as COVID-19 medication hours after they were launched. The company had claimed that the drugs could fully cure a COVID-19 patient after a week of treatment.

Madhya Pradesh to screen everyone

With 12,000 COVID-19 cases, Madhya Pradesh plans a door-to-door surveillance programme, called Kill Corona Campaign, from July 1. A total of 10,000 survey teams will be deployed who will screen the state's 80 million population.

China in excise net?

India may impose a 20 per cent customs duty on all green energy equipment from China. More than 80 per cent of India's solar projects use cells and modules from China and the government is aiming to reduce its dependency on Chinese green energy equipment and technology. India plans to install 100 GW grid-connected solar power plants by 2022.

FOR MORE, CLICK

PHOTOGRAPH: MANAGE AUTISM NOW TRUST, V IKAS CHOUDHARY / CSE

Missing voice

This refers to the article "Autistic Pride Day 2020 dedicated to neurodiversity, celebrating differences", published online on June 18, 2020. In an article marking a day to support autistic self-advocacy, you didn't quote a single autistic person.

NORA
VIA EMAIL

Check your facts

This is in reference to "When did CO_2 become our planet's arch enemy?" published online on May 19, 2020. Under the Paris Agreement, it was agreed upon to keep the average global temperature rise to below 2°C of pre-industrial levels and to limit it to 1.5°C, not to keep it below 1.5°C, as the article incorrectly mentions.

POOJA YADAV
VIA EMAIL

Leave noodles alone

This refers to the article "Spare me my noodles", published online on June 18, 2020. If instant noodles disappear from the market, what will be the fate of our soldiers in sub-zero terrain? So politicians, please spare us.

J C GHAI
VIA EMAIL

Why blame the government?

This is in reference to "Lessons from COVID-19 on reducing India's environmental pollution", published online on May 4, 2020. Can you please provide any case or instance where government officials brought out a notification or policy decision in haste that has affected the small and medium enterprises. Also, kindly elaborate how courts are blamed for taking arbitrary decisions, when authorities are not timely filing the documents.

SIDDHARTH SINGH
VIA EMAIL

DTE response

Take the case of Continuous Emission Monitoring System (CEMS) to monitor emissions/effluents from 17 categories of industries. The government introduced it in 2014, but the objective of using CEMS as a compliance monitoring tool is yet to be achieved. One of the primary reasons for this failure is the hasty execution of the decision. CEMS was introduced in 2014 but the guidelines came only in 2017. There was no categorisation of industries on the basis of scale, due to which many industries with small boilers invested in CEMS and ended up with faulty, useless installations even after investing crores of rupees.

Regarding the second part of the question, a National Green Tribunal (NGT) order in April said: "In absence of responsiveness of the statutory authorities who have to carry out the orders of this tribunal, mere passing of paper orders will not advance the purpose for which this tribunal has been constituted under the law". This was just one case where NGT rapped the Delhi Pollution Control Committee for failing to prosecute, or recover compensation from, a factory for damaging the environment. NGT relies on government agencies for implementation and this was one example of the authorities not performing their duties in time.

Errata

The name of the author of the article "Tangy taste", published in the April 1-15 issue of *Down To Earth*, is Chitra Balasubramaniam and not Chitra Subramaniam as was printed. We regret the error.

Down To Earth *welcomes letters, responses and other contributions from readers. Write to Sunita Narain, Editor,* Down To Earth, *41, Tughlakabad Institutional Area, New Delhi - 110062 or send email to editor@downtoearth.org.in*

DATA CENTRE

COVID deaths cross 0.5 mln

More than 581,000 have died of COVID-19 while 7,851,480 have recovered in 213 countries and territories, as of July 15 The number of people infected globally stands at 13,461,400.

Cases near 1 mln in India

Number of COVID-19 cases in the country was about 937,500 as of July 15. Some 319,840 were active cases; 592,031 cured/migrated patients; and 24,309 deaths.

Threat of indoor pollution

Household air pollution threatens 2.8 billion people who rely primarily on polluting cooking systems, says the World Health Organization.

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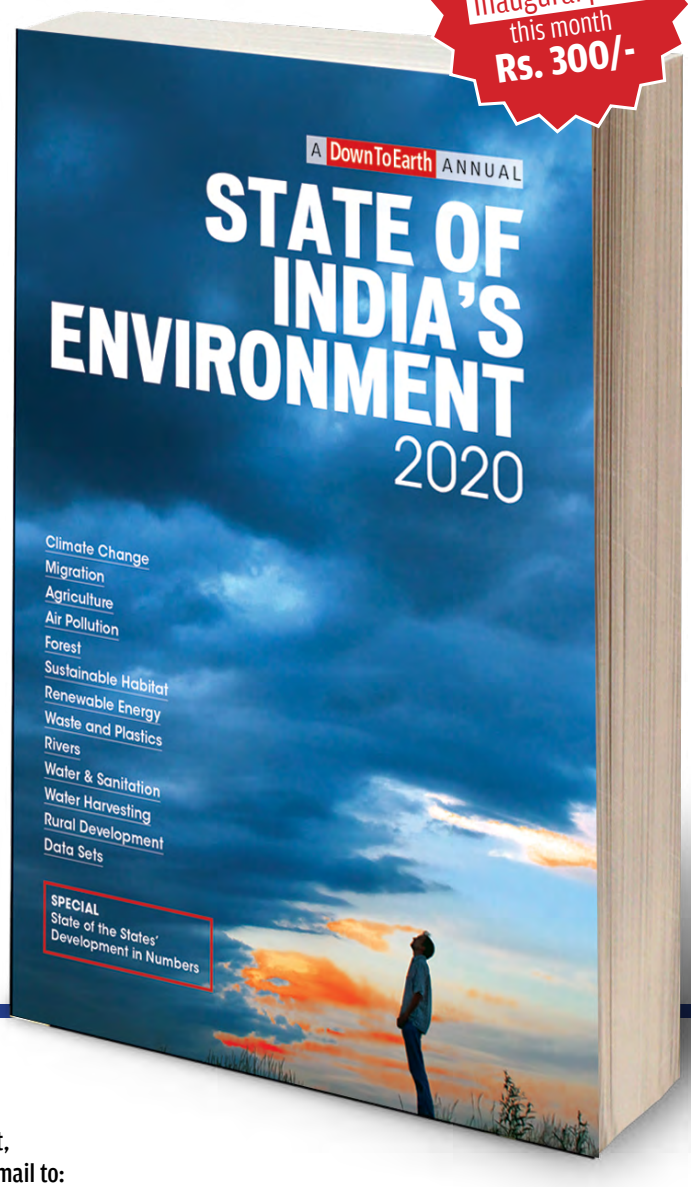

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Digest

WHAT'S INSIDE

1,000 WORDS VIKAS CHOUDHARY

Severely damaged solar panels along the Delhi-Meerut highway after storms hit the National Capital Region mid-June. The current spell of lightning and violent rainstorms has already killed over 100 people across north India

FOR MORE PHOTOS, SCAN

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RELATED STORY
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Student power

A group of students in West Bengal provide relief to 5,000 migrants across the country

RAJIT SENGUPTA

MY FRIENDS and I teach children in rural areas adjoining our college in Kalyani, a suburb some 50 km from Kolkata, West Bengal. When the COVID-19 crisis deepened in April, we started receiving calls from the families living there for help," recalls Julekha Pervin, a third-year student with the Bidhan Chandra Krishi Viswavidyalaya. So Pervin, along with 30-odd students, started reaching out to individual households with food packages. Later, they started a community kitchen. They raised ₹60,000, primarily through contributions from professors.

"We soon realised that almost all the households in rural West Bengal had family members stuck in cities without jobs," she says. So they came up with a simple idea: start a forum with a helpline service where people could call up and inform distressed workers from West Bengal and then pass on the information to non-profits operating in the state where they are stranded.

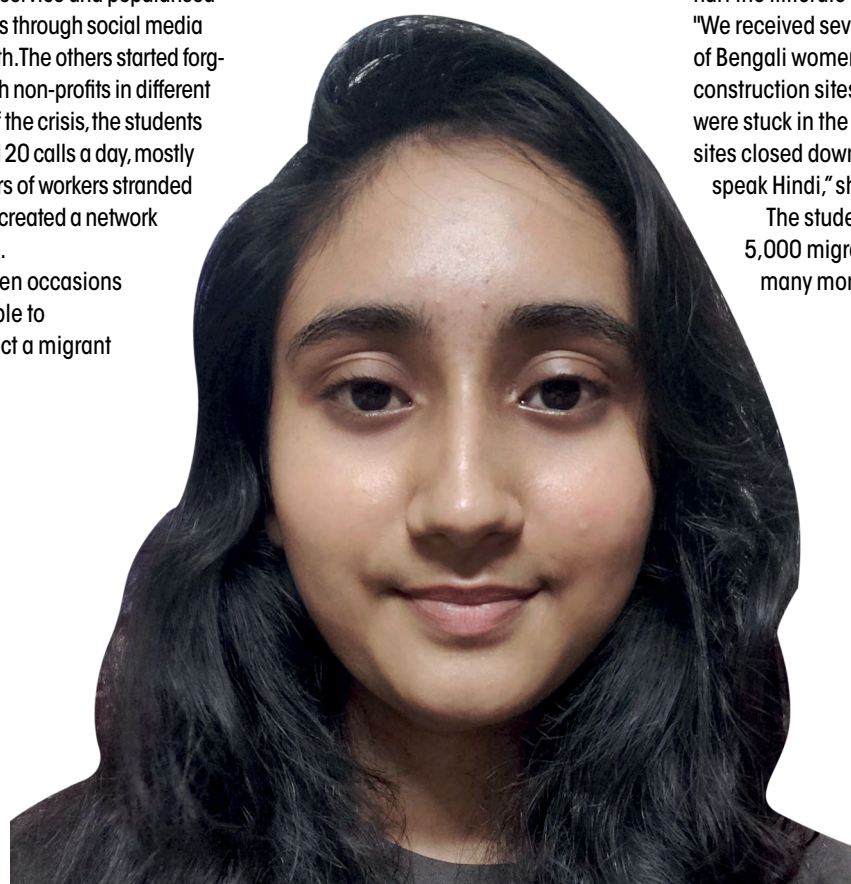
Pervin and two others, Tamonash Roy and Chandan Bhattarcharya, took the responsibility of the helpline service and popularised their phone numbers through social media and by word of mouth. The others started forging associations with non-profits in different states. At the peak of the crisis, the students would receive over 120 calls a day, mostly from family members of workers stranded in other states. They created a network of 50-60 non-profits.

"There have been occasions when we were unable to immediately connect a migrant with a non-profit. We transferred money directly to them," says Pervin. For instance, a couple in Dharavi slums of Mumbai needed immediate help for their youngest child who suffers from thalassemia, which requires regular blood transfusion. Dharavi, at that time, was completely locked down due to high number of COVID-19 cases. "We transferred some money. They eventually got their jobs back and are doing better now," she says.

During the second phase of the lockdown, the students started sensitising families about various government schemes and initiatives. They rolled out small how-to videos on the Sneherparash mobile application, released by the West Bengal government to transfer ₹1,000 to rural beneficiaries and circulated it among the people. They created similar content on how to book tickets for shramik trains and apply for e-passes to enter West Bengal districts.

While the migrant distress has eased ever since, Pervin thinks the lockdown hurt the illiterate population the most. "We received several calls from groups of Bengali women who were working at construction sites in Jaipur. These groups were stuck in the city after the construction sites closed down because they could not speak Hindi," she says.

The students have helped over 5,000 migrants and provided relief to many more households in the state.



Why India should worry about a warming Arctic

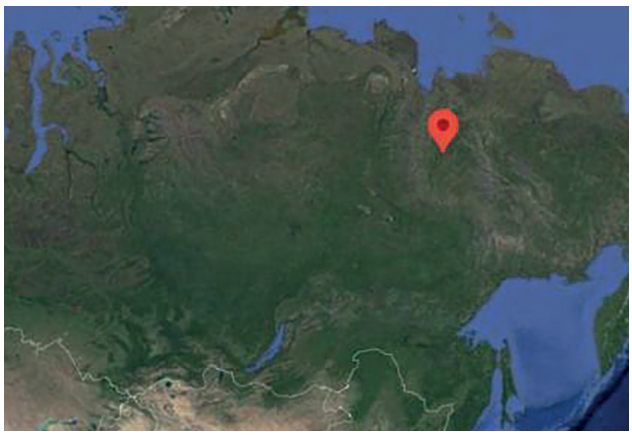
AKSHIT SANGOMLA

THE SIBERIAN town of Verkhoyansk, known for the largest temperature range in the world from -67 °C to 37 °C, got scientists worried when on June 20 it recorded the highest temperature in the Arctic circle in the last 140 years at 38 °C. This is around 18 °C higher than the normal for this time of the year for the place.

"The new high shows temperature swings may be increasing," says Raghu Murtugudde, climate scientist at the University of Maryland, US. The region, warming at twice the rate as the rest of the world, has faced repeated heat waves in the last few months, with Siberia recording some 10°C more than the normal in May 2020.

Arctic warming increases the north-south migrations of the polar jet stream, a permanent band of winds over the region. "The jet stream is like the fence between the cold high pressure air of the Arctic and the warm low pressure air of the subtropics. If this fence swings north-south then the cold and warm air follow the jet stream," says Murtugudde.

The impacts of a warming Arctic can be felt as far as in India in various ways. For instance, Western Disturbances respond to the pressure variations associated with the jet stream swings. Western Disturbances are extra-tropical storms that originate in the Mediterranean and are responsible for rainfall in the northwest, northern and northeastern India during the winter and spring months and snowfall in the high altitude regions.



Verkhoyansk in Siberia is one of the coldest towns in the world

This year, they were particularly active and caused heavy rainfall in March, April and May over northern and northwestern India. These rains, moisture and the vegetation they produced were partly responsible for the early locust attacks in Rajasthan which has spread as far east as Chhattisgarh for the first time in decades.

'WE ARE RESPONSIBLE FOR THIS EXTREME'

The World Meteorological Organization (WMO) has set up an evaluation committee to check the record-breaking temperature reading on June 20. **Randall Cerveny**, the UN agency's rapporteur on weather and climate extremes, tells ***Down To Earth*** about its ramification on the region's climate

How accurate is the reading at Verkhoyansk?
Our preliminary analysis indicates that it is a good observation but we will examine the equipment, its calibration, the observation practices, the correspondence to surrounding stations' observations and other parameters.

Is it unprecedented?
Well, we do not have as many weather stations in the Arctic as we would want so it is possible that temperatures of that magnitude have occurred in the past but were not measured. But in terms of our records, it is likely that we have not seen temperatures like the 38°C value in the Arctic over the length of our observed temperature records of ab out 150 years.

Siberia and the Arctic region have been recording extreme temperatures for quite some time now. What is the reason?
The Arctic is one of the more climatically sensitive regions. As warmer temperatures create lesser snow cover for the area, the feedback response (less white to reflect sunlight) can continually increase the temperatures. Because the global temperature increase is primarily the result of human activity, we have to take responsibility for these extremes.

What are the chances of such extremes in the future?
Unless governments change their policies, the likelihood remains high and more frequent extremes of this type will be observed.

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India stares at a locust plague

Exceptional summer breeding might prompt locusts to stay in the country till the year end and move towards the east and south

SNIGDHA DAS

BLAME IT on the weather unusually favouring locusts for the past three years or the inability of the international community and the governments to control their growth, the global upsurge of locusts is on its way to reach plague levels.

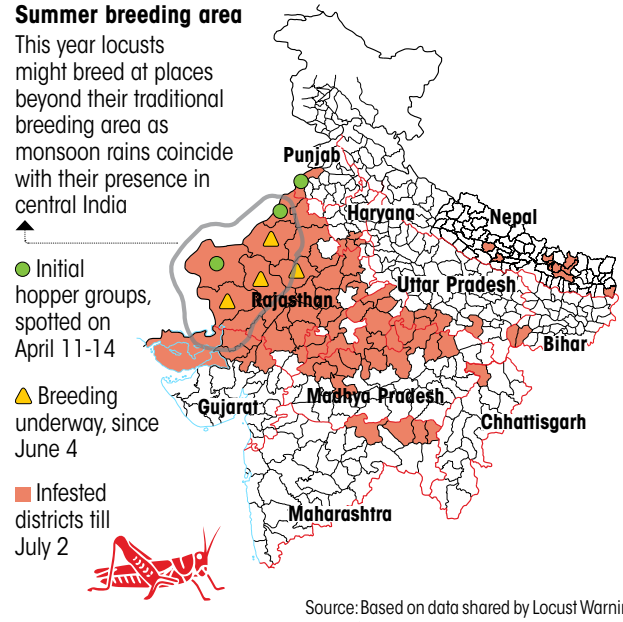
After taking Delhi and the National Capital Region by surprise on June 27, which as per some estimates is for the first time since the locust plague of 1926-31, and spreading across Bihar, locust swarms are causing mayhem in Nepal. By July 2, locusts have spread to almost a dozen districts in the Himalayan country where kharif crop cycle is underway. As per its Plant Quarantine and Pesticide Management Center, located in Lalitpur, locusts have caused some damage to transplanted rice fields, maize, fodder grass, vegetables and other perennial crops in the districts, with severe damage reported from Dang and Pyuthan districts. While some groups have stayed in Kathmandu valley, others have headed further north towards Ramechaap. In the past, locusts have invaded Nepal on rare occasions and only during plagues.

Over the next four weeks, alerts the June 27 update of the Food and Agriculture Organization (FAO) on desert locusts, India should remain on high alert as swarms developed in Somalia will cross the Arabian Sea to reach Gujarat and Rajasthan from early July. These are second generation swarms that have developed in the Horn of Africa, despite aggressive control operations.

In the past, such spectacular migrations have occurred during upsurge and plague periods. For example, immature swarms crossed the Atlantic Ocean from West Africa to the Caribbean in October 1988, covering 5,000 km in 10 days. Swarms migrated from West Africa to the British Isles in 1955. From time to time, they have crossed the Red Sea to reach from northeast Africa to the Arabian peninsula or vice versa; the Gulf of Aden to reach from Yemen to Kenya; the northern Africa to reach from Sudan to Morocco; the Sahel to reach from Guinea to Ethiopia; and the Arabian Sea to reach from the Horn of Africa to Indo-Pakistan border. FAO describes the current spread of infestation as an "upsurge" and says a plague is declared when widespread and heavy infestations occur in one or more years. But this, too, does not seem far off. Usually, the summer-bred or monsoon swarms start returning to their spring breeding areas in Iran and southwest Pakistan by September and October. But this year, their migration may not be uni-directional. In years of exceptional breeding, says a 2014 FAO document, monsoon swarms may move from the source areas eastwards over northern India from September onwards. Between 1950 and 1961, monsoon swarms on several occasions moved east to reach western Uttar Pradesh and Madhya Pradesh and south to reach Gujarat, Mumbai in Maharashtra and Kerala in the months of October, November and December. These years coincide with the plague years of 1949-1955 and 1959-1962. With the monsoon rains sweeping across all the five states—Rajasthan, Haryana, Madhya Pradesh, Uttar Pradesh and Bihar—that currently have locust presence as per FAO, they might breed in pockets where the soil is just right and undisturbed.

Locust sweep

Locusts have invaded nine states in India and a dozen districts in Nepal since arriving at Rajasthan in April



Source: Based on data shared by Locust Warning Organization, Jodhpur; ground reportage; and the Plant Quarantine and Pesticide Management Centre of Nepal

FOR MORE CARTOONS, SCAN

Forest fires reach 13-year high in Amazon in June

THIS JUNE Amazon rainforest in Brazil recorded a 20 per cent increase in fires, a 13-year high for the month. The alarming spike in forest fire incidents during the dry season has raised concern that the year's total incidents could be higher than last year's. Activists suggest the COVID-19 outbreak has reduced surveillance in the forests, leading to the sharp increase.The South American country has the world's second-highest coronavirus cases and death toll, just behind the US.

In June, the country's National Institute for Space Research recorded 2,248 fires using satellite imagery, as opposed to 1,880 fires in June 2019.The burning usually increases in July, August and September. Last year's fires peaked in August, with 30,901, three times the number for the same period the previous year. The 2019 fires led to worldwide protests, with threats of trade sanctions by developed countries even as President Jair Bolsonaro bulldozed with his anti-environmental policies, which includes slashing the conservation funds to encourage business activities in the rainforests.

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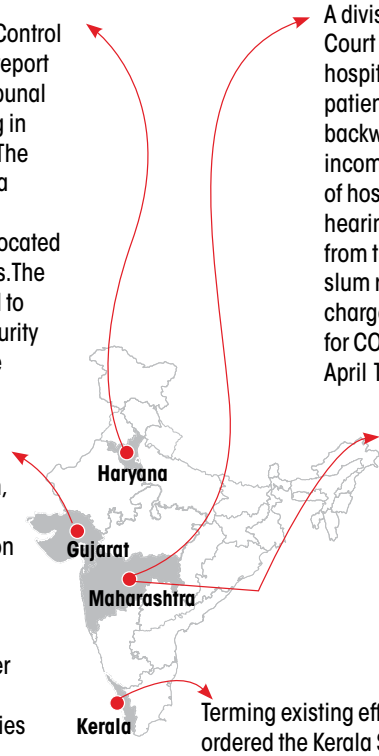
Haryana State Pollution Control Board has submitted its report to the National Green Tribunal (NGT) over illegal mining in the state's Garhi village.The report found that Haryana Mining Corporation was operating beyond the allocated area and did not royalties.The government has decided to forfeit the ₹2.5 crore security amount submitted by the company as penalty

A division bench of Bombay High Court has made it clear that hospitals cannot ask COVID-19 patients from economically backward sections to produce income certificates at the time of hospitalisation.The court was hearing a petition filed by a family from the city's Bharat Nagar slum rehab building who were charged ₹12.5 lakh by hospital for COVID-19 treatment between April 11 and 28

The Supreme Court has given Yashashvi Rasayan, a chemical industry, 10 days to pay compensation to the victims of a blast at their factory in Dahej, Gujarat.The National Green Tribunal had earlier ordered the company to pay ₹15 lakh to the families of the deceased, ₹5 lakh to the families of those grievously injured and ₹2.5 lakh to the families of people hospitalised



The Bombay High Court has directed the Maharashtra government to clarify whether it was disposing all coronavirus-related biomedical waste in a safe manner

Terming existing efforts as inadequate, NGT has ordered the Kerala State Pollution Control Board to take effective steps to curb pollution at the Brahmapuram solid waste processing plant on the outskirts of Kochi city in Kerala.The agency has to check the unscientific waste handling at the plant and file an update report by August 4

So far...

Number of cases on environment and development tracked from January 1, 2020 to July 1, 2020

Supreme Court	High Courts	National Green Tribunal
44	50	260

Compiled by DTE-CSE Data Centre

FOR DETAILED VERDICTS, SCAN

Patanjali gets notice over Coronil

ACTING ON a public interest petition that accuses Patanjali Ayurved Limited of misleading people with the new Coronil drug, the Uttarakhand High Court has issued a notice to the company. Notices have also been served to the Union and state governments, director of the AYUSH department in Uttarakhand; Indian Council of Medical Research (ICMR) and Rajasthan's NIMS University, which collaborated with the company in manufacturing the medicine, to file their replies. The PIL has sought a ban on the drug claiming it is not certified by ICMR and does not have the mandatory manufacturing license. Meanwhile, the Union AYUSH Ministry says Patanjali can sell Coronil but only as an immunity booster, even though the company claims it is effective against COVID-19.

BITS

IN AN open letter to the World Health Organization, 239 scientists in 32 countries have outlined the evidence showing airborne transmission could be a significant factor for coronavirus. If true, the consequences on containment will be significant. Masks may be needed indoors, even in socially-distant settings and healthcare workers may need N95 masks that filter out even the smallest respiratory droplets as they care for coronavirus patients.

THE WORLD lost nearly 400 million full-time jobs in the year's second quarter (April-June 2020) due to the novel coronavirus disease (COVID-19) pandemic, suggests the International Labour Organization. This adds to the 179 million jobs that were lost in the first quarter of 2020.Asia Pacific recorded the maximum 235 million job loss in the second quarter.

PHYSICISTS HAVE reported what could be the first incontrovertible evidence of the existence of unusual particle-like objects called anyons, first proposed more than 40 years ago.Anyons are latest addition to a growing family of phenomena called quasiparticles, which are not elementary particles but collective excitations of many electrons in solid devices.Their discovery could represent the first steps towards making anyons the basis of future quantum computers.

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Waste Water Technology


Environmental Materials


Environmental biotechnology, genomics, virology


Eco-restoration

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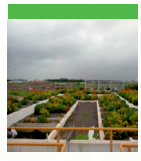
SIGNIFICANT ACHIEVEMENTS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RELATED STORY
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The great digital divide

The lockdown has shown that urban and rural India are miles apart in their online presence

KUNDAN PANDEY NEW DELHI

THE PRIMARY school in Kota Gunjapur village of Madhya Pradesh's Panna district has 31 registered students. After the Central government announced a nationwide lockdown on March 24 and the school received orders to hold classes online, the principal, Rohni Pathak, organised a door-to-door survey to assess its feasibility. "We found that households of only eight of the 31 students had mobile phones, and just two were active," Pathak says. Hakki Bai, a daily wage labourer belonging to Gond tribe, whose son Brij Kumar, 13, studies in the school, says the family does not have a phone. "Even if we buy one, there is no power supply to charge it. I don't know how will he catch up with the studies once the classes start," she says. "The situation is the same in other villages," adds Pathak.

Education is just one area that has highlighted the digital divide between India's rural and urban areas during the lockdown. The trend is evident everywhere—telemedicine, banking, e-commerce, e-governance, all of which became accessible only via internet during the lockdown.

The divide exists despite the rise in the number of wireless subscribers in India over the past few years. As per the monthly report released by the Telecom Regulatory Authority of India (TRAI) on June 29, the country had over 1,160 million wireless subscribers in February 2020, up from 1,010 million in February 2016. This is a rise of 150 million subscribers in five years, or 30 million per year. The growth has been evenly distributed in urban and rural areas, with the number of urban subscribers increasing by 74 million (from 579

ILLUSTRATION: RITIKA BOHRA / CSE

million to 643 million) and rural subscribers by 86 million (from 431 million to 517 million).

But this growth only indicates the rise in basic telecommunication facility. Services such as online classrooms, financial transactions and e-governance require access to internet as well as ability to operate internet-enabled devices like phones, tablets and computers. Here the urban-rural distinction is quite stark. As per the 75th round of National Sample Survey conducted between July 2017 and June 2018, just 4.4 rural households have a computer against 14.4 per cent in urban areas, with just 14.9 per cent rural households having access to internet against 42 per cent households in urban areas. Similarly, only 13 per cent people of over five years of age in rural areas have the ability to use internet against 37 per cent in urban areas (see 'Network strength' on *p*20). "Urban areas have over 104 internet subscriptions per 100 people (many have dual SIM cards with internet connectivity), while the figure for rural areas is a little over 27. Such numbers confirm the extent of India's rural-urban digital divide," says Apar Gupta, executive director of Delhi-based charitable trust Internet Freedom Foundation.

Clearly, the internet penetration is not deep enough. "At one level, we all recognise that internet has become indispensable. On another level, it still doesn't have adequate attention of the decision makers," says Aruna Sundararajan, former secretary in the Union government's telecommunication department and member of Kerala's COVID-19 task force. The first thing we recommended was to ensure uninterrupted internet services, she says. "We put in suggestions that people who normally don't have access to internet need to be given access because they are the ones who require it most," she says.

There is another dimension to the problem. Smriti Parsheera, a lawyer and policy researcher with Delhi-based National Institute of Public Finance and Policy, who interacted with several students in Himachal Pradesh government schools during the lockdown, says that most students are from families that have only one mobile phone. "The earning member of the family has to carry the phone while going out to work. In a family that has, say, three children, how does one decide who gets to attend classes, assuming the phone is accessible," says Parsheera (see 'Make handsets affordable' on *p*21).

There is also a gender divide. *The Mobile Gender Gap Report 2020* released in March by GSMA, an association of industry organisation representing interests of mobile network operators worldwide, says that while 79 per cent men own a mobile phone in the country, the number for women is 63 per cent. The gender gap in mobile internet users is a huge 50 per cent, it states. Access to phone and internet is not just an economic factor but also social and cultural. If one family has just one phone, there is a good chance that the wife or the daughter will be the last one to use it, says Parsheera.

States too greatly differ in terms of people that have access to computer or in the know-how to use internet. Himachal Pradesh leads the country in access to internet in both rural and urban areas. Uttarakhand has the most number or computers in urban areas, while Kerala has the most number of computers in rural areas (see 'Regional disparity' on *p*20). Overall, Kerala is the state where the difference between rural and urban areas is the least.

OFFICIAL PUSH FOR DIGITAL

OVER THE past decade, governments have been trying to improve internet access in the country. In 2011, the BharatNet project was launched to connect 0.25 million panchayats through optical fibre (100 MBPS) and connect India's villages. Its implementation began only in 2014. The initial deadline was March 2019 but since only 0.12 million panchayats had been connected by then, the deadline was extended to August 2021.

In 2014, the government launched National Digital Literacy Mission and the Digital Saksharta Abhiyan. The Standing Committee on Information Technology in January 2019 said that both these schemes were similar in design as well as implementation with sufficient scope for creating confusion among beneficiaries. In 2015, the government launched several schemes under its Digital India campaign to connect the entire country. This includes the Pradhan Mantri Gramin Digital Saksharta Abhiyan, launched in 2017, to usher in digital literacy in rural India by covering 60 million households. Its outlay is ₹2,351 crore, but ₹500 crore have been allocated so far. The Standing Committee on Information Technology in January 2019 concluded that the digital literacy efforts of the government are far from satisfactory.

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Regional disparity

There is significant difference among states in their ability to access internet and operate computers

1. Andhra Pradesh

	Rural	Urban
Able to operate computer (in %)	1.5	11.6
Able to use internet (in %)	10.4	29.5

2. Assam

	Rural	Urban
Able to operate computer (in %)	3.7	30.8
Able to use internet (in %)	12.1	46.9

3. Bihar

	Rural	Urban
Able to operate computer (in %)	2.7	20
Able to use internet (in %)	12.5	38.6

4. Chhattisgarh

	Rural	Urban
Able to operate computer (in %)	3.2	22
Able to use internet (in %)	10.6	34.6

5. Delhi

	Rural	Urban
Able to operate computer (in %)	NA	34.7
Able to use internet (in %)	NA	55.8

6. Gujarat

	Rural	Urban
Able to operate computer (in %)	4.4	20.1
Able to use internet (in %)	21.1	49.1

7. Haryana

	Rural	Urban
Able to operate computer (in %)	5.9	29.5
Able to use internet (in %)	37.1	55.4

8. Himachal Pradesh

	Rural	Urban
Able to operate computer (in %)	10.5	28.3
Able to use internet (in %)	48.6	70.6

9. Jammu & Kashmir

	Rural	Urban
Able to operate computer (in %)	3.5	16
Able to use internet (in %)	28.7	57.7

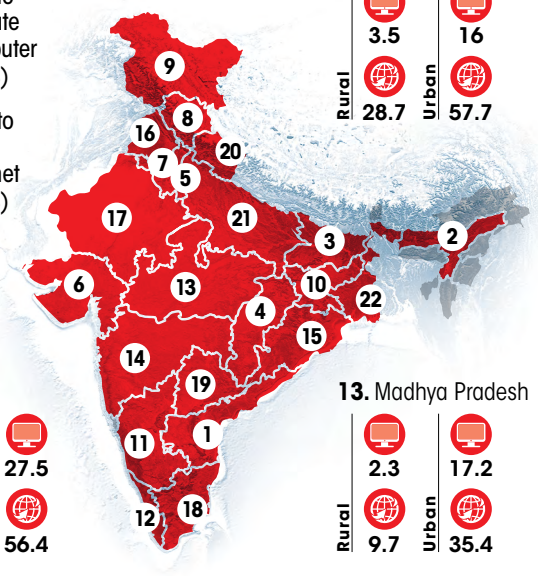
10. Jharkhand

	Rural	Urban
Able to operate computer (in %)	1.3	15.6
Able to use internet (in %)	11.9	40.2

Able to operate computer (in %)

Able to use internet (in %)

(XX) State



11. Karnataka

	Rural	Urban
Able to operate computer (in %)	2	22.9
Able to use internet (in %)	8.3	33.5

12. Kerala

	Rural	Urban
Able to operate computer (in %)	20.1	27.5
Able to use internet (in %)	46.9	56.4

13. Madhya Pradesh

	Rural	Urban
Able to operate computer (in %)	2.3	17.2
Able to use internet (in %)	9.7	35.4

14. Maharashtra

	Rural	Urban
Able to operate computer (in %)	3.3	27.4
Able to use internet (in %)	18.5	52

15. Odisha

	Rural	Urban
Able to operate computer (in %)	1.8	17.2
Able to use internet (in %)	5.8	31.2

16. Punjab

	Rural	Urban
Able to operate computer (in %)	9.4	26.7
Able to use internet (in %)	39.4	57.1

17. Rajasthan

	Rural	Urban
Able to operate computer (in %)	6.4	26.6
Able to use internet (in %)	18.5	49.9

18. Tamil Nadu

	Rural	Urban
Able to operate computer (in %)	11.6	24.7
Able to use internet (in %)	14.4	24.8

19. Telangana

	Rural	Urban
Able to operate computer (in %)	1.6	17.6
Able to use internet (in %)	9.9	41.9

20. Uttarakhand

	Rural	Urban
Able to operate computer (in %)	7	32.5
Able to use internet (in %)	35.2	64.3

21. Uttar Pradesh

	Rural	Urban
Able to operate computer (in %)	4	22.3
Able to use internet (in %)	11.6	41

22. West Bengal

	Rural	Urban
Able to operate computer (in %)	3.3	23
Able to use internet (in %)	7.9	36

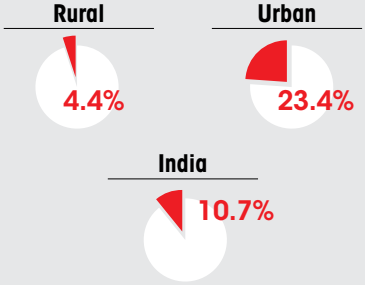
Source: 75th Round of National Sample Survey conducted between between July 2017 and June 2018

GRAPHIC: SANJIT / CSE

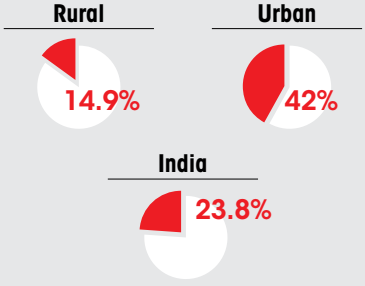
Network strength

Urban and rural India greatly differ in access to internet and computers

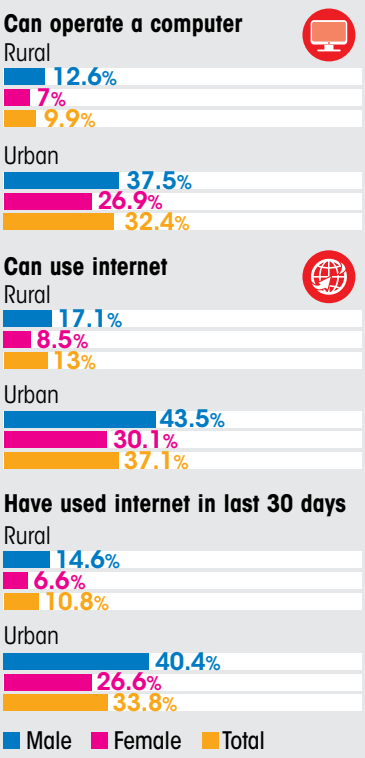
HOUSEHOLDS THAT OWN COMPUTER



HOUSEHOLDS WITH INTERNET FACILITY



PERSONS OF AGE 5 YEARS AND ABOVE WHO:



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Make handsets affordable

Despite cheap data packs, why the huge digital divide in India?

BY SMRITI PARSHEERA

WHY IS it that despite boasting of the world's second largest internet user base and the cheapest data prices India still has a vast digital divide? What can be done about this in the short to medium term?

Adoption of internet is shaped by many factors, including availability and affordability of internet services and the social and cultural norms around its use. Yet, most conversations on the digital divide tend to focus on network availability or other supply-side factors. This includes important questions about the government's obligations to ensure universal coverage, commercial incentives to reach under-served areas and overall state of telecom infrastructure.

However, in many cases, the lack of digital access stems from a much more immediate barrier, namely the absence of an Internet-enabled handset or device. As per *The Mobile Gender Gap Report 2020* by GSMA, 42 per cent of women and 31 per cent men who did not have a mobile phone in India reported that the main reason for this was the cost of the handset.

Until a few years back, the common practice in India was to sell only unbundled mobile phones—where the device is not tied to any particular network, especially in the low cost segment of the market. The launch of the Jio Phone in 2017 changed this trend leading to the rapid adoption of bundled "smart feature phones". While this has certainly helped in addressing the affordability issue, these phones do not support that same functionality as a full-fledged smartphone. This can lead to practical as well as aspirational barriers, particularly given the limited selection of devices available in this range.

One way to marry affordability and choice for consumers could be through the promotion of micro lending schemes to facilitate the purchase of mobile phones by low income users. For instance, in 2017, Vodafone had tied up with the non-profit Hand in Hand to facilitate micro finance loans for the purchase of smartphones by rural women entrepreneurs.

With the COVID situation far from being resolved, the relevance of being online will only grow. Placing mobile devices into the hands of as many users as possible has to be the first step bridge the digital divide. This will require the cooperation of stakeholders at all levels, including the government and device manufacturers. The government should revisit its decision to increase GST on mobile phones to 18 per cent, at least for low-end devices.

(The author is a lawyer and technology policy researcher. She is a Fellow with the CyberBRICS Project)

For complete article, log on to www.downtoearth.org.in

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ONLINE FOCUS

There has been a significant push towards digitalisation from both the government and the private sector, triggered by the government, in the past five years. 2014 saw the launch of National Digital Literacy Mission with the target to train 1 million people in selected districts in 18 months, followed by the launch of Digital Saksharta Abhiyan the same year to train an additional 4.2 million people in four years.

The schemes, say critics, overlapped and were only partially successful (see 'Official push for digital' on *p*19). Internet traffic saw a big jump after the launch of Reliance's Jio phone in 2017, which provided free voice calling facility and data packs in the initial period after its launch. This is corroborated by the Nokia MBiT Index 2020, which shows that data traffic in India has increased by 44 times in past four years.

Still, there is a huge population on the wrong side of the divide, lacking access to a technology widely considered a fundamental right. "Most of them belong to the most vulnerable sections of society," says Parsheera. DTE @kundanpandey158

RELATED STORY
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Silver lining

From real-time monitoring to flying drones, Indian cities are innovating ways to handle COVID-19 biomedical waste

DINESH RAJ BANDELA
NEW DELHI

ONE OF the cornerstones of the fight against the novel coronavirus, which will define how humans survive its aftermath and contain community spread, is the effective handling of biomedical waste—masks, gloves and other protective gears used by COVID-19 patients and health practitioners. Yet, biomedical waste management during the outbreak is daunting as individual households, along with hospitals and medical establishments, become the new primary source and the overall volume of waste increases substantially. In Gurugram, biomedical waste generated due to COVID-19 has increased from 500 kg a day in April to 3,000 kg a day in June, as per Biotic, the company responsible for collecting biomedical waste in the district. News reports esti-

A transfer station in northwest Delhi exclusively for waste generated from quarantined households and testing centres

PHOTOGRAPH: DINESH RAJ BANDELA / CSE

mate close to 500 per cent increase in biomedical waste generation due to the outbreak.

This explains why the Central Pollution Control Board, despite an existing biomedical waste guideline, decided to issue separate COVID-19 biomedical waste guidelines in April, and revised it thrice to keep up with the growing burden. The guidelines broadly suggest that biomedical waste needs to be disposed in yellow packets which will be collected and transported separately to common biomedical waste treatment facility for incineration. It also suggests guidelines on waste handling and precautions for sanitation workers.

While most urban local bodies are following the CPCB guidelines, some are innovating ways to improve the sanitation coverage while reducing costs. Hyderabad, for instance, has roped in 300 members of the disaster response force who are using modified vehicles with jetters to disinfect the entire city. The vehicles are sourced on a temporary basis from the waterworks department. "We are pooling in all available resources with different departments to reduce expenditure and ensure effective sanitation coverage," says Viswajit Kampati, director of the Enforcement, Vigilance and Disaster Management wing of Greater Hyderabad Municipal Corporation.

In Vijaywada, the municipal corporation has employed drones to disinfect containment zones and trained sanitation workers to handle biomedical waste with zero contact. Surat Municipal Corporation is regularly testing samples from sewage treatment plants for traces of COVID-19 virus. The Bruhat Bengaluru Mahanagara Palike has gone ahead and set up a command centre to attend civic complaints and monitor effective waste collection, cleaning of streets and other common places. The centre is also checking unauthourised dumping and burning of garbage in the city.

HOW TO SAFELY DISPOSE USED PROTECTIVE GEARS

HOUSEHOLDS

should keep all used protective gears (masks, gloves, personal protective equipment, head gear and others) in a paper bag for at least 72 hours prior to their disposal as general waste. They should be cut to prevent reuse

QUARANTINED HOUSEHOLDS AND CONTAINMENT ZONES

should disinfect all used protective gears in ordinary bleach solution or sodium hypochlorite solution before disposing it in yellow packets for incineration or deep burial (more than 3 metres from the surface). Sanitation staff must not mix waste from these hotspots with the other localities

COVID-19 ISOLATION WARDS / TEST CENTRES

have to collect their protective gear in separate yellow colour-coded plastic bags, suitable for biomedical waste collection, and hand it over to waste collector engaged by common biomedical waste treatment facility operator at the doorstep and should be incinerated

Source: Central Pollution Control Board

The Navi Mumbai Municipal Corporation has created the real-time Covi Guard dashboard and the Covi Care mobile application to identify areas from where biomedical waste needs to be collected. The app uses remote sensing tools to track quarantined individuals and identify containment zones. In Port Blair, the municipal corporation has started a WhatsApp group where people can request essential services. The platform is also being used to train people in composting of regular waste and other good waste management practices. The city has also started transportation facilities and refreshments for sanitation workers. In Bhopal, sanitation workers have been provided insurance and those working in high-risk zones are being administered chloroquine doses to reduce infection risk. The municipal corporation has also installed foot-operated wash basins at public places and at waste transfer stations. The wash basins are made from discarded tanks.

The situation is not equally promising across the country though. Chennai has had to halt its 162 decentralised composting centres because "all its staff are now engaged in disinfection activities". Similarly, the city's resource recovery and material recovery facilities used for recycling waste are also not operating properly. Several urban local bodies in West Bengal are yet to separately collect waste from quarantined households.

The other challenge is that India has over 57,000 unauthorised healthcare facilities in 2017, as per the 2017 estimate released by CPCB in May 2019. In contrast, the country has nearly 85,000 authourised hospitals. DTE

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Back to basics

The lockdown has made rice farmers reconsider a long-ignored sowing technique

SHAGUN KAPIL
NEW DELHI

WHILE OTHER farmers of his village wondered how to overcome the labour shortage caused by migration of workers during the lockdown, Kewal Singh was without a worry. The 55-year-old farmer from Kothe Amberhar village of Punjab's Ferozepur district did not need to hire labourers to sow rice. He had been doing it himself for the past five years with minimal help.

It was in 2015 that Singh experimented with direct seeded rice (DSR), also called broadcasting seed technique—an alternative way of sowing rice. The traditional and the prevalent way across India is transplanting rice (TPR) seedlings from a nursery to waterlogged fields. But TPR is extremely labour- and water-intensive, unlike DSR.

Inspired by a fellow farmer of his village, Kewal shifted part of his 16 hectare (ha) farmland to DSR in the first year. The yield increased and the input cost reduced by ₹7,000 per ha. He kept bringing more land under DSR every year and this year, when the labour shortage was extreme, he used DSR on his entire farmland.

Sowing by direct seeded rice method is practised only on 10 per sent of land under paddy in India

PHOTOGRAPHS: BY SPECIAL ARRANGEMENT

There is no nationwide official data on how much rice in India is grown through DSR. M L Jat, principal scientist with Mexico-based CIMMYT (International Maize and Wheat Improvement Centre), estimates that about 10 per cent of India's 44 million ha under rice cultivation is through DSR.

In the past few decades, many state governments have been encouraging farmers to move to DSR because it is easier on the environment, but without much success. Most recently, the Punjab government, on April 16, issued a statement citing a Punjab Agricultural University (PAU) study asking farmers to shift to DSR (see 'Overall gains'). Since June, when kharif sowing started, 0.7 million ha has been brought under DSR in Punjab, says the state government, as per media reports. "The government did not try hard enough to popularise DSR all these years. But COVID-19 has done the trick," says B S Rajewal, president of Bharatiya Kisan Union's Rajewal unit in Punjab.

"Bihar is also moving towards adopting DSR. So are Chhattisgarh, Andhra Pradesh, Tamil Nadu and small areas in Madhya Pradesh," says Jat. A study by the Indian Council of Agricultural Research and Indian Institute of Rice Research in 2016-17 says DSR is gaining popularity among the farmers of Raichur, Koppal and Bellary districts of Karnataka where water shortage is acute.

Globally, around 23 per cent rice was directly seeded in 2007, as per the study 'Weed Management in Direct Seeded Rice', published in *Advances in Agronomy* in 2011. Countries have been gradually shifting to DSR. In south Asia and southeast Asia, which produce, supply and consume a large proportion of the global rice, the shift to DSR started in the late 1980s and 1990s, mainly in growing economies such as Malaysia and Thailand as well as in countries where rapid intensification of rice production took place, for example Vietnam, says the study. China shifted to DSR in the 1980s, Korea in 1991, and experiments on direct seeding in Bangladesh started in the 2000s. Much of the shift was due to rising wages and labour shortages.

Overall gains

The direct seeded rice (DSR) technique of sowing has a clear advantage over the prevalent way of transplanting rice (TPR)

Cost of field preparation and sowing

Transplanting rice
₹11,312 per ha

Direct seeded rice
₹5,312 per ha

Yield

Transplanting
8 tonnes per ha

Direct seeded rice
7.8 tonnes per ha

Water required to produce 1 kg of rice

Transplanting
3,000 litres

Direct seeded rice
2,100 litres

Cost of weed and nutrient management

Transplanting
₹625 per ha

Direct seeded rice
₹2,450 per ha

₹6,875 per ha
Total savings in DSR

Source: Comparison of Direct Seeded Rice and Normal Transplanted Rice report by Punjab Agricultural University

WHY ISN'T DSR POPULAR?

Ever since rice cultivation started, farmers across the world followed the practice of broadcasting seeds directly on dry or puddled soils, says Jat. The shift to TPR happened only in the past century primarily for two reasons—seed rate and weeds. "The seed rate was high, with farmers using 100 kg seed per ha under DSR while transplanting rice needed just 15 to 10 kg per ha. Another major factor was the emergence of weeds and the lack of effective weedicides," explains Jat. In transplanting, since the field is waterlogged, weed growth is minimal.

Even in India, the practice of transplanting started only after the Green Revolution. "All the rice grown in the country a hundred years ago was through DSR," says Jat. When Punjab and Haryana shifted from their traditional crops (maize, millet, pulses and oilseeds) to the wheat-paddy cultivation cycle, the change in cropping pattern was to ensure food security for the country and, therefore, neither the Centre nor the states showed concern for the sustainability of the resources. "Rice comes from wild plant spe-

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Compared to the transplantation method of sowing, direct seeded rice technique requires 35 per cent less water

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cies and its cultivation was adopted in naturally flooded areas. So when farmers adopted it in non-naturally flooded areas, they flooded the fields themselves," says Surinder Singh Kukal, dean, College of Agriculture, PAU, explaining how TPR became prevalent even in regions that are not rich in water resources.

DSR BENEFITS

Rice is the major kharif crop of India and is grown in all the major agrarian states, such as Punjab, Haryana, Uttar Pradesh and Bihar. Since groundwater is the main source of irrigation in these states, rice cultivation by TPR has depleted the water table. In Punjab, for instance, the groundwater declined in about 85 per cent of the state between 1984 and 2016, shows Central Ground Water Board data. In such a scenario, DSR can help reduce water consumption by as much as 35 per cent, says the 2011 study in *Advances in Agronomy*. The study was an analysis of 77 published studies from across the globe. It also stated that DSR can reduce labour needs by 60 per cent and the cost of production by US $30 to US $51 per ha.

The transplanting technique is also a major source of methane, a greenhouse gas. The study found that methane emissions were reduced by 6 per cent to 92 per cent in the DSR method, depending on the type of variant used.

There are DSR variants that can be practised as per the agro-climatic and soil conditions. The two main methods are—dry DSR (in which rice seeds are sown by drilling in dry soil) and wet DSR (in which sprouted seeds are sown in wet soil). PAU, which first recommended DSR in 2010, has now suggested a few refinements and called it *tar wattar* (optimum moisture) DSR. This is a modification of wet DSR. In *tar wattar* DSR, the field is laser-levelled and a pre-sowing (*rauni*) irrigation is done. The field is prepared to optimum soil moisture condition and rice is seeded immediately. Herbicides to control weeds are sprayed simultaneously with the help of drill machine. The first irrigation is done 21 days after sowing, which is a major departure from the DSR being tried earlier in Punjab. "The delay in first irrigation promotes deep root penetration and minimises nutrient deficiencies. The three-week post-sowing period covers most of the driest month of June in which no irrigation is done and hence water is saved," says M S Bhullar, principal agronomist, PAU.

BY 2025, ABOUT 20 MILLION HA UNDER RICE IN ASIA WILL FACE WATER SHORTAGE. BEING A STAPLE CROP, THERE IS AN URGENT NEED TO MAKE RICE CULTIVATION MORE SUSTAINABLE

PAU's recommendation for DSR in 2010 was only for medium to heavy textured soils, but demonstrations last year showed the refined DSR technology can work even in sandy loam soils. This has increased the area suitable for DSR in Punjab from 45 per cent to 85 per cent.

However, there are a few drawbacks with DSR. Rain immediately after seeding can reduce availability of soil nutrients and damage the crop. "Germination stopped on at least 30 per cent of my field after the untimely rain on June 4," says Gurbinder Singh Bajwa, a farmer from Punjab's Gurdaspur district, who had sowed rice on 0.8 ha through DSR on June 2. "A crust got formed and to break that I irrigated before the recommended 21 days. It didn't work," he says. Jaskarana Singh Khosa, a farmer of Kothe Amberhar, planted rice through DSR in 8 ha this time, but the crop was destroyed since the machine was faulty and the sowing was too deep.

With DSR, farmers and researchers will also have to work on weed management. "The intensity and diversity of weeds keep increasing. New weeds emerge; so it's likely that the same medicine won't work next time," warns Kukal. Bhullar, however, is optimistic. "Next year will be better. It will take some time for farmers to fully adapt." DTE

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UNDERSTANDING ENVIRONMENTAL LAWS FOR BETTER ENVIRONMENTAL MANAGEMENT

Course date: August 24-30, 2020
Last date to apply: August 10, 2020

COURSE FEES: INR 2000

India has a comprehensive system of regulations to protect its natural environment and the health of its people. From the enactment of Water Act in 1974, a number of laws and regulations have been put into force in this regard. However, the intended purposes of these laws are far from being fulfilled due to various reasons. One of the issues which sterns out is a holistic understanding of the different laws and how they should be looked into in a concerted manner for better environmental management.

Considering the need to fill the gaps, Centre for Science and Environment, is organizing a one week online training course on "Understanding Environmental law for improving environmental management".

COURSE OBJECTIVE

This one week online course has been designed to capacitate the people working in the field of environment and the prospective environmentalist with an objective to develop a better understanding and knowledge of the laws and their interrelationship. This course will also be beneficial for students as well who aspire to develop their carrier in environment field.

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- Better understanding of environmental governance structure of the country, major institution, and their implementation statistics.
- Increased understanding of the obligations of industry and individuals under various environmental laws and regulations and how to meet these obligations.
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- Understanding that environmental compliance is not a financial burden but a clear business opportunity.

WHO CAN APPLY?

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- Students aspiring to work in environment field

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COURSE LINK:

https://www.cseindia.org/understanding-environmental-laws-for-better-environmental-management-10248

COURSE ORGANIZERS

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DIGITAL ILLUSTRATION: AJIT BAJAJ / CSE

LET THERE BE BLUE SKY

The nationwide lockdown due to the COVID-19 pandemic has unwittingly given us a glimpse of what our cities can look like if we wean away from polluting vehicles and industries. Let's make this an everlasting reality

ANUMITA ROYCHOWDHURY
with contributions from
ANANNYA DAS, SAYAN ROY, SHUBHAM SRIVASTAVA, SHANTANU GUPTA, AVIKAL SOMVANSHI, NIVIT YADAV, SOUNDARAM RAMANATHAN

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THE REACTIONS were bewildering. During the 70 days of nationwide lockdown, when people were forced to stay indoors, business shutdowns froze the economy, raising the spectre of job losses and pay cuts, and yet the novel coronavirus (COVID-19) continued to tighten its grip over India, many places across the country revelled in clear, blue skies and clean air. With a lot less traffic on road and closure of factories and industries, suspended particles thinned out from the air within a few days of the lockdown. People were able to see the moon, the stars and sharp contours of trees, hills and monuments without the usual barrier of smog, and breath easier. Places like Delhi and exurbs, where people had become accustomed to intermittent closure of industry, construction cites, suspension of schools and the use of N95 masks to battle winter pollution even before COVID-19 originated in Wuhan, witnessed history. The lockdown, imposed in phases from March 23, did not help much to flatten the COVID-19 infection curve, but it did bend the pollution curve. And there is hard evidence for this change.

During the lockdown, the levels of particulate matter 2.5 (PM2.5) declined dramatically across the country. PM2.5 are fine particulates, smaller than 2.5 microns, that can go deep into the lungs and cause respiratory illnesses, heart diseases and even cancer. During the lockdown, their levels in Delhi, Mumbai, Kolkata, Chennai, Hyderabad and Bengaluru dropped by a phenomenal 45-88 per cent. The drop in Delhi and the National Capital Region (NCR) was 66-79 per cent, shows a study by Delhi-based Centre for Science and Environment (CSE), which conducted granular analysis of real-time air quality data recorded by the monitoring stations of the Central Pollution Control Board (CPCB) in these cities. PM2.5 levels were at their lowest possible range at several regions (see 'PM2.5 drops by 45-88%'.). Air cleaned

up so much that the impact of pre-monsoon burning of crop residues during April in Punjab, Haryana, Rajasthan and western Uttar Pradesh on the air quality of Delhi-NCR went unnoticed by the general public, though it showed up in the air quality data.

Similarly, nitrogen dioxide (NO2), which comes primarily from road transport and is linked to chronic obstructive pulmonary disease, asthma and hypertension, plummeted with the onset of the lockdown. Bengaluru saw a 55 per cent drop in NO2 levels, Delhi 49 per cent, Hyderabad 30 per cent, Kolkata 65 per cent and Mumbai 70 per cent from the week preceding the lockdown 1.0 (see 'NO2 drops by 50-70%').

The most dramatic evidence of traffic off the roads was flattening of the hourly change in NO2 levels, which is present in high concentrations during the peak hour traffic periods. CSE analysis shows morning peak for NO2 collapsed in Mumbai and Delhi by 78 per cent and 60 per cent. Kolkata and Bengaluru saw 53 per cent drop in morning peak, while it was 29 per cent for Hyderabad. Likewise, evening peak for NO2 dropped in Mumbai by 77 per cent and in Bengaluru by 71 per cent. Delhi, Kolkata and Hyderabad saw a drop of 60 per cent, 55 per cent and 50 per cent respectively (see 'NO2 peak flattens', *p*32).

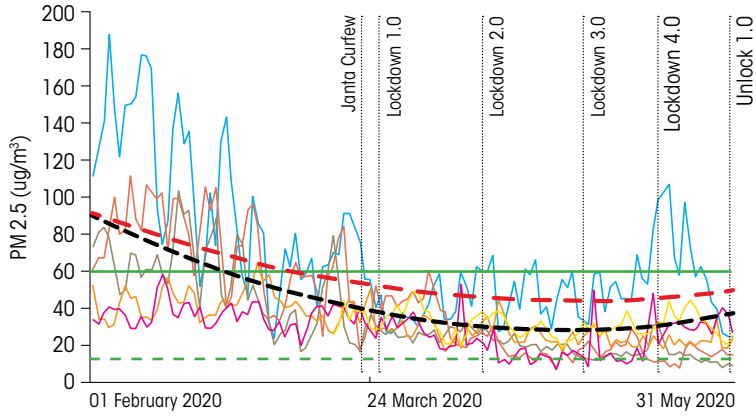
BUT THE CHANGES DIDN'T LAST

Pollutants returned as the country opened up during lockdown 4.0. CSE analysis shows that PM2.5 levels increased by two to four times in all the six mega cities during these 14 days compared to the previous three phases. Delhi-NCR alone experienced a rise of PM2.5 levels by four to eight times. The NO2 levels increased in Chennai by 77 per cent, in Delhi by 41 per cent, in Mumbai by 21 per cent and in Hyderabad by 16 per cent. Kolkata, however, registered a drop of 10 per cent due to cyclone Amphan that hindered reopening of the city. Overall, the trend established the impact of traffic on the build up of air pollutants in our cities.

Yet, air pollution remained a complex story to narrate as certain disturbing trends continued. One is the increased levels of ground-level ozone, which irritates the airways and can worsen respiratory diseases like bronchitis and asthma. It is not directly emitted by any source but is produced when pollutants, nitrogen oxides (NOx) and volatile organic compounds (vocs), react with each other under the influence of sunlight and temperature. It exceeded the eight-hour average standard in several cities during the lockdown (see 'Ozone

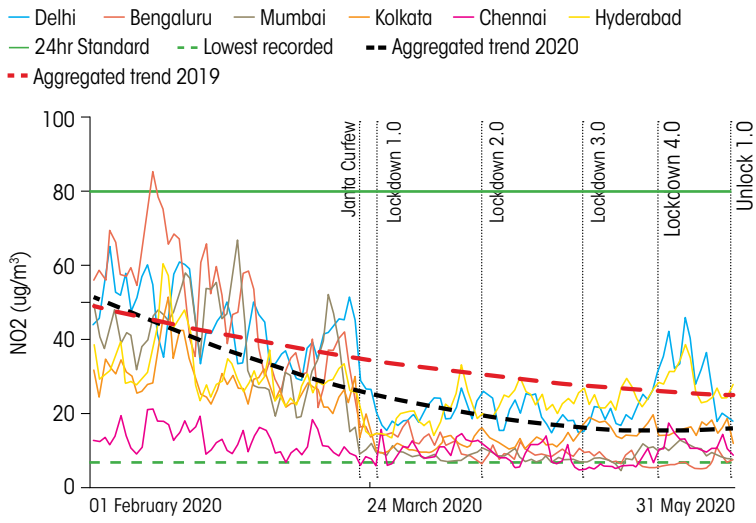
PM2.5 drops by 45-88%

Daily trends through the lockdown in six mega cities show PM2.5 levels were at their lowest range at several regions



NO2 drops by 50-70%

Daily trends through the lockdown show a massive reduction in this road-transport related pollutant across six mega cities



Source: Pandemic and Mobility, a Centre for Science and Environment paper

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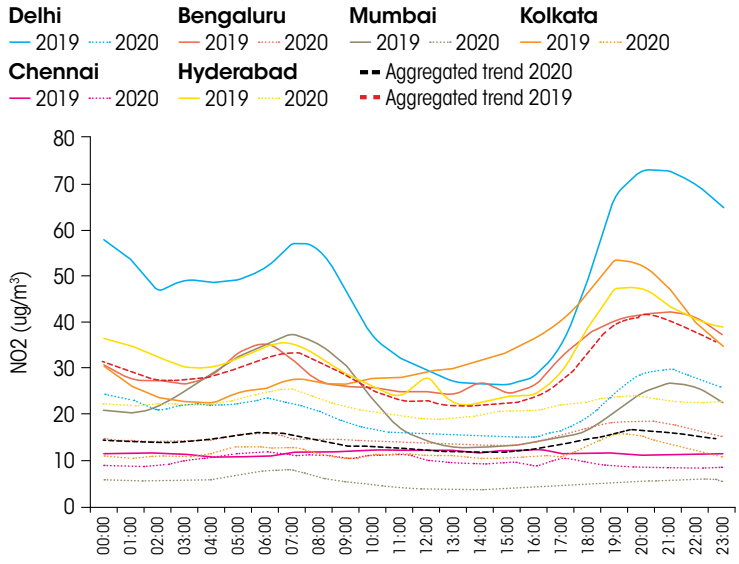
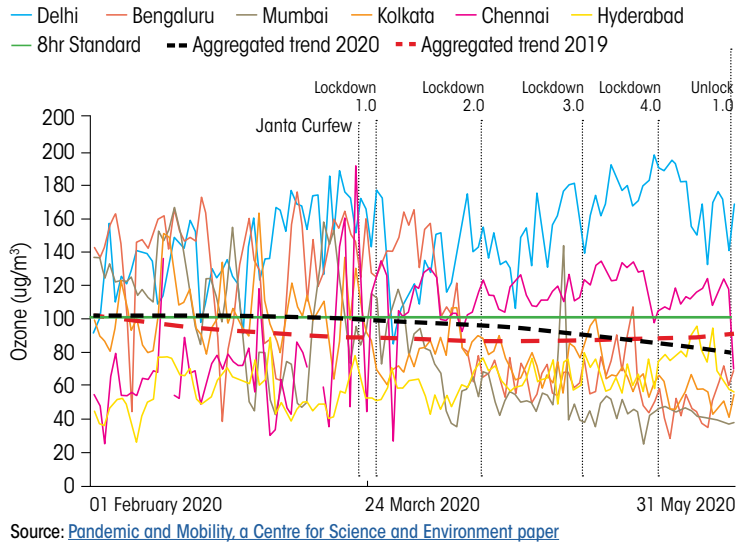
NO2 peak flattens

Peak pollution collapsed during the lockdown in all mega cities, except Kolkata where cyclone Amphan hindered reopening



Ozone remained above standard

Some pollution that continued from power plants, burning of solid waste and vehicles kept churning out the pollutant



Source: Pandemic and Mobility, a Centre for Science and Environment paper

anomaly', *p*33). However, its levels were largely lower than the levels recorded during the spring and summer of 2019.

WHAT MADE THE DIFFERENCE

The lockdown provided an otherwise improbable opportunity for studying the influence of key sources of pollution on the ambient air quality of a city. So, in Delhi-NCR, CPCB rushed to estimate how different pollution sources may have contributed to the clean up of the region's air immediately after lockdown began. Based on the available studies on source apportionment and pollution inventory in Delhi, CPCB has estimated an overall reduction of 35-40 per cent in particulate pollution during the period. It says 10 per cent of the reduction was due to closure of industries, 15 per cent due to reduced transportation and 10-15 per cent due to less dust generated by road traffic. Other activities like burning of less refuse and reduced activities at the airport have also contributed to Delhi's clean air.

CSE conducted an in-depth study to assess this scale of change made possible in Delhi-NCR by industries and vehicles. On an average, key industry clusters of Sonipat, Panipat, Gaziabad, Gurugram, Faridabad, Alwar and Bhiwadi that surround Delhi-NCR consume 1.41 million tonnes of coal annually, whereas their dependence on cleaner fuel like natural gas is limited to just 0.22 tonnes. Sonipat is in fact the largest coal-consuming district and has the highest overall pollution load among all the seven regions. Some of its hotspot areas contribute between 35 and 80 per cent of the pollution load of the district. This pollution was nearly eliminated during the lockdown.

But power plants remained a challenge. While all coal-based power plants have been shut down in Delhi, those in NCR did not meet the initial 2019 deadline to install pollution control devices. These are not expected to meet the extended deadline of 2022 either. It is thus clear that to sustain this temporary reductions in noxious emissions, dirty fuels in industry, including coal, will have to be replaced with cleaner natural gas. But the problem is dirty fuels have outpriced clean fuels. Coal is under the lowest slab of 5 per cent under the good and services tax (GST), which benefits industries. It is also under the open general licensing so that coal can be imported. But clean fuel like natural gas, which is outside

GRAPHIC: SANJIT / CSE

the ambit of GST so that state governments can earn revenue from it, is heavily taxed at over 40 per cent.

Similarly, the gains made from reduction in vehicular emissions is not that straightforward. While a large number of vehicles disappeared from the roads, a major change was in the number of trucks entering Delhi every day. With radio frequency identification (RFID) systems at 13 key entry points for cashless collection of environment compensation charge, it was possible for the Environment Pollution (Prevention and Control) Authority to track the number of trucks entering Delhi on a real-time basis. They say there was a 91 per cent drop in trucks and commercial vehicles that entered Delhi during April compared to December-January. This is a dramatic reduction keeping in view that in 2015 CSE found that unregulated entry of trucks was responsible for 30 per cent of the vehicle-generated particulate load in Delhi. Moreover, nationwide introduction of Bharat Stage-VI emisisons standards and fuels that make vehicles 70-90 per cent cleaner coincided with the lockdown phase.

Additionally, during the lockdown, most people worked from home. It is estimated that 40 million travel trips made daily in Delhi came to a near halt. This led to a massive decline in emissions. With slackening of lockdown, emissions are rising again.

While regional experiences with pollution sources are expected to vary, Delhi-NCR mirrors the change. COVID-19 outbreak and the lockdown have disrupted lives and lifestyles across India at an unbelievable scale and speed. But to ensure that our skies remain blue, we continue to breathe easy and our lungs remain clean, we need to implement some action agenda on a priority basis and at a similar scale and pace.

First, curb vehicular pollution. The government must ensure there is no slip in the ongoing implementation of the BS-VI emission norms due to the pandemic. It should in fact use this opportunity as a double-win strategy, and scrap old heavy vehicles and replace them with the BS-VI-compliant ones. It must introduce cleaner battery vehicles for paratransit and public transport; mandate and pay for their revival starting with autorickshaws, taxis, buses and trams. It must use global best experiences of ensuring safety and financial stimulus to augment public transport in cities—bus, metro and light-rail. Cycle and walk must also be part of the "new-normal". So, incentivise people to reduce travel and take cycles to work.

Second, to curb industry and power plant pollution, the government must urgently bring natural gas under GST to reduce tax burden on those using it and to incentivise clean fuel over dirty. Remove coal from open general license so that imports can be regulated and its use can be monitored. Ensure that power plants across the country meet the 2015 emission standards—introduce "First-Run" policy to allow only those plants that meet the new standards to sell electricity first, so that only clean plants get the priority to sell electricity. Third, speed up action on solid waste management to stop its burning and eliminate solid fuels for cooking.

OZONE ANOMALY

DESPITE THE clean up, summer air quality during the lockdown remained complex as some pollution continued from power plants, burning of solid fuels, reduced number of vehicles and waste burning. Volatile organic compounds also have natural origin. These toxic and volatile gases together contributed towards ozone build up, though at reduced rate. All mega cities except Hyderabad exceeded the ozone 8-hour standard at least on one day at one of its stations during the lockdown. The city-wide average exceeded the standard on four days in Delhi and eight days in Kolkata. But Delhi and Kolkata had 67 days (every day of lockdown 1.0-4.0) and 17 days when at least one station exceeded the standard. Not acknowledging this can massively undercount the problem. Almost all stations that exceeded the standard did so for at least two continuous days. Dr Karni Singh Shooting Range station in Delhi exceeded the standard for 41 contiguous days.

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Mobility redefined

The pandemic offers probably the last chance to reform our public transport and make way for walking and cycling

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FEAR OF infection and the need for social distancing have altered the way we used to move around just a few months ago—in the pre-COVID times. Since then our activity and mobility patterns have changed dramatically, so much so that it has led to a near-collapse of the public transport in cities.

CSE's analysis of Google Mobility Data for the period between February 15 and May 16 shows that activities in residential areas have increased by 29 per cent but visits to workplaces have reduced by 60 per cent and to retail and recreation by 84 per cent. Grocery and pharmacy visits also indicate a drop, though marginal. (see 'COVID-19 has altered our activities').

The data also shows a massive drop in visits to transit stops and nodes as the use of public transport has plummeted across the country. COVID-19, it seems, has stigmatised the public transport. And this has provoked more worries. Since opening up of the economy is not possible without transport, the fear is it might lead to an increase in the number of cars and two-wheelers on the roads, making the cities even more congested and polluted.

Clearly, there is an urgent need to organise mobility services. Here are a few steps that can help the authorities do this in a prudent manner.

REINVENT PUBLIC TRANSPORT

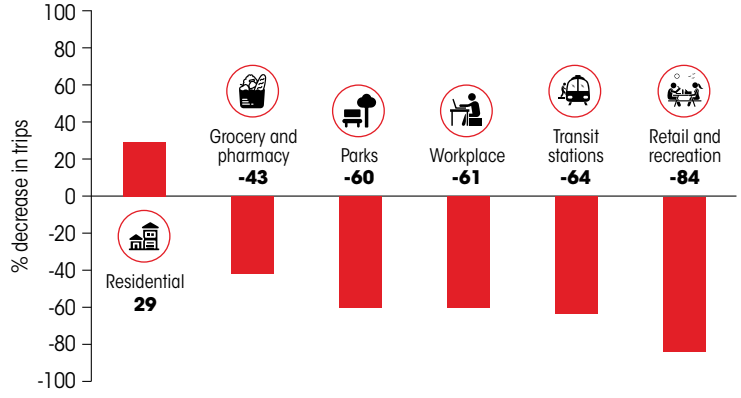
Public transport ridership came to a halt due to complete lockdown in India. Other countries that did not impose a lockdown and kept their public transport functional have also faced drastic reduction in ridership—by as much as 70 to 90 per cent. This calls for an urgent need to rebuild confidence in the public transport.

State transport corporations in Delhi, Mumbai, Kolkata, Bengaluru, Bhubaneswar and other cities have already begun adopting COVID-19 guidelines on hygiene and sanitisation and physical distancing through reduced occupancy, cashless transaction, separate boarding and alighting, health checkup and communication. But this has added to the cost of operation as earnings have plummeted due to low occupancy. Besides, several state transport corporations are already facing bankruptcy.

The private bus service providers who form a sizeable part of the public transport

COVID-19 has altered our activities

Activities in residential areas have increased, but visits to workplaces, retails and transit stations have reduced

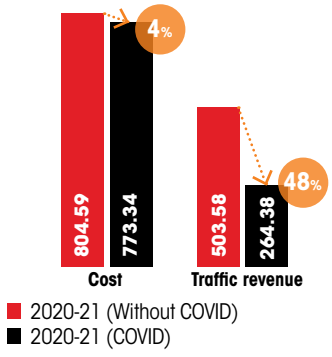


Source: Google Mobility Report (from March 18, 2020 till April 30, 2020)

Bus transport too bears the brunt

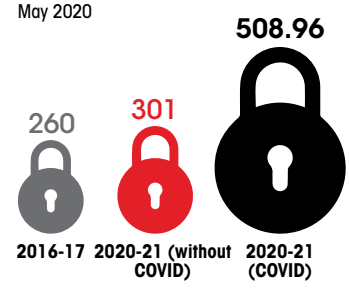
Low occupancy has hugely slashed reduced revenue earning by bus operators

Impact of COVID-19 **lockdown on total cost and traffic revenue compared** to normal operations (in ₹ 100 crore), 2020-21



Impact of COVID-19 **lockdown on annual VGF requirement*** (in ₹ 100 crore) in 2020 values, 2020-21 **69% increase**

Note: *Estimated for period from March 2020 to February 2021 considering regular operations from May 2020



Source: Laghu Parashar, 2020, Reinventing Public Transport and Mobility in the "NEW NORMAL", GIZ, at Centre for Science and Environment, Webinar, May 25; **Note:** *Estimated viability gap funding from March 2020 to February 2021 considering regular operations from May 2020

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MASS TRANSPORT GETS A BOOST

Governments worldwide are working on specific fiscal packages to revive public transport systems

HONG KONG government has designed the most extensive relief package for public transport. According to Alok Jain, managing director of Hong Kong-based Trans-consult Asia Ltd, transport businesses in Hong Kong experienced a drop of 40-60 per cent in fare incomes due to the pandemic. Its package benefits both customers as well as public and private operators. This includes 20 per cent fare subsidy to commuters for six months, employment support scheme for operators with the government providing 50 per cent of their wages, fuel subsidy to franchised buses, ferries, trams, taxis, and public light bus operators; and one-time subsidy to private buses, school buses and hired car owners.

LONDON has introduced a £1.6 billion (about $2.02 billion) funding and financing package after the pandemic to protect and continue its public transit services

THE US has created a $25 billion fund under the Relief Act for Transit Services to be managed by the Federal Transit Administration

FRANCE government has introduced a cash relief fund of €50 million (over $56 million) for road-based passenger transport in the bus and tourism sector, including social security contributions

CHINA's transport ministry in February announced it will wave road toll fees, worth over ¥140 billion (about $20 billion), until the pandemic ends

KAZAKHSTAN has introduced tax and social payment exemptions for various sectors including transportation

POLAND has introduced a government assistance package for leasing financing for transport companies

GHANA AND NIGERIA are providing support to public transport operators. In Nigeria, the government set aside funds to resolve challenges in this sector. Along with banks, it is designing relief for transporters. In Lagos, subsidy is being given to transporters, including soft loans to operators

fleet in cities, have also been badly hit. In Kerala, 70 per cent of private bus owners are reportedly reluctant to resume operations with a low occupancy. In Kolkata, private bus associations have proposed three times the fare to compensate for the loss in ridership.

Those offering intermediate transport and shared mobility services have already started to repurpose their vehicles for emergency health services, delivery of groceries and essentials and courier service, or are offering fixed route services.

The pandemic situation has dealt a major blow to the country's precarious public transport system. There is already a huge shortfall in the number of buses needed in urban India. There are only 48,000 buses against the requirement of 188,500, as estimated by the Union Ministry of Housing and Urban Affairs (MOHUA). Even this capacity has now been reduced by more than half, and has also led to equity concerns over commuting needs of lower income groups who are in an urgent need of livelihood security.

But helping the public transport sector recover from the current crisis cannot be done in a business as usual manner. Estimates by German development agency, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), show that while the overall cost of operations of bus transport has reduced by 4 per cent during the lockdown, the traffic revenue has reduced by a massive 48 per cent. This has created a 69 per cent increase in the annual viability gap funding requirement of bus transport agencies (see 'Bus transport too bears the brunt', *p*35). Poor bankability of state transport corporations, limited revenue sources with urban local bodies and disproportionate share of transport-related funding for road infrastructure further aggravates the challenge.

While an immediate bailout package is needed to tide over the crisis, well-designed investment plans in the public transport infrastructure, its digital

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Save water

- Repair leakages
- Install low-flow showerheads or take bucket baths
- Turn off the faucet in between washing dishes, brushing, bathing, car wash, etc.
- Harvest rainwater

Save nature

- Planting more trees help keep the Earth cleaner and greener. More trees mean improved air quality, climate, and biodiversity
- Renewable sources of energy are constantly replenished naturally. Sources such as solar, hydroelectric, or wind energy, to name a few, can drastically reduce carbon footprint

Reduce, Reuse, Recycle

- Say NO to plastic. Avoid using plastic bottled water and carry eco-friendly shopping bags
- Segregating waste and using organic waste as compost helps improve soil quality
- Donating or recycling electronic gadgets helps conserve natural resources, avoids air and water pollution, as well as greenhouse gas emissions
- Purchase reusable items instead of disposable ones

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management, technology transition, electric mobility and infrastructure development for integrated services are immediate opportunities for directing the economic stimulus. The authorities can also learn from the experience of other countries (see 'Mass transport gets a boost', *p*36)

SUPPORT WALKING, CYCLING

To maintain physical distancing norms, the demand for contact-free transport—walking and cycling—has caught the public imagination. Estimates show that over the past few months, the share of walking trips has increased and is more than driving trips. This is also evident from the survey conducted by CSE, which found an increased preference for walking and cycling immediately after the lockdown was imposed and also in the long run (see 'Changing facet of travel' on *p*39). This is an opportunity to scale up micro-mobility for shorter trips.

Cycling and walking infrastructures for shorter trips can thus make a big difference in cities across the country. As per the Census 2011, some 47 per cent of daily trips in urban India are by walking and cycling. In NCR, the share is 40 per cent and for the National Capital Territory (NCT) of Delhi, it is 37 per cent (or more than one-third of daily trips in the region). In fact, across urban India almost 60 per cent of the daily trips are within five kilometres. The share is almost 47 per cent for NCR and 48 per cent in NCT.

Another estimate from MOHUA report shows that the share of walk and non-motorised transport trips is 41 per cent in Delhi, while 80 per cent of all trips is made within six kilometres.

Yet, actual public funding remains narrowly focused on the construction of car-centric roads and highways. Data on the setting up of smart cities, accessed from MOHUA in February 2019, shows that footpath and non-motorised transport infrastructure accounted for only 7 per cent of the funds spent; public transport accounted for 17 per cent of the funds, whereas 50 per cent of the funds was spent on road and highway infrastructure.

This needs to be reversed to prioritise micro-mobility on a neighbourhood scale and at a network scale across the cities (see 'Walking, cycling gets space', *p*40).

A 2019 ESTIMATE SHOWS THAT STRUCTURES FOR FOOTPATHS AND NON-MOTORISED TRANSPORT ACCOUNT FOR ONLY 7% OF THE FUNDS SPENT; PUBLIC TRANSPORT ACCOUNT FOR 17% OF THE FUNDS, WHEREAS 50% OF THE FUNDS IS SPENT ON ROADS AND HIGHWAYS

PLAN WELL, PLAN COMPACT

Fear of contagion has made many weary of crowded cities. There is a growing anxiety that high population density will increase human contact and lead to more infections and deaths. Some new studies on the contrary have reinforced that well-planned cities with high population density and with walking and cycling connectivity are needed to secure economic wellbeing as well as environmental and health protection, especially during the times of a pandemic.

A recent report by Tod Litman of Victoria Transport Policy Institute, Canada, states that the risk is actually associated with "crowding" in terms of the number of people per unit of space and not "density", which is the number of people per unit of land. Many dense and highly urbanised places such as Hong Kong, Japan, Singapore and South Korea have been more successful at reducing COVID-19 transmission and deaths.

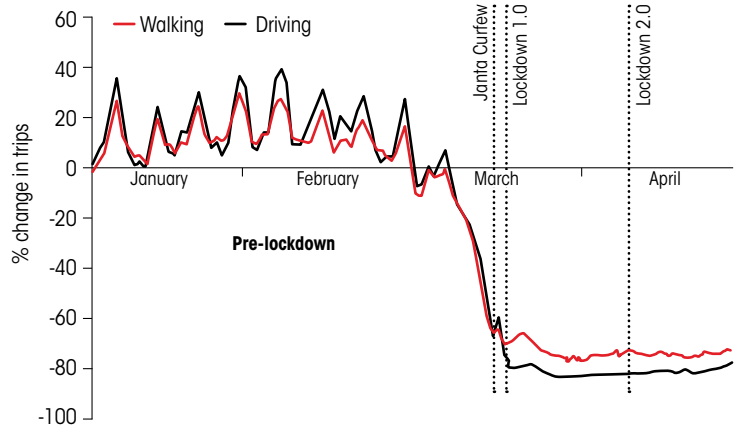
A compact city with walking and cycling and public transport access can save 10-30 per cent of the transport cost, reduce travel time, increase productivity, reduced traffic casualty rates, use up less land for parking and allow energy savings and emissions reduction. A 2016 World Bank study estimates that an extensive sprawled urban development model in India would impose an additional cost in the range of US $330 billion to $1.8 trillion per year by 2050, or 1.2-6.3 per cent of the GDP, as compared to a better managed urban development model. Compact cities perform economically better than sprawled city.

CHANGING FACETS OF TRAVEL IN COVID TIMES

The Centre for Science Environment carried out a rapid perception survey in Delhi and the National Capital Region on the changing commuting choices of middle- to high-income groups because of the pandemic. This is what it has found:

HEALTH SAFETY TOPS THE RANK: Health safety is of top concern followed by road safety, availability of mode options, comfort, distance of trips, cost of journey and environmental consciousness. Only high-income group ranks comfort above all else.

Soon after the lockdown was imposed, people showed higher preference for walking than driving



Source: Pandemic and Mobility, a Centre for Science and Environment paper

GREEN SIGN FOR MASS TRANSPORT, WALKING, CYCLING: Within six months of lockdown, preference for metro ridership will decline to 16 per cent from 37 per cent during the pre-lockdown level. The share of cars and two-wheelers will increase to 47 per cent from 35 per cent, while that of walking and cycling will increase to 12 per cent from 4 per cent.

However, over the next one to two years, the preference to use bus and metro services will regain and the share of ridership will increase to 47 per cent from 44 per cent. Intent to use personal vehicles shows an arrested trend and will reduce to 31 per cent from 35 per cent. The share of walking and cycling will however increase to 9 per cent in the long run from 4 per cent during the pre-lockdown period.

CAR OWNERSHIP TO INCREASE ONLY IN SHORT-RUN: Only about 23 per cent of the respondents have said they may buy a vehicle for safety reasons in the near future. Some 36 per cent of the 43 per cent who do not own any vehicle said they do not wish to own any vehicle in near future.

PREFERENCE TO RISE FOR HIGH-QUALITY PUBLIC TRANSPORT: Most respondents, as many as 73 per cent, say they would prefer to move to the public transport if it offers high quality services. About 38 per cent prefer public transport for easy connectivity, 23 per cent each for cost effectiveness and sustainability, and 16 per cent to avoid traffic.

TRAVEL DISTANCES TO INFLUENCE CHOICE: For those living within 5-10 km of their workplaces, the use of cars is expected to increase to 32 per cent from 20 per cent at pre-lockdown level; the use of Metro to decline to 10 per cent from 30 per cent; and the use of paratransit vehicles to increase to 15 per cent from 10 per cent. For those living within 5 km, car usage will reduce to 16 per cent from 23 per cent; Metro usage will reduce to 5 per cent from 16 per cent, while the interest in walking and cycling will increase to 43 per cent from 14 per cent.

PUBLIC TRANSPORT NODES WILL INFLUENCES CHOICE: Most in NCR do not have convenient access to public transport. Close to 40 per cent do not have access to bus stops within 500 m and 69 per cent do not have access to Metro within 500 m. Only 34 per cent have access to a bus stop within 200 m and 11 per cent have access to Metro within 200 m. Only paratransit vehicles like autos are available widely and closely.

BEHAVIOURAL CHANGE TO FOLLOW: The middle- to high-income groups have shown strong preference for work from home. Some 54 per cent have opted to work from home; 34 per cent for flexi-timing.

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REDUCE NEED FOR MOBILITY

One of the biggest learning from the COVID-19 crisis has been the lifestyle adjustment to work from home (WFH) to reduce the need for travel. To practise physical distancing, institutions and offices have maximised the use of digital platforms. There are also several other benefits of WFH, which include saving of rent for office spaces, reduction in associated operational costs and increase in productive time due to less commuting.

Some companies have already expressed their intent to move to WFH permanently. Retail giants like Amazon and Walmart, telecommunications companies like AT&T; software firms like SAP; management consultants like PwC and life insurance companies like Guardian Life Insurance have all announced their plans to re-skill their employees for digital working. Infosys is setting up a "digital economy aspirations" lab. Google and Facebook are planning to allow employees to WFH. Tata Consultancy Services is planning to allow 75 per cent of its employees to WFH by 2025. Professional services network Deloitte has reported that WFH has in fact boosted individual employee productivity.

As per data available with Census 2011, some 24 per cent of Indians already work from home. In 2016, the Department of Information Technology of the Government of India launched a scheme as a part of its business process outsourcing promotions to incentivise WFH for tier-2 and tier-3 cities in the country.

However, studies such as the one by the CEPT University, Ahmedabad, carried out in Bengaluru indicate that WFH does not necessarily reduce the number of total trips in a day. It changes the peak time travel, but increases overall social trips after work. This means along with reducing work trips, it is important to price automobile trips through measures like hiked parking price. Models like low emission zones where polluting vehicles are restricted or deterred from entering should also be replicated to maximise the gains from this initiative.

A new study from GIZ shows that post the pandemic the current dominant idea of having office hubs in central business district with large concentration of office spaces will change substantially. There will be less demand for office spaces due to growing WFH culture. In fact, the demand for larger homes will increase to accommodate work stations. This will transform urban form, travel and the real estate industry.

India is reopening the economy to secure jobs and livelihoods to end the human misery unleashed by the pandemic. Public transport and safe access are non-negotiable. The pandemic has indeed re-emphasised the need for equity in transportation systems, public spaces and street spaces for safety and accessibility for all. DTE

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WALKING, CYCLING GETS SPACE

To contain the spread of COVID-19 and to stem rapid increase in personal transport modes, global cities are expanding non-motorised transit infrastructure

Mayor of London has rolled out the "London Streetscape" programme to accommodate a 10-fold increase in cycling and five-fold increase in walking during the pandemic. This includes wider footpaths and cycle tracks, pedestrianisation of streets and reclaiming parking spaces to make cycle tracks. An extensive cycling network has been mapped out and newer car-free zones have been identified. Congestion charges are scheduled to increase. Work-from-home is the supportive strategy to restrain auto-mobility.

Several cities are seeing a boom in the use of cycling amid the lockdown. Rapid increase in usage and sale of bicycles has been reported in the UK, other European countries and the US. City bike counts have increased by 74 per cent to 470 per cent in cities including Melbourne, New York, Philadelphia, Chicago, Shenzhen, Edinburgh, Glasgow, Manchester and Wuhan. Several other cities including Melbourne, Auckland, Milan, French cities, New York, California among others are expanding city-wide cycling and walking network.

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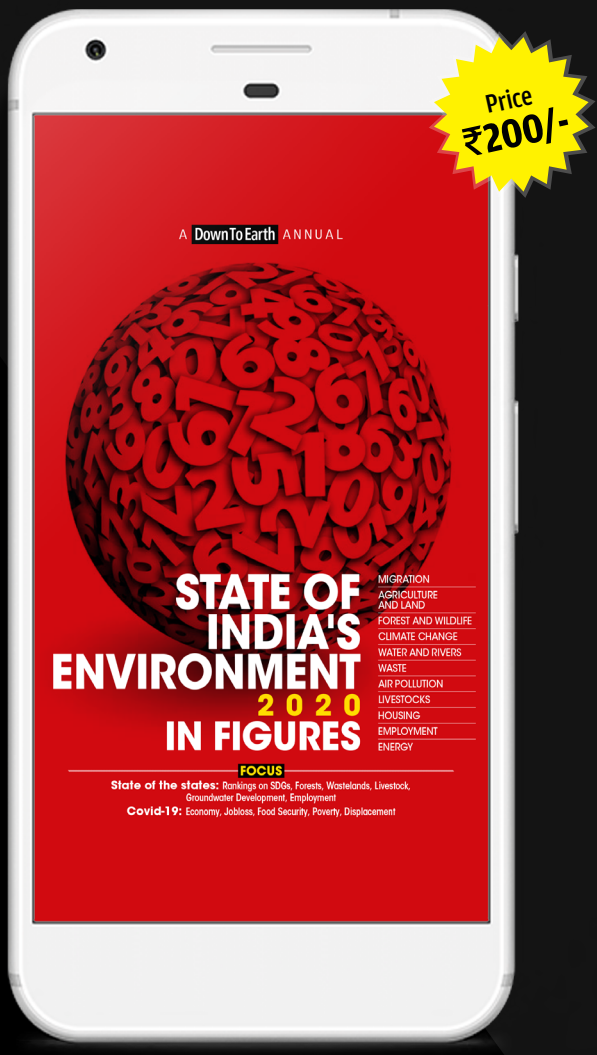
BOOKS



STATE OF INDIA'S ENVIRONMENT 2020 IN FIGURES

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A healthcare worker collects a swab sample from a woman during a medical campaign to trace coronavirus

PHOTOGRAPH: REUTERS

CORONA 2.0

The next coronavirus is round the corner. But scientists don't know when, and how it will explode

ISHAN KUKRETI

THERE HAS always been a declaration from the World Health Organization (WHO) about when a pandemic would end. In August 2010—when the last pandemic struck us, the H1N1—world's apex agency declared: "The world is no longer in Phase 6 (full-fledged pandemic) of the influenza pandemic". The H1N1 virus had largely run its course." But as we enter the eighth month of the COVID-19 pandemic, a similar declaration seems a far cry. Unlike H1N1, the current one is far from over; it is setting records in terms of spread. So, how will the world will handle such pandemics in the future.

The H1N1 pandemic lasted 15 months, and arguably, it is the shortest pandemic spell in recent history. The COVID-19 pandemic, by far, has turned out to be unbridled and deadly, and has given no hope of a slowdown. It could beat historic records, as daily record cases show. As of July 8, 2020, more than 180 countries reported new cases by the thousands every day. But no fresh academic articulation of the end of the COVID-19 pandemic has caught people's attention. Rather, there seems to be a certain feeling that many more such pandemics will be striking us. But are we prepared?

Purely on medical terms, the

current situation is no different from previous pandemics. In 2009-10, there was utter confusion over the development of vaccines and medicines for the H1N1 pandemic. After that, the world realised the grievous slow process of vaccine development. The current situation is stalking us now.

But the response to the current pandemic has only reiterated the fact that the world is still sleeping, including the scientific establishment, and ignoring that these outbreaks are outbursts of our already misaligned relationship with nature. This issue is fast getting global recognition. We were already warned that pandemics were just round the corner, and like the COVID-19, it would also originate from animal sources. Last fortnight, the United Nations Environment Programme (UNEP) released a report *Preventing the Next Pandemic: Zoonotic Diseases and How to Break the Chain of Transmission*. This is the first such report that focused on the environmental side of the zoonotic dimension of disease outbreaks—about 60 per cent of known infectious diseases in humans and 75 per cent of all emerging infectious diseases are zoonotic in nature. COVID-19 may have killed over half a million people, but around 2 million people die each year due to zoonotic diseases. "Most of these deaths occur in poorer countries," says the UNEP report. Zoonotic diseases have resulted in loss of more than US $100 billion of economic activity in the past two decades. "Pandemics are devastating to our lives and our economies, and as we have seen over the past months, it is the poorest and the most vulnerable who suffer the most. To prevent future outbreaks, we must become much more deliberate about protecting our natural environment," says UNEP executive director Inger Andersen.

The planet is brewing under a deadly cocktail of many environmental ills. "Pandemics such as the COVID-19 outbreak are a predictable and predicted outcome of how people source and grow food, trade and consume animals, and alter environments. Like, climate change is facilitating spread of zoonotic diseases. Climate change is a major factor in disease emergence. The survival, reproduction, abundance and distribution of pathogens, vectors and hosts can be influenced by climatic parameters affected by climate change," says the UNEP report.

The UNEP assessment authoritatively argues that climate change would particularly affect diseases transmitted by insects, ticks and other arthropod vectors. Warmer temperatures will increase the vector population size and distribution, along with the season duration when infectious vector species are present in the environment. Erratic weather events will have an impact on the transmission of diseases as well. For instance, in 2010 in Africa, an outbreak of Rift Valley fever, a mosquito-borne zoonotic disease, occurred with higher than average seasonal rainfall. The report stated that emerging diseases in Brazil showed a relationship between infectious diseases outbreaks with extreme climate and human-induced events.

The melting of permafrost in the Arctic and sub-arctic region can significantly transform soil structures, vegetation and habitats. "Degradation of the permafrost can expose historic burial grounds, enabling the revival of deadly infections from the past. Rising temperatures increase the risk of zoonotic diseases in the vast Republic of Sakha (Yakutia), which makes up a fifth of Russia's territories," says the report. "Humans are changing zoonotic disease systems and increasing their impacts in many different inter-linked ways through habitat encroachment, human population pressure and settlement, intensive agriculture, forest loss and degradation, global trade and travel, climate change," says Bethan Purse, an ecologist with the UKs Centre for Ecology and Hydrology, an independent not-for-profit research institute. The urgent call is to understand how these changes bring people in closer contact with animals and alter the dynamics of diseases. DTE

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HUMANS ARE CHANGING ZOONOTIC DISEASE SYSTEMS AND INCREASING THEIR IMPACTS IN MANY DIFFERENT INTER-LINKED WAYS

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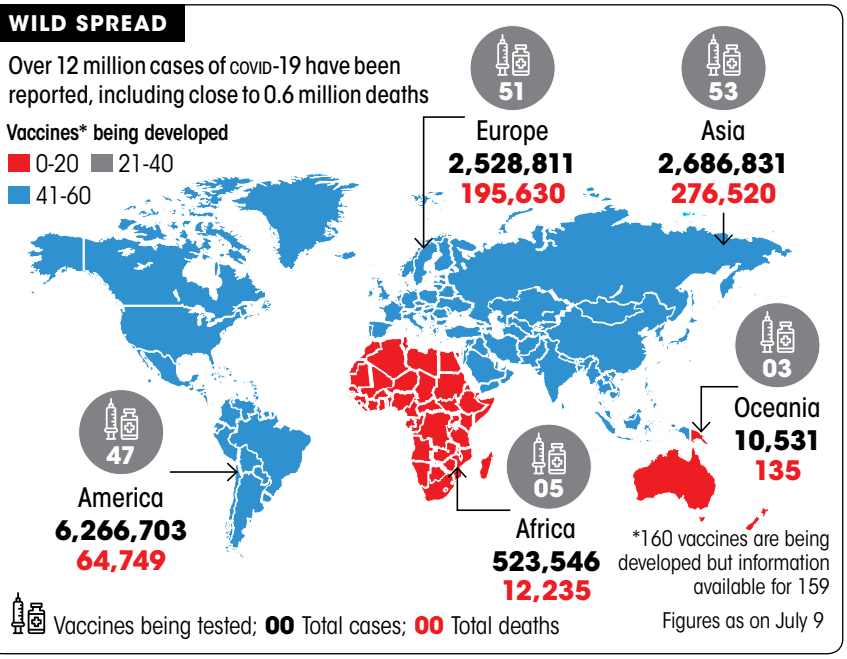
TRIALS FOR CURE

Scientists across the globe are working hard to develop vaccines for COVID-19, while also exploring if the existing drugs can be used to cure the disease

WILD SPREAD

Over 12 million cases of COVID-19 have been reported, including close to 0.6 million deaths



FAILED ATTEMPTS

Hydroxychloroquine (HCQ)

Used to treat malaria, scientists initially thought it helped in decreasing viral load. Soon, it got an emergency use authorisation from US FDA. However, the EU found that the drug did not reduce mortality in COVID-19 patients. Later, WHO also stopped its trial on HCQ saying it is of no use for COVID-19.

Lopinavir/Ritonavir

The drug, currently used on HIV patients as antiretroviral, was being used in various countries. However, its use has stopped worldwide after WHO found that the drug was not working on COVID-19 patients.

MEDICINE

About 25 existing drugs are being tested for COVID-19; FIVE ARE AHEAD IN THE RACE

Remdesivir

This common antiviral drug produced by Gilead Inc leads the race in COVID-19 treatment and is being **used in several countries, including India, the US and some European countries.** As per the World Health Organization (WHO), its effectiveness is also being tested for Ebola and has generated promising results in animal studies for Middle East Respiratory Syndrome (MERS-CoV) and severe acute respiratory syndrome (SARS), caused by coronaviruses. This suggests it may also benefit patients with COVID-19.

Favilavir

This is an antiviral drug being **used in China and Russia** for treating COVID-19. China's National Medical Products Administration approval document says Zhejiang Hisun Pharmaceutical gave a nod to "work on pharmacy and clinical pharmacology research" of the generic version of Favipiravir after it showed to signs of benefitting COVID-19 patients with mild symptoms

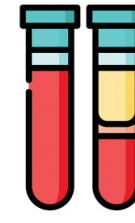
Dexamethasone

Trials are on for COVID-19 treatment for this drug, used for skin diseases and some allergies. **It is already part of Indian clinical management protocol on "compassionate use" for COVID-19 patients.** In the UK too, it is allowed on compassionate use. Preliminary results of Recovery Trial of UK have found positive results.

Infliximab

This monoclonal antibody drug, used as line of treatment in autoimmune disease, is among the ones showing promise for COVID-19 treatment. Scientists are exploring its **potential to prevent cytokine storm that is responsible for mortality in COVID-19 patients**. In case of severe infection in the body, cytokine levels in the blood rise to the extent of causing what is called cytokine storm.

Convalescent Plasma



This is a passive treatment in which a patient who has recovered from COVID-19 donates his plasma. The plasma, containing antibodies against SARS-CoV2, helps the patient fight the infection.

VACCINE

160 vaccine candidates being assessed;
HUMAN TRIAL ON FOR 21

How much time does it take to develop a vaccine?
10 to 20 years through the normal procedure

How much time will the fast-tracked procedure take?
At least 1.6 years even in best-case scenario

Six to eight months or on emergency use authorisation

Shortened as genome sequence of the virus was available in about a **fortnight of the outbreak**

20 days-1 month

11-17 months

Exploratory stage: Consists of basic laboratory research and identification of antigens, which alert the body to harmful pathogens

Pre-clinical stage: Animal testing to see if it stimulates immune system

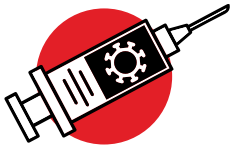
Clinical trial stage: is a three-phase process:

Phase I: small group of people (5-50) receive trial vaccine to assess safety, immunogenicity and to optimise dose schedule

Phase II: Vaccine is given to infected people (25-1,000) suffering from the disease

Phase III (Confirmatory trial): Vaccine is given to thousands of people and tested for efficacy and safety

Regulatory review, approval and market launch



CLINICAL TRIALS OF THE 21 VACCINE CANDIDATES NOT TO END BEFORE 2021

Only two of the candidates have entered phase III of clinical trial (green), another two are in the phase II (blue). The remaining are in phase I

*All dates suggest eastimated clinical trial completion

China, Oct 2021*
Developer
Sinovac
Platform
Inactivated

UK, Jul 2021
Developer
University of Oxford / AstraZeneca
Platform
Non-Replicating Viral Vector

China, Jan 2021
Developer
CanSino / Beijing Institute of Biotech
Platform
Non-Replicating Viral Vector

US, Aug 2021
Developer
Moderna/ NIAD
Platform
RNA

China, Sept 2021
Developer
Anhui Zhifei Longcom Biopharma / Chinese Academy of Sciences
Platform
Inactivated

US, Feb 2022
Developer
Inovio / International Vaccine Institute
Platform
DNA

China, Nov 2021
Developer
Beijing Institute of Bio Products / Sinopharm
Platform
Inactivated

India, Not Available
Developer
Cadila Healthcare Limited
Platform
DNA

Germany, Jan 2023
Developer
BioNTech / Fosun Pharma / Pfizer
Platform
RNA

China, Mar 2021
Developer
Clover Biopharma / GSK / Dynavax
Platform
Protein Subunit

Japan, Not Available
Developer
Osaka University / AnGes / Takara Bio
Platform
DNA

China, Sept 2021
Developer
Chinese Academy of Medical Sciences
Platform
Inactivated

Australia, Jul 2021
Developer
Vaxine Pty Ltd / Medytox
Platform
Protein Subunit

Canada, Apr 2021
Developer
Medicago Inc/ Université Laval
Platform
VLP

UK, Jul 2021
Developer
Imperial College London
Platform
RNA

China, Dec 2021
Developer
PLA Academy of Military Sciences / Walvax Biotech
Platform
Protein Subunit

Russia, Aug 2020
Developer
Gamaleya Research Institute
Platform
Non-Replicating Viral Vector

Germany, Aug 2021
Developer
Curevac
Platform
RNA

US, Jul 2021
Developer
Novavax
Platform
Protein Subunit

S Korea, Jun 2022
Developer
Genexine Consortium
Platform
DNA

Source: Draft landscape of COVID-19 candidate vaccines by World Health Organization, as on July 7, 2020

Platform types | **Inactivated** vaccines consist virus particles that have been grown in culture and then lose disease producing capacity; **Non-Replicating Viral Vector** vaccines contain an inactivated pathogen (such as a virus) incapable of replication; **RNA** vaccines provide acquired immunity through an RNA containing vector, such as lipid nanoparticles; **DNA** vaccines inject genetically engineered plasmid containing the DNA sequence encoding of the antigen against which an immune response is sought; **Protein Subunit** vaccine presents an antigen to the immune system without introducing viral particles, whole or otherwise; **VLP or virus-like particles** are molecules that closely resemble viruses, but are non-infectious because they contain no viral genetic material

GRAPHIC: SANJIT / CSE

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Dangers of a nationalist vaccine

OUR SCIENTIFIC credentials are in tatters. For decades, India has made much of the fact that it sets great store by its achievements in different fields of science, but that reputation has taken a thorough drubbing in recent weeks. In the time of COVID-19, the Indian government has shown an embarrassing readiness to cut corners by allowing teacher Ramdev to launch a medicine for COVID-19 and, more worryingly, by seeking to push through a vaccination by conducting clinical trials at breakneck speed.

It's true that the world over, governments are feeling the public pressure to develop vaccines to fight the COVID-19 pandemic. In turn, there is tremendous political pressure on drug companies to bring a vaccine to market as quickly as possible, not to mention the market pressure from investors who have been throwing money at research firms. That funding came in the wake of premature claims that vaccines would be ready in next to no time, some of the claims coming from top-notch research outfits. In this spiral of hope, hype and anxiety, scientists have been cautioning that there is the risk of releasing therapies and vaccines without due process and care. The scramble over hydroxychloroquine and remdesivir illustrate high-profile instances where governments, primarily the US Administration, have rushed heedlessly when science would have advised caution.

At home, there is complete disbelief over the order issued to a dozen hospitals and research institutes by the Indian Council of Medical Research (ICMR), which controls biomedical research in the country, to complete clinical trials on a new vaccine in flat 38 days! The vaccine has been developed by Bharat Biotech of Hyderabad in collaboration with ICMR and the National Institute of Virology (NIV), Pune, by taking an inactive strain of SARS CoV-2 which cause COVID-19 to develop antibodies in those vaccinated. The absurd timeline of completing thousands of clinical trials for safety and efficacy in humans, collating and evaluating the data in just five weeks so that the vaccine can be launched on 15th August, has provoked many scientists to question the ethics of it. There is much anger and there is criticism of the choice of Independence Day as the vaccine launch date because of its nationalistic overtones.

Admittedly, the pandemic has changed many things worldwide, most noticeably in the speed with which vaccines are sought to be developed. Vaccines normally take years to develop, sometimes as long as a decade, but now the pharma industry is hoping to crunch this dramatically to 12-18 months. The US, for instance, has launched Operation Warp Speed which aims to deliver 300 million doses of "a safe, effective vaccine for COVID-19 by January 2021".

By mandating that vaccine trials must be finished in just 38 days, ICMR has raised safety concerns

The fast-tracking of Bharat Biotech's Covaxin is of a piece with the global trend but expecting clinical trials to be completed in just a few weeks for its immunity booster vaccine is clearly an impractical goal that is fraught with risk since it throws scientific norms to the winds. Besides, Bharat Biotech has a penchant for publicity and making tall claims. In February 2016 it announced that it had developed ZIKAVAC against the zika virus and that it was the first in the world to file for a global patent for its vaccine candidates. Nothing further has been heard of the vaccine. DTE

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Palette

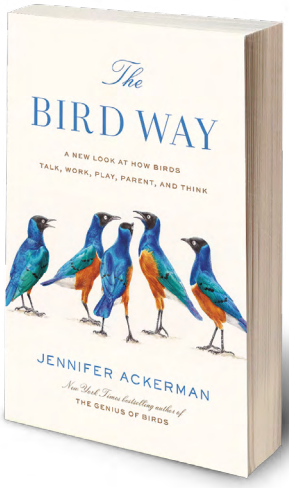
WHAT'S INSIDE

RECOMMENDATIONS

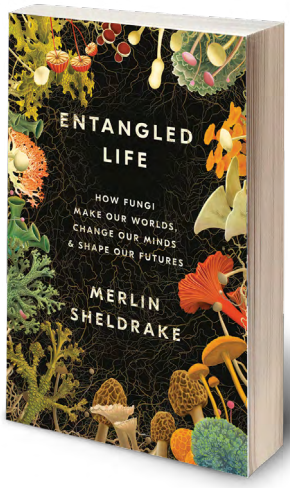
DOCUMENTARY

Expedition Everest captures the impacts of what climate change will do to the Himalayas and other places. In this new documentary, an international group of scientists and climbers use drones, laser scanners and cameras to generate a comprehensive picture of the mountain, which contains water supply for one-fourth of the world's population. They say glacial melting could devastate the future of billions of people living in the region. The scientists plan to install five weather stations along the climbing route to monitor temperature, humidity, air pressure, wind speed and other factors to alert meteorologists of an impending flood.

BOOKS



Hitherto unknown aspects of the avian species are revealed in a new book by Jennifer Ackerman. Thematically divided into five parts—talk, work play, love and parent—*The Bird Way* says birds are capable of sophisticated behaviours. They can laugh, lie and even ignite a forest fire. The author writes about crows that manufacture their own hook tools; raptors that intentionally start forest fires to flush out prey; and, hummingbirds that not only remember when they visited nectar-filled flowers, but also when to return, after the flowers replenish their stock.



This book is a tribute to the fungus that is found everywhere but is very easy to miss. It traces the history of fungi—how it colonised the land from sea and made it possible for plants to move ashore; how it connects trees in a network; and, how it helps produce alcohol and the making of bread. Though we may group fungus along with plants, the author says they are more closely linked to animals. It is time we came out of our fungal blindness.

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WINGED WONDERS

THE PANDEMIC HAS MAGNIFIED FEAR OF BATS, BUT THEIR CONSERVATION IS CRUCIAL TO PREVENT SUCH EVENTS FROM ARISING AGAIN

VIKRAM ADITYA, ARAVIND N A AND **SUMASHINI P S**

BATS EVOKE awe and aversion in equal measure from humans. They are the only mammals capable of true flight and have a unique sonar-based echolocation mechanism to capture prey at night. Their ability to navigate and fly in darkness has inspired many *Batman* stories popular among children. On the flip side, their unique body shape, behaviour of hanging upside down, communal roosting and nocturnal habit have given rise to baseless myths and created unfounded fears leading to their persecution. The fears have become exacerbated since the COVID-19 pandemic.

Studies suggest the novel SARS-COV-2 could have originated from bats and unknown intermediate hosts and spilled over to humans at a wet market in Wuhan, China. As a result, some misinformed individuals are destroying their roosts. To put things in context, scientists identified two bat coronaviruses

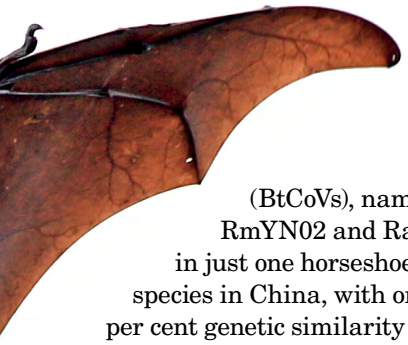
Night heroes

Fascinating facts about the only flying mammal

1,300 species of bats exist in the world

70% of all bats are predators of insects and crop pests, directly contributing to enhancing crop productivity

29% of all bats depend on plants for food



(BtCoVs), named RmYN02 and RaTG13, in just one horseshoe bat species in China, with only 90 per cent genetic similarity to SARS-CoV-2. This is far less than the similarity between chimpanzees and humans. The two species of BtCoVs that Indian Council for Medical Research found in Indian Pteropus and Rousettus bats have little similarity to SARS-CoV-2.

Bats are the largest mammalian group after rodents, with over 1,300 species making up a quarter of all mammals. They occur on all continents except Antarctica and are particularly diverse in South Asia, with 114 species of insect-eating bats and 14 fruit bats, also known as "flying foxes", occurring in India. They roost in large colonies on trees, tree hollows, caves, rock crevices and abandoned man made structures. Bats are diverse in their food preferences, foraging on insects, nectar, fruits, seeds, frogs, fish and small mammals. They play a unique role in maintaining ecosystem structure, making a singular contribution to our food production, economy and well-being.

BOON FOR AGRICULTURE

Bats are long-distance dispersers; often their feeding ranges up to 20 km from their roosting sites. The diet of fruit-eating bats consists

BATS PLAY A UNIQUE ROLE IN MAINTAINING ECOSYSTEM STRUCTURE, MAKING A SINGULAR CONTRIBUTION TO OUR FOOD PRODUCTION, ECONOMY AND WELL-BEING

largely of flowers and fruits such as mangoes, bananas, guavas, custard apples, figs, tamarind and many species of forest trees. Therefore, bats play a vital role in seed dispersal and forest regeneration. Studies have shown that seedlings raised from bat dispersed seeds show higher germination and vigorous growth. A study by T Ganesh and Soubadra Devy of the Ashoka Trust for Research in Ecology and the Environment, Bengaluru, showed that bats played a significant role as seed dispersers for 21 forest trees in the southern Western Ghats, particularly for trees like *Syzigium cumini* (commonly known as Malabar plum).

Studies have found that bats play a vital role in pollination, mainly of large flowered plants, and in crop protection. Fruit bats (Megachiroptera) being large, require big flowers with copious amounts of nectar. About 29 per cent of all bats depend upon plants for food. Nectar-feeding bats are major pollinators for 528 species of ecologically and economically important plants. Being arboreal mammals, bats are major pollinators of rainforest trees in the Western Ghats, as well as 141 species of fruit trees in the tropics, including economically important species like mahua, neem, wild banana and palms. In Asia and Africa, about 300 economically important plant species rely on bats for pollination and dispersal. Bats are major pollinators for many species of mangroves which are important for coastal ecosystems and local livelihoods. Unfortunately, there have been few quantitative estimates of the contribution of bats to pollination services in agriculture and forests across India, but they are likely to be incalculable.

Insects are a major problem for agriculture, destroying up to 26 per cent of the annual production of crops worldwide every year, roughly amounting to $470 billion. Insectivorous bats, which make up 70 per cent of all bat species, are voracious predators of nocturnal insects and crop pests, thus their diversity contributes directly to enhancing crop productivity with tremendous economic impact. For example, a single colony of 150 insectivorous bats in the US has been estimated to eat nearly 1.3 million insects each year,

141 species of plants depend in nectar-feeding bats for pollination

300 economically important plant species in Asia and Africa rely on bats for pollination and dispersal

5,000 mosquitoes can be consumed in one night by a small bat, which can reduce mosquito-borne disease incidence

BITS ON BATS

- Bats are the largest mammalian group after rodents
- They are diverse in their food preferences, foraging on insects, nectar, fruits, seeds, frogs, fish and small mammals
- Their feeding can range up to 20 km from their roosting sites
- They roost in large colonies on trees, tree hollows, caves, rock crevices and abandoned man made structures

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The behaviour of hanging upside down, among other things, has given rise to baseless myths about bats

contributing significantly to agricultural pest control. In the Western Ghats, 46 species of bats are insectivorous and forage actively for insects throughout the night, especially along rivers and streams where a number of insects breed. Some large insectivorous bats are also reported to feed on small rodents. Studies have found that bats enhance crop yield consistently across landscape gradients in crops such as corn and cocoa by suppressing crop pests. In the US, the economic value of insectivorous bats connected to the agriculture sector is about $22.9 billion a year. Another study estimates between $3.7 and $53 billion per year in agricultural losses without bats in North America.

Bats contribute significantly to soil fertility and nutrient distribution due to their large numbers, high mobility and varied habitats for roosting and foraging. Bat guano (droppings) provides organic input to soil and facilitates nutrient transfer, contributing to soil fertility and agricultural productivity. The practice is harmless vis-a-vis human health. Several species of bats, in fact, contribute to human health by reducing populations of mosquitoes and other insect vectors that spread malaria, dengue, chikungunya and other diseases. It is reported that a small bat may feed on almost 5,000 mosquitoes each and every feeding night far more than other measures adopted to eliminate them.

SEVERAL BATS CONTRIBUTE TO HUMAN HEALTH BY REDUCING POPULATIONS OF MOSQUITOES AND OTHER INSECT VECTORS THAT SPREAD MALARIA, DENGUE, CHIKUNGUNYA

DON'T RESENT BATS

Understanding the role played by bats helps us appreciate how their absence can greatly affect all facets of our lives. Viruses don't jump directly from bats or other animals to humans. Rather, illicit trade in wildlife, high levels of hunting of bats for consumption of wild meat, and destruction of natural habitats is responsible for this pandemic by bringing host animals into close contact with humans and amplifying the risks of spillovers.

As per the International Union for Conservation of Nature, about 5 per cent of bats are categorised as endangered and another 11 per cent are data deficient. Many more species may be threatened, while a large proportion may be of least concern as far as health risks are involved. Perhaps because of this, all conservation plans ignore bats. Further, some species of fruit bats are categorised under Schedule 5 of the Wildlife (Protection) Act, 1973, along with other vermin species like rats, making it difficult to legally conserve them.

Bats originated in the early Eocene period of the Earth's history, around 52 million years ago. During this long evolution, their bodies have gained resistance to viruses and other microbes. This immunity derived through co-existence has helped them safely live with pathogens. Hunting and wildlife trade in bats, therefore, ultimately jeopardise our own safety. A more prudent approach is to avoid eating fruits partially eaten by bats and not venturing into caves and closed spaces laden with bat excreta to minimise risks of cross-contamination. However, killing or harming bats diminishes the critical ecological services that they perform for us.

The pandemic has demonstrated that conservation of biodiversity and natural habitats is absolutely essential to prevent such events from arising again. A world without bats would not just be poorer, but also unlivable. DTE

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Lighting the gaps

A HYBRID MINI POWER GRID GENERATES HOPE FOR STEADY AND ROUND-THE-CLOCK POWER SUPPLY IN RURAL AREAS

PRATHA JHAWAR and **KOTI REDDY**
WEST CHAMPARAN

Biomass gasifier power plant at the Chanpatia unit of Husk Power ensures steady supply

NOT FAR from the foothills of the Himalayas in Bihar's West Champaran district is located a nondescript village Chanpatia. Most houses here were connected to the national power grid much before the state was declared "100 per cent electrified" in January 2019 under the Pradhan Mantri Sahaj Bijli Har Ghar Yojana, Saubhagya. But a steady round-the-clock supply remains a dream. "During the winters we receive electricity for 18 hours a day. In summers it becomes highly erratic. Voltage drops so low that we cannot use any electrical appliance, be it mixer or refrigerator," says Ranjesh Kumar, a resident.

For Vijith Kumar, who owns a cloth store, such poor power supply means heavy losses. "Customers usually throng the shop towards evening. That's the time when we face long power outages or low voltage," he adds. Like most other shops and commercial centres in the village, Vijith initially hired a diesel-run generator for power backup. "In

the beginning, the owner charged ₹80 a day as rental. But soon, he raised it to ₹100," he says. That's when he decided to break away from the national power grid and join a mini-grid set up in the village by Husk Power Systems, an off-grid utility that generates power entirely from renewable energy sources.

Though Husk Power has been operating since 2007 and has a network of 85 mini-grids across the country and in Tanzania, it set up the utility at Chanpatia in 2017 and with a difference. Unlike most of its other plants that run on solar energy, the Chanpatia plant is a hybrid one that uses a combination of biomass along with solar power.

"Solar photovoltaic is, of course, the cheapest source of energy," says Manoj Sinha, co-founder and chief executive officer of Husk Power. However, one can use it only during the day. Some energy can be stored in the battery, but it might not be enough. Besides, batteries are expensive, and one can never get 365 days of sunshine. This gives rise to the need for a second source of power, Sinha explains. So, along with a 40-kW solar PV plant, Husk Power has set up a 25-kW biomass gas power plant that kicks in after sunset. Engineers at the plant say since the biomass plant can be operated on an as-need basis, it helps the utility provide a steady output and reduces the need for batteries for storage of electricity. Batteries are primarily used for ensuring constant voltage.

As of now, Husk Power's biomass plant uses rice husk as raw material. Since the village falls in the rice belt of Bihar, where paddy is grown twice a year, feedstock is available in plenty. Husk Power buys it from threshers for ₹1 to ₹4. It, however, says the plant can use other raw materials like wood pallets with slight changes to it.

Over the past three years, its consumer base has increased to 100, which includes 60 per cent commercial establishments, 30 per cent households and 10 per cent industries. Though Sinha does not divulge the tariff he charges for the hybrid power, he acknowledges that it is higher than the tariff set by public utilities. Yet, most consumers *Down To Earth* spoke with find it reasonable. Vijith says he now saves over ₹1,000 a month on electricity bills as well as on generator rental. His business runs smoothly due to no power outage. Aman Kumar, who also depended on diesel generator for running his welding shop, says his monthly electricity bill has reduced from ₹5,000 to ₹3,200 ever since he joined the mini-grid. Besides, says Aman, unlike public utilities Husk Power does not charge extra for providing commercial connection.

Primary school Vivekananda Academy is another commercial consumer of Husk Power. Nikhil Kumar Pandey, caretaker of the school, says, it is still connected to the national grid. "But Husk Power is our major supplier. We do not experience power outages even during the worst monsoon." Husk Power has a smart prepaid metering system which reduces electricity theft and helps consumers monitor and manage their electricity consumption.

Such decentralised solutions play a great role in bridging the gap between the government supply of electricity and customer demand. In 2019, the Initiative for Sustainable Energy Policy, a programme at the Johns Hopkins School of Advanced International Studies, US, conducted a survey in Odisha, Rajasthan, Bihar and Uttar Pradesh and found that almost 16 per cent of the 10,000 rural households and 40 per cent of the 2,000 commercial establishments depend on decentralised sources of electricity like diesel generators due to unreliable supply by the national power grid. These are the consumers who can benefit from Husk Power-like mini-grids. DTE

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Solar photovoltaic plant of Biomass gasifier power plant keep the tariff affordable

PHOTOGRAPHS: PRATHA JHAWAR, KOTI REDDY / CSE

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Bitter gourd leaves can be prepared in a number of ways. Here, it has been included in scrambled eggs

PHOTOGRAPH: VIBHA VARSHNEY / CSE

Bitter bounty

BITTER GOURD LEAVES NOT ONLY HAVE MEDICINAL AND NUTRITIVE PROPERTIES, THEY CAN BE ADDED TO TASTY RECIPES AS WELL

VIBHA VARSHNEY

IT WAS a clear case of home gardening gone wrong. I had planted bitter gourd seeds in a flower pot hoping to get gourds, but as there's not enough sunlight in my home in Delhi, all I got was a profuse harvest of leaves. The only consolation was that the plant is pretty—the slender climber has lobed leaves and delicate tendrils and works well as an ornamental. A friend suggested that I make *pakodas* from the leaves. I made a batch dipping the whole leaf in a rice and chickpea flour batter. They were tasty enough for me to plant more seeds next year for a fresh harvest.

Bitter gourd or *Momordica charantia* is part of the diet regime suggested to diabetics as it can lower blood sugar levels. Usually, the juice of the raw gourd is used for the purpose. However, the gourd could counteract with diabetes medication and reduce blood sugar levels to dangerously low levels. Pregnant women, too, are advised to avoid it as it can lead to abortions.

While most Indians love the bitter taste of this vegetable, some cannot understand why it should be consumed. They use recipes to reduce the bitterness. They boil the gourd and squeeze out the bitterness. Or they peel the gourds and apply salt on them so that it releases the water which can be then squeezed out. It is then prepared whole or stuffed with a mixture of spices.

Usually, raw mangoes and dried mango powder are used liberally in these recipes. Chips prepared by frying thin slices of bitter gourd with a sprinkle of *chaat masala* are very popular. These methods manage to reduce the bitterness a bit, but it cannot be removed completely. It is better to just embrace the bitterness and enjoy it. These gourds flood the market during summer season. This is the time to consume them as the seeds are soft and don't have to be removed before cooking.

Other than the gourd itself, the leaves too are bitter and useful to control blood sugar levels. As the leaves are not as bitter as the gourd, this may be more palatable to people who do not like the taste of the vegetable. Tea prepared from both fresh and dry leaves are quite popular among diabetics.

RECIPE SCRAMBLED EGGS

INGREDIENTS

Eggs: 2
Onion: 1/2 (diced)
Butter: 1 tbsp
Tender bitter gourd leaves: a handful (chopped)
Salt to taste

METHOD

Beat the eggs, onions and the leaves together and add salt. Add butter in a frying pan. Pour the egg mixture and cook slowly. Transfer to a plate when it turns golden yellow and enjoy the slightly bitter taste.

VERSATILE INGREDIENT

Its medicinal properties do not take away the fact that the leaves are a versatile ingredient for perking up the plate. In Odisha, the leaves are added to sautéed onions and then cooked rice is added to it. The mild bitterness works well with starchy rice.

In West Bengal, the leaves are added to the traditional *shukto* dish when the vegetable is not available. Similarly, there are recipes where the leaves are used along with potatoes. The leaves can also be used as stuffing for a *paratha*. They complement chicken and fish recipes too, and can be used raw in salads or added to boiled *dal*. I like them with eggs too (*see recipe*).

The leaves are nutritious and rich in minerals like potassium, sodium, calcium, zinc, magnesium, iron, manganese and copper, and vitamins like carotene, tocopherol, folic acid, cyanocobalamin and ascorbic acid along with some traces of vitamins B3, B6, D and K.

Bitter gourd belongs to the cucurbitaceae family, which includes cucumber, melon and pumpkin. Although the exact origin of *Momordica* genus is unclear, most experts agree that the centre of domestication was in eastern Asia, possibly eastern India or southern China. Many species of *Momordica* are endemic to different parts of the country but *Momordica charantia* is distributed across India, except in the northeast region.

Despite the fact that the bitter gourd has been extensively described in Ayurvedic texts, the health benefits have attracted many biopirates who have patented products prepared from this vegetable from our backyards. In 1999, a case of a company run by non-resident Indians patenting the extracts of the gourd for its anti-diabetic properties strengthened the government's resolve to document the medicinal properties of indigenous plants and share with patent offices around the world. Before this, the US patent office had also given a patent on the wound healing properties of turmeric, which too is prior knowledge as this has been used in India for centuries for this purpose. DTE

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Don't ignore plant pathogens

THEY CAN JUMP KINGDOMS, INFECT HUMANS AND ANIMALS, AND CAUSE OUTBREAKS TOO

G RAVIKANTH

NEVER BEFORE did the world feel the need for "One Health" approach as it does now, during the COVID-19 pandemic. The concept that has taken shape over the past decade and is now being jointly promoted by the World Health Organization (WHO), Food and Agriculture Organization (FAO) and the World Organisation for Animal Health (OIE), recognises that we live in a shared ecosystem. It acknowledges that human health and animal health are interdependent and linked closely to the health of the environment they live in. Thus, there is a need to break down the interdisciplinary barriers that separate human and veterinary medicine from ecological and environmental sciences. However, over the past one decade, with the emergence and spread of zoonotic diseases such as H1N1, SARS, Ebola, Zika and Nipah that have the potential to cause widespread outbreaks or pandemics, the focus of the One Health approach seems to have been more on the study of zoonotic pathogens, their niche adaptation, epidemiology and transmission. Although One Health recognises the importance of plant pathogens, they somehow remain sidelined.

This can be gross negligence as plants are directly and indirectly related to human and animal health. While on the one hand they provide energy and essential nutrients, on the other hand they harbour pathogens like fungi, bacteria, viruses and nematodes that risk food safety and bio-security. Evidence shows plant diseases often cause large-scale damage

ILLUSTRATION: RITIKA BOHRA / CSE

to human health and well-being. Towards the late 19th century, infestation by fungus *Phytophthora infestans* in potato crops led to starvation and deaths of millions of Irish citizens.

Though such large-scale infestation has been to a large extent managed with the advent of fungicides, nematicides and other chemicals, contamination of fruits and leafy vegetables by bacteria like *Salmonella* and *Escherichia coli* are still a cause of worry. Estimastes show food and water contaminated with these bacteria cause infectious diarrhoea among 3 to 5 billion people across the world every year and are responsible for the deaths of nearly 1.5 million people, most of them young children.

However, what is important at this juncture is to ask if these pathogens merely exist in plants or do they have a wider host? Is there a possibility of these pathogens to jump from plants to animals? The answers are not straight forward. For a pathogen, the mechanisms involving adaptation, colonisation and virulence are common across hosts, whether it belongs to the plant or the animal kingdom. They overcome the host defence system by disrupting its cell and by producing virulence factors such as toxins or enzymes. The virulence factors then go on to trigger expression or repression of host genes.

Plant pathogens have evolved to breach the plant cell wall, a significant physical barrier which the human and animal pathogens have never encountered. Yet, a number of examples exist of pathogens crossing kingdoms. For example, *Burkholderia cepacia*, which causes pink rot of onions, and *Pseudomonas aeruginosa*, which causes bacterial leafspot of tobacco, are reported to cause human cystic fibrosis. Several *E coli* and *Salmonella* strains are recently seen to be interacting with plants irrigated with sewage water. One study in the US, published in *Frontiers in Microbiology* in May 2020, links four multi-state food-borne disease outbreaks between 2013 and 2016 to consumption of fresh cucumbers infested with *Salmonella*.

Though the number of pathogens shared between plants and humans are much less compared to those between animals and humans, many a time plants indirectly play a role in the spread of pathogens harboured by animals. For example, mass flowering of bamboo in India often results in rapid multiplication of rodents that feed on bamboo seeds. Once the seeds are exhausted, they enter human habitations and carry with them bacteria *Yersinia pestis* that gets easily transmitted to humans and causes plague.

FOR A PATHOGEN, MECHANISMS INVOLVING ADAPTATION, COLONISATION AND VIRULENCE ARE COMMON ACROSS HOSTS, WHETHER IT BELONGS TO THE PLANT OR THE ANIMAL KINGDOM

The other major concern is the genetically modified (GM) crops, particularly GM food crops, which are developed by biotech companies by the genes of engineered microbes into plants. Increasing numbers of studies point out that people are reporting allergic reactions to some of these GM foods. Besides, there is a possibility that some of the GM DNA might move into the human gut bacteria through horizontal gene transfer—movement of genetic material from a bacteria into plants or vice versa as opposed to vertical gene transfer, where the genetic material is transferred from parent to offspring.

While there have been limited studies regarding this, increasing amounts of genomic data reveal some cases of horizontal gene transfer not only between the bacteria and the host plant but also between the bacterium and other eukaryotes (organisms such as animals that possess complex cells). A 2019 study by researchers from the Indian Institute of Science and University of Agricultural Sciences, Bengaluru, shows a cross-kingdom transfer of *Salmonella* from rodents' faeces in the soil to the roots of rockcress (*Arabidopsis*) plants. A number of studies show that viruses could act as vectors in this process and also provide the genetic material for horizontal gene transfer to eukaryotic organisms. There is also evidence that GM food and microRNAs can survive digestion, enter the human body and affect gene-expression patterns.

While more studies are required to understand the gene transfer systems, it is important to be cautious about the potential ecological impacts. With shared genes, the transmission and sharing of diseases across plant and animal kingdoms will likely become more prevalent in the foreseeable future. Understanding the disease processes and outcomes would help us stay prepared to contain an outbreak just as the current one. DTE

(G Ravikanth is senior fellow at the Ashoka Trust for Research in Ecology and the Environment, Bengaluru)
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Farming is back

ANECDOTAL STORIES are often powerful indicators of change and a straw poll for a forecast. Some decades ago, when farmers spoke of "disappearances" of insects and pollinators, they were labelled as anecdotal stories. But they stand confirmed as mass extinction of these useful creatures are already impacting agricultural production negatively. At present, we are hearing some anecdotal stories from farmers in India. Indian villages are presently alive with unusually more residents. It is because millions of informal workers have come back to villages due to the lockdown that caused cessation of economic activities. What are the points of conversation in the villages now? Mostly, they are talking about future livelihoods. And whether they could return to the daily wage jobs in urban areas. If not, then what would they do?

From across the country, particularly from states with high informal workers working outside like in Uttar Pradesh, Madhya Pradesh and Bihar, anecdotal stories are pouring in about people wanting to join back farming. These stories are heartening for the distressed farm sector in the country. It is for a decade now that we have been living with the fact that farmers are quitting agriculture—2,000 farmers a day going by the last Census.

The latest bulletin on the kharif season from the Union Ministry of Agriculture and Farmers Welfare says that coverage area has almost doubled as compared to last year, which was 43.3 million hectares (ha). In the current season, paddy coverage has gone up—from 4.9 million ha last year to 6.8 million ha this season. States with high returnee worker population like Bihar, Uttar Pradesh and Madhya Pradesh besides others are reporting high increase in coverage areas. While this piece of data can't be attributed to people joining back farming with certainty, it does indicate that people have increased acreage due to certain reasons. It may be due to better rainfall, but it could also be due to the availability of labour to take up cultivation in more areas.

Conversations with farmers unveil another story. Many say it is just a risk-adoption phenomenon. Farmers who had family members supplementing income by migrating out are now back. And to compensate earning, they are just deploying extra labour. But whether it would lead to a trend of more people joining back farming depends on the results of the current extra deployment of resources on agriculture? It means if they get remunerative returns from farming, people may just stick to it.

It is an opportunity; particularly at a time when India has become non-agrarian not only in terms of economic opportunity but also in contribution to the national income. But the opportunity has many challenges; and those are the known ones that have crippled the sector till now. One of them is: how to make farming economically lucrative? Producing more is not an issue anymore as farmers have been giving us our historic bumper foodgrain production for many years now. The problem is to ensure a fair price for them. The idea that a free market would enable a fair price has also helped. This leaves us with the sole solution of giving farmers access to markets with favourable safeguards to trade. Here, the government must stand as the guarantor for farmers. It has to procure, ensure fair price, and assure the market for farmers. This is the opportunity to revive farming in India. The government must declare a new deal for farmers. Farmers need the government more than ever, today. DTE

The current kharif acreage is impressive. It is inspiring farmers to re-embrace farming as we live through an everlasting COVID times

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ONLINE GLOBAL TRAINING PROGRAMME

FAECAL SLUDGE MANAGEMENT IN RURAL AREAS

COURSE DURATION 15 hours (2 weeks) between 29 July and 12 August 2020

BACKGROUND

Will construction of toilets in numbers end our quest for sanitation utopia? Certainly not. Countries will now have to wake up to fresh challenges of disposal of the massive quantities of solid and liquid waste generated by the new toilets we have built.

How do we prevent this waste from turning into an unmanageable health hazard by seeping into our groundwater and water bodies like lakes and rivers. These challenges are intensified in rural areas, where on-site containment is the only solution. Out-of-the-box thinking on safe containment and management is needed in such areas.

The recent Joint Monitoring Progress report flags issues of safely managed sanitation services. The report stresses the need for hygienic toilets and safe management of excreta at each step of the sanitation trajectory from containment and emptying to conveyance, treatment and, most importantly, reuse.

ABOUT THE TRAINING PROGRAMME

Centre for Science and Environment (CSE) is organizing a training programme to educate participants on the key topics of faecal sludge management in rural areas. The course comprises of self-study, learning tools such as presentations, audios and videos, featuring case studies. Wherever required, the training will provide online forums for discussion. Quizzes and assignments will be part of this programme. The course will facilitate online interaction of participants with experts. A webinar will also be organized to discuss the subject threadbare.

KEY TAKEAWAYS

- Knowledge of safe, adaptable and sustainable technologies for managing toilet waste
- Understanding of decentralized technologies to manage grey and black water
- Training on how to reuse wastewater and faecal sludge
- Guidance on the use of Information, Education and Communication (IEC) material effectively for safe disposal and reuse of faecal sludge
- Connecting water to toilets how to make usage of toilets sustainable

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