16-30 JUNE, 2024

Down To Earth

FORTNIGHTLY ON POLITICS OF DEVELOPMENT, ENVIRONMENT AND HEALTH

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WORLD ENVIRONMENT DAY SPECIAL

ELECTIONS 2024

Price rise, job loss, farm crisis deciding factors

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PLANT PANDEMICS

The threat is now more real than ever

RESIDENTIAL TRAINING ON

SOCIAL IMPACT ASSESSMENT

As the country is progressing towards development, the arising need for more land is inevitable and so are the conflicts with the displacement of people. In order to minimize these conflicts, it is prudent to provide the inhabitants fair information on the impacts of the projects and the reimbursements against the acquisition of their lands. It is where Social Impact Assessment plays a crucial role.

Social Impact Assessment (SIA) is the process of analyzing, monitoring and managing the social and cultural consequences of projects. It is an important tool to inform decision makers, regulators and stakeholders about the possible social and economic impacts of a development project. In order to be effective, SIA requires active involvement of all concerned stakeholders.

With an objective to enhance the capacity of the stakeholders on SIA, Centre for Science and Environment is conducting a four-day residential training programme which focusses on the complete process of SIA including baseline data collection, land acquisition survey, preparation of the resettlement action plan (RAP) and evaluation of SIA reports. The programme aims to build a cadre of trained professional who can conduct and review SIA reports.

WHO CAN APPLY?

• SIA practitioners and consultants • Government officials from state revenue department, municipality, district collector, mining etc • Development corporations and industries • Academicians, students, researchers • Civil society groups, NGOs, advocates • Anyone else interested in the subject

CSE AAETI

DATE: August 6-9, 2024

VENUE: Anil Agarwal Environment Training Institute (AAETI), Neemli, Alwar, Rajasthan

COURSE FEES: ₹28,000
(includes training fees, accommodation, food and travel from/to Delhi and training centre)
For relevant government officials, the course fee is sponsored by CSE.

LEARNINGS FROM PROGRAMME:

The participants will develop a complete understanding of

- SIA methodology: Tools and instruments for conducting a SIA study
- Baseline data information: Learn data need, data collection, collation and interpretation
- Act and Policies: Learn provisions of the Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act-2013, issues and challenges in land acquisition, and how to prepare land acquisition plan
- Public consultation: Learn identification of affected people, modes of engagement and stages at which it is required.
- Rehabilitation and resettlement plan: Learn how to do asset evaluation, prepare entitlement matrix and develop R&R plan.
- Reporting methodologies: Learn how to develop a SIA report

Note: Participants have to reach CSE's Delhi office on August 5 latest by 1 pm. Transport to the campus will be arranged from the CSE's office.

FOR ANY QUERIES, PLEASE CONTACT

Ishita Garg
Training coordinator
Email: ishita.garg@cseindia.org

COOL IT

THIS YEAR, when Delhi touched record temperatures of close to 50°C, I experienced first-hand what it would be like to live in extreme heat. It was an inferno; the proverbial hell. There was news of forest fires; of buildings going up in flames; of electrical equipment burning. This is the first time I have seen leaves on trees being burnt to a crisp. This is not what we should wish our future to be.

Even as I write this, I am aware that I am privileged; I am comforted by electricity that runs appliances to cool me. I am not exposed to the deadly harm that millions in my country endure each day. They are exposed to the scorching sun; they do not have access to cooling devices; they see their land bake; their water dry up; their forest on fire. They are the true victims of climate change. The irony is that they are not responsible for the greenhouse gas emissions that have caused the planet to heat up. The irony is also that the electricity that cools me and many others, will contribute to the stock of emissions and force the planet to further heat up. Unless, of course, we transform our energy systems to make them low-carbon and clean. So what do we do?

There is no doubt that we need to do much more to combat climate change so that we can contain the rising temperatures. But frankly, we also have to find ways to cope and to live with this heat. This is what I want to discuss.

First, let's accept that the heat is here to stay and will only get worse. Second, let's understand how much heat humans can tolerate. Scientists believe that this range is 40-50°C. But it depends on how temperature-acclimatised our bodies are; on whether the heat is dry or wet—accompanied by high levels of moisture in the air, which makes it more unbearable; and, of course, on the conditions in which we live.

This last factor can be controlled, and must be focussed upon in the heat management agenda. This requires, firstly, looking at what would reduce the impact of heat in the lived environment. Data shows that the heat island effect is intense in areas that have high concrete and human density and low vegetation and waterbodies. In fact, temperature trends show that big Indian cities with high concretisation are not even cooling down during the night—this then adds to the heat impacts. My colleagues point out that the rise in night-time minimum temperature is worse for human health. So, it is clear that we need a new generation of city planning, where we can maximise the cooling gains brought by green and blue cover.

But this is easier said than done, particularly in mega cities where land is already concretised and under pressure for more high-rise development. Therefore, we also need abatement measures in our buildings for thermal comfort. You could argue that this means putting air conditioner-type devices in every house, every room. But this is short-sighted—cooling devices not only add to the cost of energy but also drive up emissions because of energy usage. The use of air conditioners also leads to more heat being trapped, more increase in night temperatures and more human distress.

So, we need ways to reduce the need for cooling devices—this means we undertake construction so that we can build with nature and not against it. This is today called passive architecture. In the past, this just meant that people used their knowledge to build smart. Traditional houses incorporated all the principles of providing shade from direct sunlight and ensuring ventilation. In fact, thermal comfort is about how much the skin on our bodies can breathe; it means cooling with ventilation. In simple words, building closed rooms, with double-glazed windows and even highly efficient air cooling systems, is not as good as buildings with insulated materials, windows, fans and then the additional air conditioner. This is the traditional building science that modern architects must learn in our climate-risked and hot times. We must also relearn the science of wind-flows and incorporate it in the design of our building layouts; this is never done; never even considered.

We need ways to reduce the need for cooling devices. This means we need to build with nature, not against it

Having said that, let me be clear that no amount of adaptation will work without drastic measures to cut greenhouse gases. This is not happening; not at the scale or pace needed. Today, Europe is faced with a backlash against its action to combat climate change; the US is not yet on track to meet its target to cut emissions by 45 per cent by 2030. I could go on. But the fact is that this extraordinary Indian summer should be a warning for the world that the heat is on; the world is on a boil and all this will only get worse, not just in India but across the world. DTE

@sunitanar

DownToEarth

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Contents

WORLD ENVIRONMENT DAY SPECIAL

COVER STORY

Cover design: Ajit Bajaj

Engage

Put people at centre of hill development

I read with great interest the article "Chipko a distant memory" (16-30 April, 2024), on the 50th anniversary of the Chipko movement. The interviews with the women, who had led the movement, bring out clearly the problems that Uttarakhand villages face today. Let me reiterate a few issues that call for urgent policy attention.

The young generation, both men and women, no longer wishes to farm and prefers to seek work in cities. There are good reasons for this—wild animals and monkeys harming the vegetation; decline in soil fertility due to various factors that point to high ecosystem imbalance; and lack of employment opportunities in and around villages. Further, demand patterns have changed since cooking gas has replaced wood fuel and cement has replaced stone and wood in construction. Better road connectivity has led to an inflow of products. With more people having access to mobile phones and the internet, communication and influence of social media has also changed.

Hill development policies should recognise that poverty in this region is more due to ecological imbalances rather than income poverty. However, some eminent policymakers simply translate this into a focus on conservation. People working on the ground argue that this interpretation is misguided, since this is a densely populated area in relation to available land and forest cover. The people who cannot migrate and remain in villages have the fewest resources in terms of education and assets, and are often in socially disadvantaged communities. Equity and humanity demand that we put people at the centre of hill development plans.

At the same time, communities living in the hills cannot conserve the environment all by themselves. This has not been true for many decades and is not true today. They need assistance on new knowledge and science, access to new tools or technologies, and awareness on modifying these to suit local conditions. All of this cannot be achieved by programmes that apply a single template to all areas. This requires hands-on interactions, village-level capacity building, and locale-specific decisions.

We must focus on management of resources, not just conservation, in ways to try and improve the balance of the different elements. With climate change impacts increasing, the ways of adaptation need to be explored. Promoting local products is often the most empowering solution, because it keeps women or communities in charge.

This is a call to action. There is much that needs to be done and we need committed local action, resources and solutions from the ground up.

LALIT PANDE
ALMORA

Erratum

In the cover story "Blazing sun is on" (1-15 May, 2024), the graphic "Crucial covers lost" on *p*38 incorrectly marks the area maps of Delhi as those of Jaipur, and vice versa. The error is regretted.

ENGAGE More

Now you can access more news, daily updates and expert analysis on environmental and developmental issues from across the world through videos, data sets and our specialised newsletters. Engage with us here

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Down To Earth welcomes comments and suggestions from readers in response to its articles and opinion pieces. We are introducing a "Pick of the Postbag" award, under which the letter adjudged the best will be highlighted and the winner will receive a free one-year digital subscription of the magazine.
Letters may be e-mailed to editor@downtoearth.org.in or sent to:
The Society for Environmental Communications; 41, Tughlakabad Institutional Area; New Delhi-110 062. Letter writers should mention their full name, postal address and phone number.

Digest

WHAT'S INSIDE

1,000 WORDS VIKAS CHOUDHARY

Uttarakhand reported 457 widespread forest fires in May 2024, according to data on the Forest Survey of India's dashboard. This is a massive jump from 34 such incidents in the corresponding month last year. Forest fires may have razed 1,500 hectares of land over the past six months (forest fire season in India is from October to June), according to government officials. In mid-May, the Supreme Court reprimanded the Uttarakhand government over its mismanagement of the fires, and also criticised the Centre for providing the state with insufficient funds of ₹3.15 crore to deal with the incidents, as against the demand of ₹10 crore.

FOR MORE PHOTOS, SCAN

Native nutrition

Women of Madhya Pradesh revive native seed varieties for their families' food and nutrition security

LAKSHMI UNNITHAN

THE LUNCH menu at the Rani Kajal Jeevan Shala School in Kakrana village of Madhya Pradesh shows a healthy mix of pulses, vegetables and millets. "Providing nutritious food to the children is our responsibility," says Rayatibai, who runs the residential school for children of the Bhil tribal community in the village, located in Alirajpur district. "The village shops do not sell the local varieties of cereals and vegetables we want. So, all of us, including the children, grow the varieties on the school premises. It also helps us conserve the seeds," she says.

Rayatibai was inspired to take up cultivation and conservation of local produce after joining Mahila Jagat Lihaz Samiti (MAJLIS), a non-profit focussed on the health and food security of the Bhil community in the district. "With help from 50 women from various villages, we conserve seeds of local native cereals such as pearl millet, *ragi*, kodo millet, little millet, *sangri*, *bhadi*, *bhatti* and *rala*. We also conserve s*aath dini makke*, a variety of maize that was traditionally cultivated by the Bhils; local varieties of rice and pulses; and vegetables," says Subhadra Kharpede, founder of MAJLIS.

Along with her husband Rahul Banerjee, a social activist who also works with the Bhil tribe, Kharpede collects native seeds from conservators in the state and gives them to the women to cultivate. After harvest, the women set aside some crops for their families and deposit some seeds in a seed bank at Pandutalab village in the district.

Kharpede and Banerjee have been working with the community since the 1990s, helping them preserve their forests and apply for forest rights. Post Independence, demand for timber and forest produce led to deforestation in Alirajpur. With most men of the Bhil community having left their villages in search of work in other states, women took charge to save their forests. With Kharpede and Banerjee, they formed a trade union called the Khedut Mazdoor Chetna Sangath and have so far preserved over 13,000 hectares of forestland across 70 villages. During this time, however, the women noticed a change in their diet. With the Green Revolution and the push for high-yielding crop varieties, indigenous crops were replaced with hybrid maize. There was also an increase in the use of pesticides and fertilisers.

"Living in forested areas, we do not have easy access to towns and markets, nor do we always have enough money to buy produce. We had resorted to bland gruel made from maize, which had no nutritional value," says Tejlibai, a resident of Khodamba village in the district. "After we started producing our seeds and cultivating them we at least have enough food at home for our children and grandchildren. Native crops also do not require pesticides and fertilisers, cutting down costs," she says.

Now, apart from conserving the seeds, the women of MAJLIS visit agriculture and seed festivals in other states to display and sell them. "We are now planning to open more seed banks, including one at the Rani Kajal Jeevan Shala school," says Kharpede.

A Bhil tribal woman from Alirajpur district displays native seeds she stores in a seed bank in Pandutalab village

EXTREME WEATHER

India feels the heat this May

INDIA WAS under an intense heatwave spell in the second half of May, with temperatures soaring over the northwest region, according to data released by the India Meteorological Department (IMD). Gujarat and Rajasthan were the worst-affected, seeing 12 and 11 heatwave days, respectively, between May 16 and May 26. Delhi too recorded temperatures between 40°C and 49°C on most days.

In mid-May, World Weather Attribution, a consortium of climate scientists, also released a study saying heatwaves seen across the country in April were made 45 times more likely due to climate change.

The extreme heat this summer was accompanied by water scarcity. As per data released by the Central Water Commission on May 30, water storage in India's key reservoirs was down to just 23 per cent of their total capacity. This is not only less than the storage during the same period last year, but also less than the average storage during the last 10 years.

On the other hand, Northeast India saw excessive summer rains and floods near the end of May. Remal, the first pre-monsoon cyclone of 2024, hit the Bay of Bengal on May 26, triggering flash floods and landslides across five northeastern states.

HEALTH

First fatal human case of H5N2 bird flu in Mexico

A 59-YEAR-OLD man in Mexico died in April due to avian influenza, the World Health Organization (WHO) confirmed on June 5. The global health body also said this was not just the first human case of the disease, also called bird flu, in Mexico, but also the first time the Influenza A(H5N2) virus has ever been reported in a person. The H5N2 strain has only been reported in poultry earlier—in Mexico, two outbreaks were reported in March this year, says WHO. The US, too, reported the strain in an outbreak in 2004, according to the Centers for Disease Prevention and Control (CDC). While it is not clear how the patient in Mexico contracted the virus, health authorities said that none of his contacts reported any of the symptoms of weakness, fever or diarrhoea. Meanwhile, the H5N1 strain of bird flu, which has been in global circulation since 2020, infecting birds, mammals and humans, was reported to have caused another outbreak among dairy cows in the US. In separate studies in May, scientists detected traces of the virus in the raw milk of infected cows, sparking concerns about its further spread.

CLIMATE

African nations, US weigh in on carbon offsets

A GROUP of 10 West African countries called for allowing countries to use carbon offsets to cut emissions, despite doubts about their effectiveness. Carbon offsetting is a mechanism through which entities compensate for emissions they may generate by investing in emission reduction or carbon storage projects. However, various studies and analyses, including those by the US-based Center for Strategic and International Studies, suggest that carbon offsets do not help overall climate goals. Yet in a May 24 letter to the Science-Based Targets initiative (SBTi), a corporate climate action organisation, the West African Alliance on Carbon Markets and Climate Finance suggests including offsets within net-zero guidance to companies. Soon after, on May 28, the US released its first ever set of guidelines on carbon offsets. The non-binding guidelines attempt to define "high-integrity" offsets that deliver real and quantifiable emissions reductions, and also urge companies to focus on reducing greenhouse gases. However, experts say the norms are vague and unlikely to be effective.

BITS GLOBAL

More than 2,000 people were reported to be buried alive after a mountain collapsed onto a remote village in Papua New Guinea's Enga region in mid-May.The government conducted a two-week rescue operation till June 6, at the end of which the UN estimated the official death toll to be 670, with 11 bodies found.The International Organization for Migration said in a statement that people who could not be found would be declared missing persons, while the area would be declared a mass burial site.

The UN's International Tribunal for the Law of the Sea on May 21 for the first time called greenhouse gas emissions a marine pollutant, and said that countries have an obligation to take mitigate their effects on oceans.The court was hearing in a case brought by nine small island states to seek increased protection of oceans from climate change and rising sea levels.The ruling, while not legally binding, is believed to have created a precedent on the role of emissions in future climate litigations.

At least 11 coal miners suffocated to death due to a methane gas build-up in a coal mine near Quetta, Pakistan, on June 3. The miners were working 457 metres below ground when they succumbed to accumulation of methane, a potent greenhouse gas, said the country's officials.

Twelve European countries, including Austria, Germany, Sweden and the UK, signed the Zero Debris Charter on May 23.Announced in 2023, the charter is a commitment to become debris-neutral by 2030. As per the European Space Agency, there are more than 1 million pieces of space debris in the Earth's orbit, which could damage satellites and other space assets.

BITS INDIA

Odisha's elephant population has grown to 2,098 in 2024 from 1,976 in 2017, according to the state's latest elephant census released on June 5.Tuskers in the state increased by 40 per cent from 344 in 2017 to 474 in 2024, says the "All Odisha Census 2024".The increase in elephant population may be due to changes in the animals' foraging movement patterns and in land use, said forest officials.

More than 440 cases of diarrhoea were reported in Budhanpur village, Panchkula, Haryana in the 10 days till June 4, with one 18-month-old child dying due to the outbreak.The district's health authorities said they surveyed some 4,300 houses and tested water samples to ascertain the cause of the outbreak.

Only 28 per cent of Indians consume healthy food comprising all five food groups, while 38 per cent consumed processed food, says a new report released by International Food Policy Research Institute (IFPRI) on May 29. As a result of poor diet, 16.6 per cent of the country's population suffers from malnutrition, says the report.

The Uttar Pradesh forest department auctioned 400 trees in Lucknow on June 5, as they were believed to be obstructing construction work.The auctioning of the trees, for over ₹26 lakh, marked them for clearing. Environmentalists in Lucknow convened the same day to urge the forest department to reconsider felling the trees.

IN COURT

NATIONAL GREEN TRIBUNAL

■ Taking cognisance of mismanaged municipal solid waste in Rangri village, Kullu district, the National Green Tribunal (NGT) directed the Manali Municipal Council to pay ₹4.6 crore to the Himachal Pradesh State Pollution Control Board as compensation.

■ In a case on illegal encroachment, clearing of trees and construction on reserved forestland in Nayagarh district, Odisha, NGT directed constitution of a three-member committee to probe the claims and submit a report by the end of June.

SUPREME COURT

■ The Supreme Court told Himachal Pradesh to release 137 cusecs of surplus Yamuna water to Hathinikund Barrage in Haryana by June 7. Noting an "existential problem" of water in Delhi, the court told Haryana to direct the water from Himachal Pradesh to Wazirabad in the national capital.

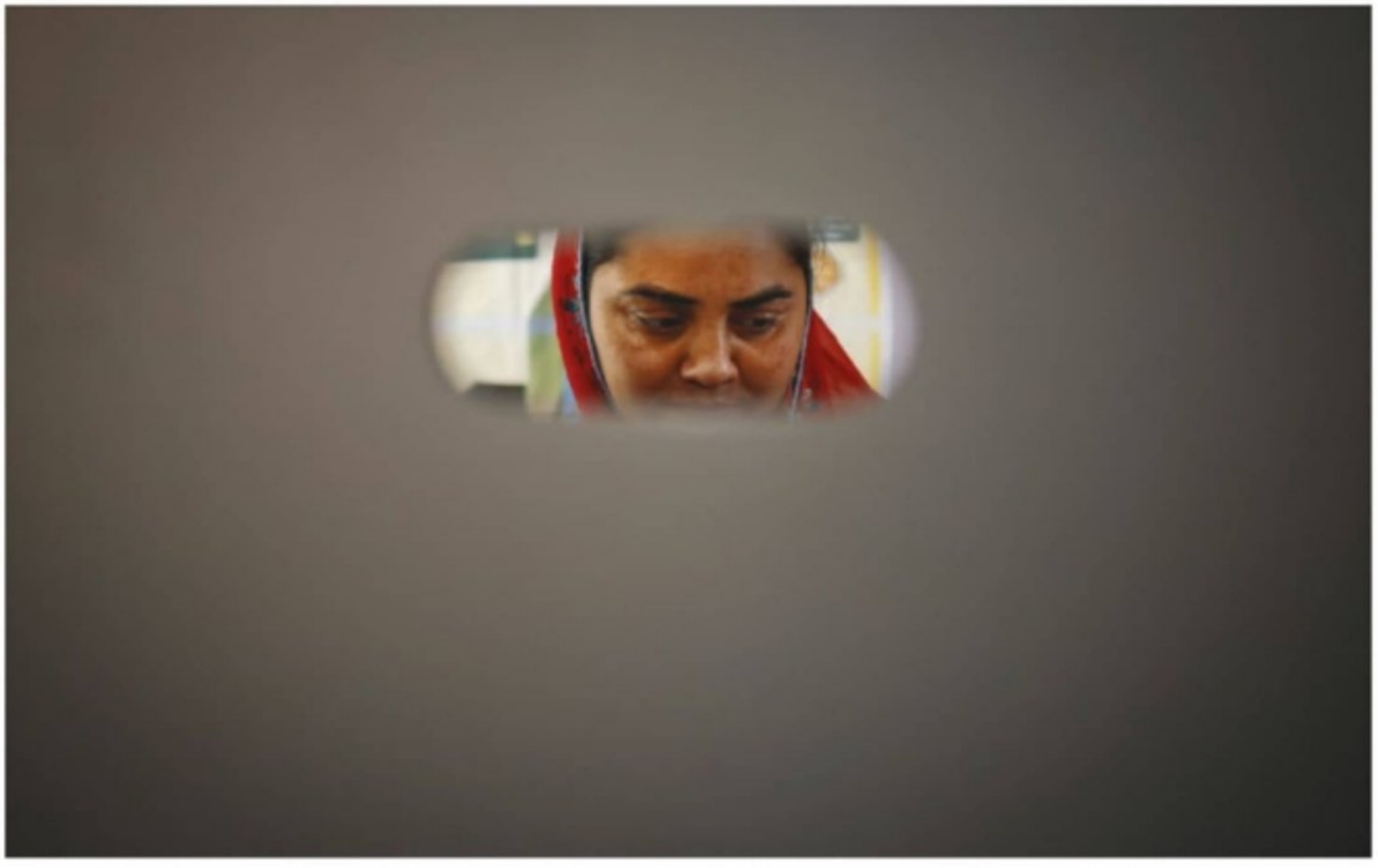
■ The apex court stayed the construction of a greenfield airport in Silchar, Assam, on the grounds that the project did not have environmental clearance and violated a 2006 NGT order.The airport is planned to be built on tea plantations.

So far...

Number of cases on environment and development tracked from January 1 to June 6, 2024

NATIONAL GREEN TRIBUNAL	SUPREME COURT	HIGH COURTS
214	38	49

FOR DETAILED VERDICTS, SCAN



Signs that local issues were the decisive factors in electoral decisions were evident in agrarian states of Punjab, Haryana and Uttar Pradesh

A local national verdict

Issues of unemployment, price rise and agrarian distress seem to have shifted voter sentiment in the recent general elections

SHAGUN, RAJU SAJWAN, MOHD IMRAN KHAN, HIMANSHU N, AJIT PANDA

LAXMAN BAG, a former daily wage labourer, defeated Odisha's five-term chief minister Naveen Patnaik from the Kantabanji Assembly constituency in the recently concluded elections. Kantabanji in west Odisha has been in the news for large-scale outward migration of labourers due to lack of employment in the area.

In Bihar, Mithilesh Tiwari of the Bharatiya Janata Party (BJP), which is in power in the state along with the Janata Dal (United), lost the Buxar Lok Sabha constituency to Rashtriya Janata Dal's Sudhakar Singh. The government's handling of a land acquisition drive over the past few years to build a power plant is reported to have played a major role in the electoral loss. "We voted against BJP for ignoring our demands. The brutal police action against our peaceful protest backfired," Haridayal Tiwari, a farmer from Buxar's Banarpur village, tells *Down To Earth* (DTE).

India just saw conclusion of its longest general election that ran from April 19 to June 1. Some 600 million people voted in the polls to elect members to the Lok Sabha as well as to four state Assemblies. By 6 pm on June 4, the verdict of the world's largest electoral exercise was out, with many unlikely defeats and victories, such as those mentioned above. The ruling

PHOTOGRAPH: REUTERS

National Democratic Alliance (NDA), led by Prime Minister Narendra Modi's BJP, was expected to sail into a third consecutive term, with a bigger majority in the Lok Sabha. The opposing bloc—the Indian National Developmental Inclusive Alliance (INDIA)—led by Indian National Congress, was to be pushed into electoral oblivion. But the final results show a relatively close contest: 292 seats to NDA and 234 seats to INDIA bloc, with BJP falling much short of the majority mark of 272 seats.

On June 9, Modi took oath as the prime minister for the third consecutive term, but the dip in BJP's seats—from 303 in 2019 to 240 in 2024—poses a critical question: Why did it not perform as expected?

First, a quick electoral profile of India. Despite the country's skewed sex ratio, the number of registered male voters to female voters is 100:110. Women are also increasingly voting more. In terms of occupation, every second voter belongs to an agricultural household. The world's largest democracy also hosts the maximum number of poor as well as unemployed youth.

As the campaign for the elections started in early April, Modi set the agenda: a clear majority to establish the electoral consent for making India a "developed country" by 2047. The parameters that define a "developed" country included a US $5 trillion economy; employment for all; and rise of India's clout in the world. Modi sold the idea as his guarantee, becoming the sole candidate, in a way of speaking, for NDA.

As the campaign progressed, the "developed" India pitch took a back seat and polarising narratives gained prominence. This is where the voters seem to have decided to make the election about local issues. The INDIA bloc campaigned solely on the raging local (but prime) issues of unemployment, price rise, agrarian distress and falling farmer incomes. They added caste-based social and economic distress to the equation, making it a very local election.

In April, a pre-poll survey by Delhi-based research institute Centre for the Study of Developing Societies (CSDS)-Lokniti had found an unequivocal resentment among voters. Some 62 per cent of the people surveyed said that it was more difficult to get jobs today than it was five years ago. In response to the question, "What about the price rise? Has it increased or decreased in the last five years?", some 71 per cent of the people surveyed said that it had increased. In its post-poll survey, CSDS-Lokniti found that "people who felt their economic situation had worsened were more likely to have voted for the Opposition, while those who felt the situation remained unchanged divided their votes almost equally between the ruling regime and the challenging party." The survey's assessment on the government's performance and its electoral impact says: "Nearly a quarter of the electorate cited price rise and unemployment as the most disliked work of the Union government's performance. Additionally, one in 10 highlighted poverty."

IN 159 OF INDIA'S 344 RURAL PARLIAMENTARY CONSTITUENCIES, CANDIDATES BELONGING TO THE INCUMBENT CENTRAL OR STATE GOVERNMENTS LOST THE ELECTION

A DTE analysis of India's 344 rural parliamentary constituencies finds that people voted for candidates belonging to the incumbent government in 185 constituencies while in 159 constituencies they voted against them.

Signs that local issues were the decisive factors in electoral decisions were evident in the agrarian states of Punjab, Haryana and Uttar Pradesh (especially western districts), where BJP suffered major losses. This is also the reason for the results being perceived as an aftermath of farmer anger seen during the agrarian protests along the borders of the national capital from August 2020 to December 2022. In Punjab, BJP did not win any seats, while it had won two seats in the last election. The party's performance in Haryana was similar. In the last Lok Sabha polls, the saffron party had won all the 10 seats. But this time, it won only five. Interestingly, after the Centre repealed the farm laws in December 2021, the electoral performance of BJP in the western Uttar Pradesh during the 2022 Assembly elections was remarkable. But it failed to repeat that success in the 2024 Lok Sabha elections, perhaps, because the farmers are protesting again in Uttar Pradesh.

In Maharashtra, the onion proved to be more than a kitchen staple. Of the 13 Lok Sabha constituencies where the majority of the state's onion farmers are concentrated, 12 were won by the INDIA bloc. In the 2019 Lok Sabha election, NDA had won 11 of these 13 seats, with BJP securing seven seats.

The discontent of farmers is due to a decision taken by the Centre in March, when it extended the ban on onion export. With this, the *mandi* (wholesale market) prices nosedived and farmers struggled to recover cultivation costs. "Onion farmers have taught a lesson to BJP in a big way this time," says Anil Ghanwat, of Shetkari Sanghatana, a Maharashtra-based farmer union. DTE

@down2earthindia

INDUSTRIAL POLLUTION AND GOVERNANCE

AAETI

RESIDENTIAL TRAINING PROGRAM ON LOW CARBON PATHWAYS FOR INDUSTRIAL SECTORS

DATES: **JULY 2-5, 2024** | LAST DATE TO APPLY: **JUNE 20, 2024**

The surge in industrial activity due to the growing Indian economy is leading to heightened requirements for energy and raw materials. Key industrial sectors significantly contribute to the nation's greenhouse gas (GHG) emissions and are projected to escalate further. To align with India's commitment to reduce GHG intensity by 45% below 2005 levels by 2030, substantial interventions and actions are imperative.

Additionally, international initiatives like CBAM add pressure on Indian industries to embrace low-carbon production methods to maintain competitiveness globally. Industry stakeholders must devise a holistic strategy, encompassing visionary and pragmatic approaches to fully leverage each sector's potential in mitigating carbon emissions.

In this regard, the Centre for Science and Environment (CSE) has designed a four-day training course with experts across sectors to equip all stakeholders with the right knowledge and skills to accelerate low-carbon pathways for industrial sectors to meet their sustainability goals. The course covers critical low-carbon pathways which will help stakeholders chalk out future implementable decarbonizing pathways for their respective industrial sectors.

FEEDBACK FROM PAST PARTICIPANTS

The programme is extremely useful for the State Climate Change Cell of Odisha. The low carbon pathways will help in strategizing the State Action Plan on Climate Change to focus on the Multi Sectoral approaches in policy framing through decarbonization of different developmental activities in the state which ultimately addresses the goals of NDCs and SDGs.

- Sujeet Kumar Sahoo, Scientist, State Climate Change Cell, Forest, Environment and Climate Change Department, Government of Odisha

The industrial decarbonization training program was exceptionally comprehensive, offering practical insights and strategies for reducing emissions. Highly recommended for anyone seeking to make a meaningful impact in sustainability efforts.

- K. Praveen, General Manager, EMD, Steel Authority of India Limited

The training programme is great for industry personnel doing research & development, exploring means for low-carbon pathways

- Shashank Tandon, Assistant Manager, National Fertilizer limited

The faculties, facilities and the campus, everything about the programme was wonderful

- Vineet Mhatre, Sr. Engineer, Munters India Humidity Control Pvt. Ltd.

The experts who visited and the carefully curated lectures on industries is highly appreciated

- Shrutee Ganguly, Ex-Head-Corporate Sustainability & ESG Solutions, Sattva Consulting

PARTICIPANTS WILL BE AWARDED CERTIFICATES ON COMPLETION OF THE TRAINING

COURSE COORDINATOR

MANAS AGRAWAL
Research Associate, Industrial Pollution Unit
For Queries: Email at industry-training@cseindia.org
Phone: + 91 95214 27918

Link to register and pay: https://www.cseindia.org/otprograms/register?type=lcpis

LEARNINGS FROM THE PROGRAMME

- Accelerating low-carbon growth in India to meet our NDC and net zero target
- Feasibility of cleaner fuels such as biofuels, natural gas and hydrogen
- Role and scope of energy efficiency
- Role of resource efficiency and circularity in reducing GHG emissions
- Understanding sector-specific measures to reduce GHG emissions
- Role of renewable energy in reducing thermal power
- Feasibility of carbon capture, utilization and storage in India
- Tackling the challenge of CBAM in Indian industries
- Role of carbon markets in enabling low-carbon technology
- Environmental compliance for BRSR
- Scope of climate/green financing options for implementing cleaner technologies in industries
- Discussion and interaction with national and international sector experts

COURSE FEE

Rs 28,000

Course fee entails lodging, boarding and training kit costs. It does not cover travel costs from your respective location to Delhi and back.

**The course will offer sponsorship to professionals from government ministries and departments*

TARGET PARTICIPANTS

- Professionals, consultants and decision-makers from governmental and non-governmental institutions
- Academicians and researchers working in the field of sustainability and GHG reduction in industries
- Working professionals from industrial sectors

The Parker Lake wildfire in Canada prompted an evacuation order and emergency alert for the town of Fort Nelson in British Columbia province on May 13

Wild guess

Despite being a significant source of greenhouse gases, wildfire emissions remain underestimated

ROHINI KRISHNAMURTHY | DELHI

IF THE area that gets affected by wildfires each year were considered a country, it would be the second largest emitter of carbon dioxide (CO_2), surpassed only by China. In 2023, wildfires globally released 7,330 million tonnes of CO_2, according to the EU's Copernicus Atmosphere Monitoring Service (CAMS). This is significantly higher than the 6,000 million tonnes of greenhouse gases (CO_2 and other gases) emitted by the US in 2022 (see 'Big emitters', *p*18).

This year, as many as 11 countries have reported wildfires as of May 15. In Canada, home to 9 per cent of the world's forests, significant fires were reported as early as May 9, leading to evacuation orders in several towns in British Columbia and Alberta provinces. By mid-May, an estimated 55 million tonnes of CO_2 ($MtCO_2$) had already been released into the atmosphere from these fires, according to CAMS. The May 2024 North American Seasonal Fire Assessment and Outlook, issued by government agencies in the US, Canada and Mexico, highlights that the current warm, dry, and windy conditions could trigger additional wildfires. This raises concerns that the 2024 Canadian wildfires could follow the path of the record-breaking 2023 event, which destroyed 18.4 million hectares—an area bigger than Greece—and released 1,760 $MtCO_2$.

The actual wildfire emissions could be even higher because calculating them is challenging and "probably underestimated," says Cynthia Whaley, a researcher at Environment and Climate Change Canada, a government department that coordinates the country's environmental policies.

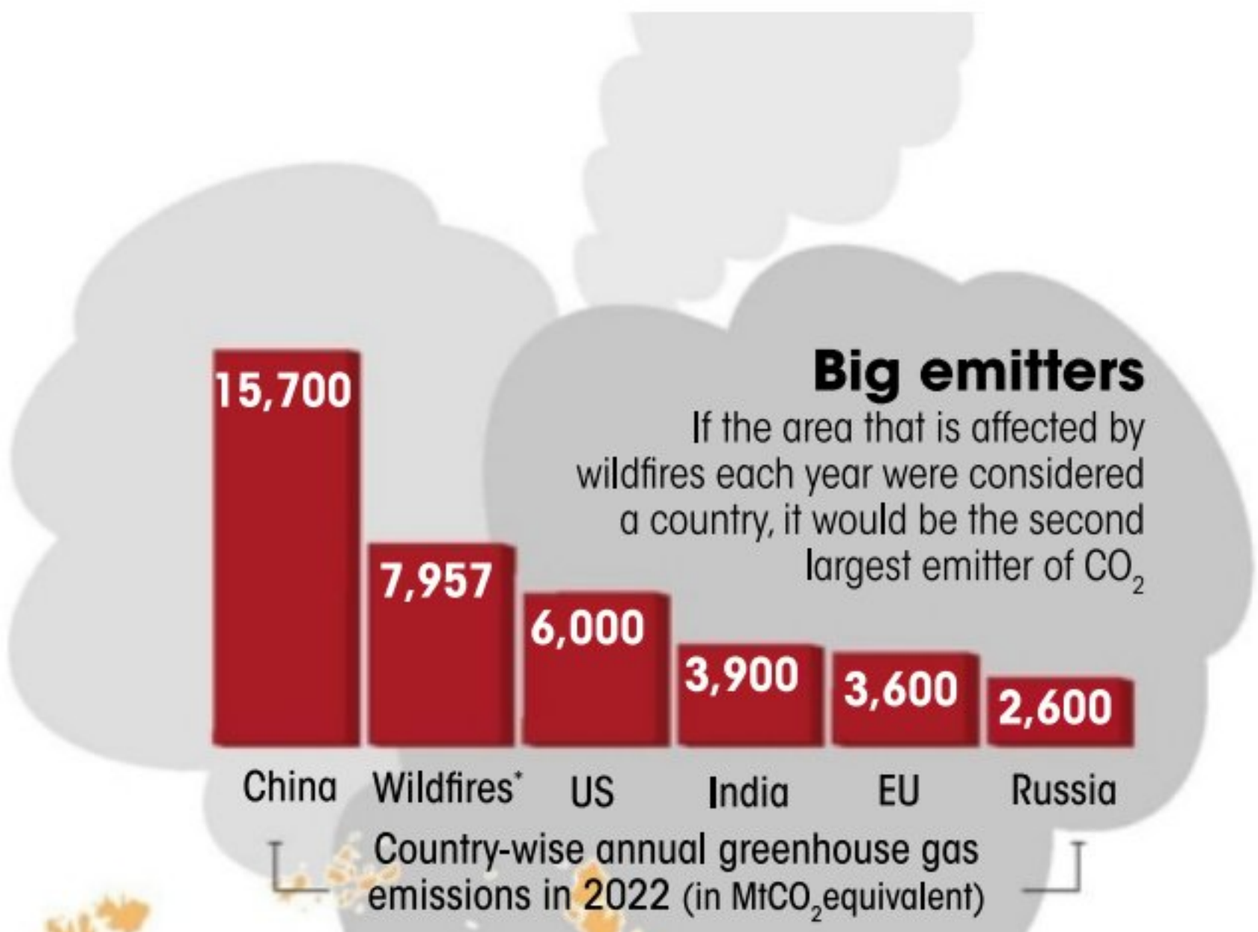
Calculating wildfire emissions is complex because it is influenced by variables like temperature, wind,

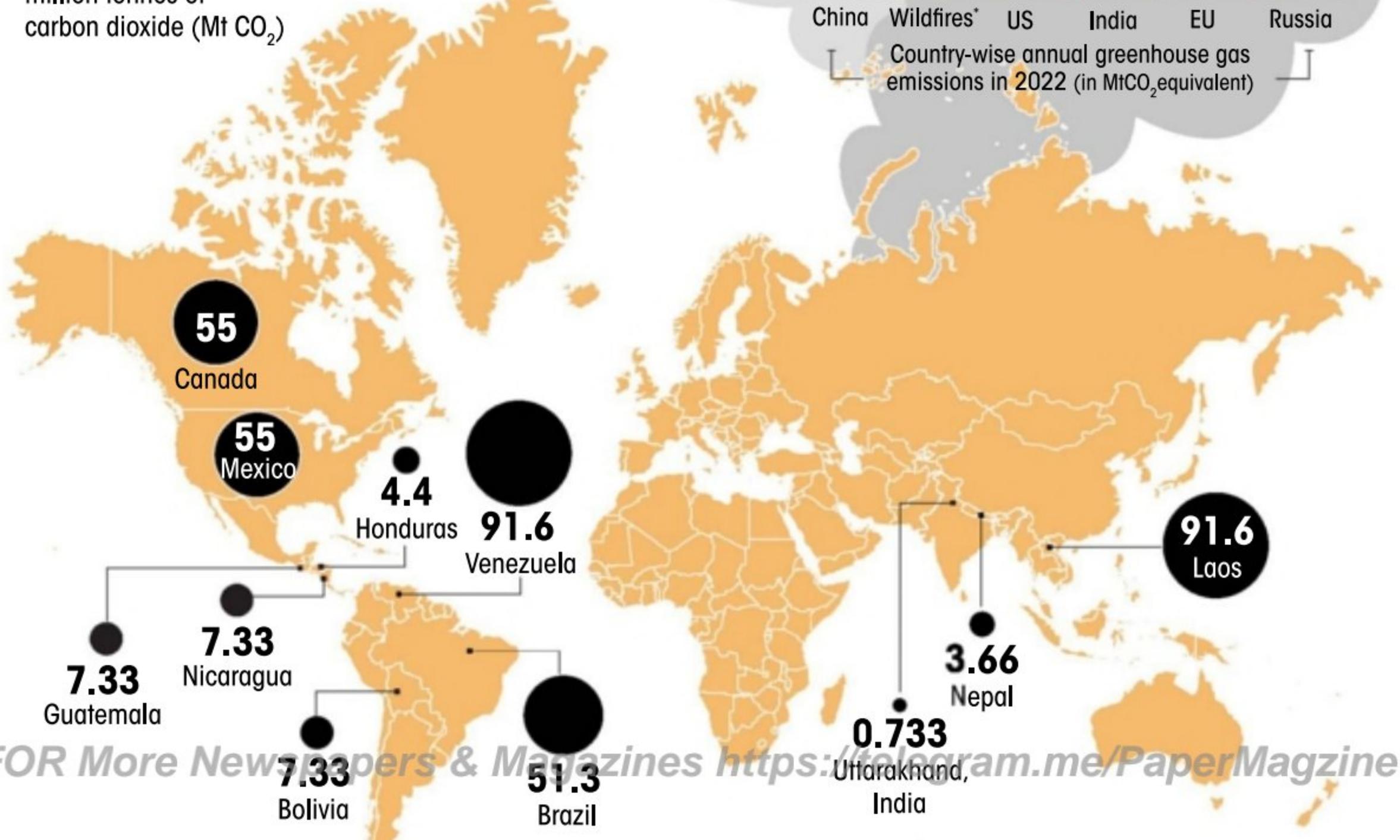
PHOTOGRAPH: REUTERS

Wildfires in 2024

As of May 15, wildfires across 11 countries have produced over 375 million tonnes of CO_2 emissions

All numbers are in million tonnes of carbon dioxide (Mt CO_2)





* Global wildfire CO_2 emissions for 2023; Source: Copernicus Atmosphere Monitoring Service, updated till May 15, 2024, and Emissions Database for Global Atmospheric Research, European Commission, 2023

humidity and drought, which vary greatly and unpredictably. In the past four decades, global warming has further created conditions ripe for wildfires, leading to more frequent and intense events. World Weather Attribution, an international team of climate scientists, states that the 2023 wildfires in Quebec, Canada, were at least twice as likely and 20-50 per cent more intense due to climate change.

Wildfires are also spreading to new areas. A 2021 study published in the *Proceedings of the National Academy of Sciences* (PNAS) found that fires in the western US have been spreading to higher elevations, where blazes have been rare historically, because of warmer and drier conditions. The other concern is that the rising frequency and intensity of wildfires do not give forests enough time to regrow to absorb the emissions. Traditionally, 80 per cent of the carbon released during a wildfire is reabsorbed by new vegetation, while the remaining 20 per cent contributes to atmospheric CO_2, according to a 2022 paper published in *Science Advances*. But climate change creates a feedback cycle: Hot temperatures lead to extreme weather and droughts, which worsen wildfires and inject more CO_2 into the atmosphere. This, in turn, traps more heat, perpetuating the cycle (see 'Caught in a loop', *p*20).

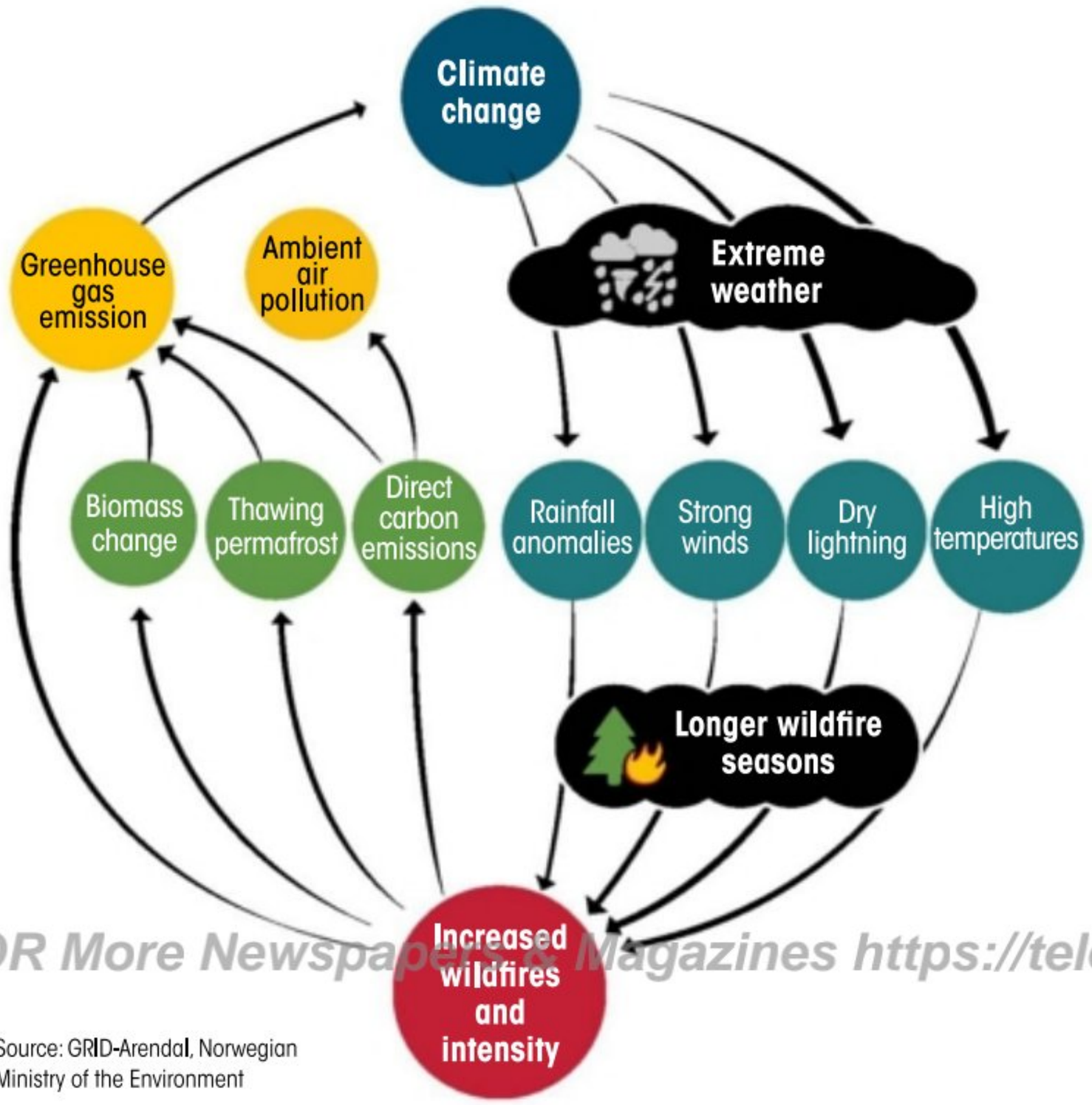
ASSESSMENT DIFFICULTIES

"The margin of error for wildfire-related CO_2 emissions can be as high as 20 per cent," Guido van der Werf, a researcher at Wageningen University in the Netherlands, tells *Down To Earth* (DTE). In contrast, the uncertainty for CO_2 emissions from fossil fuel combustion is around 6 per cent, according to a 2021 paper published in *Scientific Data*.

According to the guidelines for national greenhouse gas inventories by the UN Intergovernmental Panel

Caught in a loop

Climate change increases the frequency and severity of extreme weather, leading to more frequent and longer wildfire seasons. This heightened wildfire activity further boosts greenhouse gas emissions, exacerbating climate change



Source: GRID-Arendal, Norwegian Ministry of the Environment

on Climate Change (IPCC), scientists need to know four things to compute wildfire emissions. First is the extent of the burned area. Second is the biomass density or vegetation in the burned area. Third is the emission factor, which is the mass of pollutant produced per unit dry mass of fuel (vegetation) burned. The last is the combustion factor of the fires, which tells scientists how much coal charcoal is left after wood is burned. "Once the values are available, it is only simple multiplication," says van der Werf. India and many other countries use the IPCC guidelines to ascertain wildfire emissions.

The Global Fire Assimilation System (GFAS) used by EU's CAMS employs a slightly different approach. It is modelled around the fire radiative power, which represents radiant heat released from detected fires in megawatts from satellite data. "It is a measure of the brightness temperature anomalies in different parts of the infrared spectrum. A high anomaly indicates a heat source," Mark Parrington, senior scientist at CAMS, tells DTE. Next, they convert the observations to ascertain the vegetation consumed by the fire and then apply emission factors to estimate the emissions. "We use this measurement as it is available in near real-time," he adds.

No matter which method is used, large uncertainties remain in measuring emissions from wildfires. One key source of uncertainty is fire detection. The accuracy of satellite data can be affected by weather conditions, such as cloud cover. The most widely used tool to measure fires is the Moderate Resolution Imaging Spectroradiometer (MODIS), an instrument on two low-Earth NASA satellites Terra and Aqua, which scan the Earth's surface at least once every day or two. "But we do not know about a lot of fires that occur outside of those measurement times," says Parrington. The two satellites, for instance, cross tropical India at about 10 am and about 1 pm every day. The other option is to use geostationary satellites, which are positioned in a circular orbit at the Earth's equator. They record the same image at brief intervals, proving to be particularly useful for observations of weather conditions. But the downside is that the image resolution suffers because they are stationed at a great distance of about 36,000 km from the Earth's equator.

"So, estimates of how much is being emitted are at a lower bound," says Parrington. Low-Earth satellites also miss small fires, which occupy an area of less than 100 ha. A 2021 PNAS study concludes that the current estimates of global burn based on sensors such as MODIS should be seen as "very conservative". The team analysed a new set of images obtained using the multispectral instrument sensor aboard the European Space Agency's Sentinel-2 satellite and found 4.89 million square kilometres (km^2) of land burned in Africa in 2016, about 16 per cent of the continent's total area. Compare this to MODIS' detection of

only 2.72 million km^2 burned area in the same year. About 87 per cent of the difference was attributed to the inclusion of small fires. The analysis also found that wildfires in Africa emitted 5,280 Mt of CO_2. This is 31-101 per cent higher than previous estimates.

Another source of uncertainty is smouldering fires, which are the slow, low-temperature, flameless burning of vegetation. Smouldering wildfires have, till date, received little attention. But recent studies show that they are a global concern because they emit very large amounts of carbon, and are difficult to detect and suppress. Smouldering is predominantly observed in peatlands, a type of wetland built of partially decayed plant matter. Covering only 3 per cent of the world's landmass, peatlands exist across 180 countries and store at least twice as much carbon as any other vegetation type. Fires in peatlands can reach deep layers several metres below the surface, making it difficult to spot the extent of damage.

Then, there are emission factors, which add to the uncertainties. These are derived from laboratory- or field-based experiments. Scientists like van der Werf conduct field surveys to capture smoke in bags, which are then transported to the laboratory to calculate the amount of CO_2 emitted from a given mass. Some researchers use aeroplanes to sample the smoke plumes. However, most estimates come from the US and Europe, with little representation from countries of the Global South. Getting emission factors from different regions is important because the values can vary with geographic zones and vegetation groups. Emission factors are not available for India. N H Ravindranath, a retired professor at the Indian Institute of Science, Bengaluru, says the country uses emission factors from tropical regions provided by IPCC.

India's Third Biennial Update Report to the UN Framework Convention on Climate Change states that the country's emissions from forest fires contribute a mere 1-1.5 per cent of all global emissions from wildfires, despite being home to about 2 per cent of the total global forest area. The report warns that this could change with climate change because temperature rise would dry out vegetation, making it more fire-prone, especially in Himachal Pradesh and Uttarakhand.

SMOULDERING WILDFIRES HAVE HISTORICALLY RECEIVED LITTLE ATTENTION, BUT RECENT STUDIES REVEAL THEY ARE A GLOBAL CONCERN DUE TO THEIR SIGNIFICANT CARBON EMISSIONS AND THE DIFFICULTY OF DETECTING AND SUPPRESSING THEM

Another issue with the current fire emission inventories is that they do not often arrive at consistent estimates. The estimations between GFAS and Global Fire Emissions Database (GFED), the most widely used fire emissions inventory among scientists, can vary by a factor of two or three, says Whaley. A 2015 study published in *Environmental Pollution* compared the average annual CO_2 emissions of the most widely used datasets in 2002-11. It found that GFED version 3 reported 6,521 $MtCO_2$, GFED version 4s reported 7,158 $MtCO_2$, GFAS reported 6,698 $MtCO_2$, and the Fire Inventory (FINN) by the US-based National Center for Atmospheric Research reported 6,919 $MtCO_2$.

There are also regional differences. Among the tested datasets, GFED versions 3 and 4s, and GFAS give relatively consistent emissions, but there are large differences in the Northern Hemisphere, South America, Boreal Asia, Central America and Mexico. Also, FINN's estimate of CO_2 emissions in South America and Southeast Asia (which includes India) is higher than in the other three inventories.

Considering the challenges, the scientific community has come together to address this problem. Parrington calls the work on emissions uncertainties a new science that is rapidly growing. In December 2022, International Global Atmospheric Chemistry, an international community of atmospheric scientists, created an initiative called Biomass Burning Uncertainty: Reactions, Emissions, and Dynamics (BBURNED). It aims to better quantify the uncertainty and variability in biomass burning emission estimation by coordinating the international scientific community to improve understanding of the current and future impacts of wildfires on public health and climate.

BBURNED organised its first workshop in November 2023, focusing on emissions inventories and their methodologies. The next workshop in September 2024 will deliberate on fire emissions and modelling to foster collaboration and data sharing. "With more certain estimates, we can improve the models and our simulations of not only what is happening right now but what could happen under different climate change scenarios," says Whaley. DTE @down2earthindia

THE NEXT PANDEMIC

Buoyed by climate change and global trade, pathogens that cause disease outbreaks in food crops are spreading far and wide. They are also evolving fast to reproduce quickly and infect new hosts

A report by **Himanshu N** from West Bengal and **Kiran Pandey** in New Delhi with

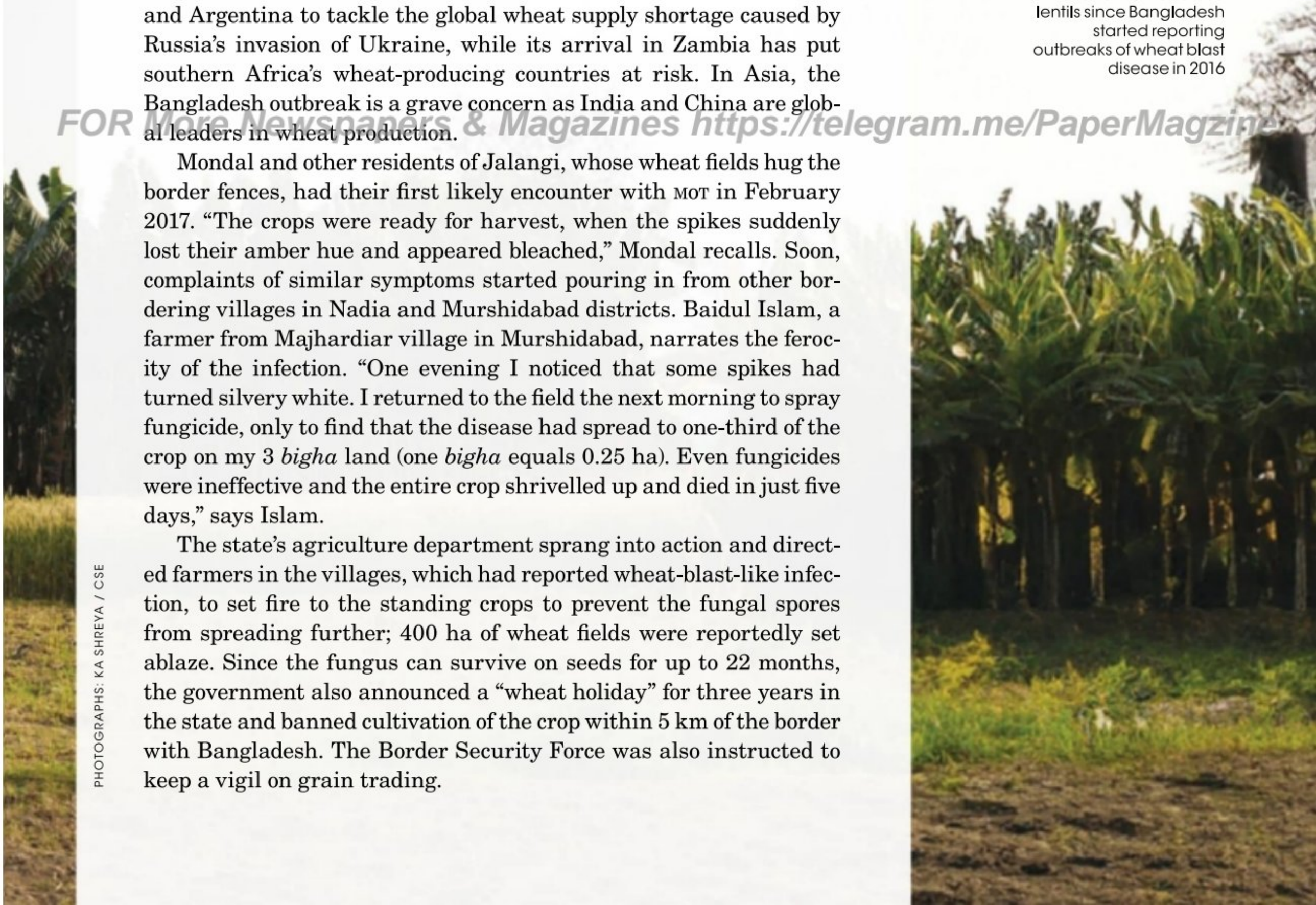
Kelvin Mbewe in Zambia, **Mekonnen Teshome** in Ethiopia, **Bennett Oghifo** in Nigeria, **Tony Malesi** in Kenya, **Angela Rwabose** in Uganda and **Newton Sibanda** in Zambia

FOR THE past seven years, Raizul Mondal and several other residents of Jalangi village in West Bengal's Murshidabad district have been guarding India's eastern borders. They have even sacrificed their livelihoods to prevent a catastrophe. Lurking across the international boundary in Bangladesh is an invisible enemy—*Magnaporthe oryzae Triticum* (MoT), a fungus that attacks wheat crops and can wipe out the entire harvest in a matter of days.

Before reaching Bangladesh in February 2016, the fungus had periodically ravaged 3 million hectares (ha) of wheat fields in South America since it was first identified in Brazil in 1985. An outbreak in 2009 had cost Brazil one-third of that year's crop. The 2016 outbreak in Bangladesh—this is when the fungus made its first appearance in Asia—was equally rapid and devastating. Estimates by the country's Department of Agricultural Extension show that the fungus caused wheat blast disease in 15,000 ha—3.4 per cent of the area under the crop in Bangladesh—reducing yield by 51 per cent in the affected fields. Since then, MoT has spread to 14 districts, including Jashore, Jhenaidah, Chadanga and Rajshahi that border India. By 2018, the fungus invaded Africa and wheat blast appeared in experimental plots and farms of Zambia. With its presence simultaneously on three continents, MoT has emerged as a global threat to food security. The fungus' presence in South America could derail the efforts by Brazil and Argentina to tackle the global wheat supply shortage caused by Russia's invasion of Ukraine, while its arrival in Zambia has put southern Africa's wheat-producing countries at risk. In Asia, the Bangladesh outbreak is a grave concern as India and China are global leaders in wheat production.

Mondal and other residents of Jalangi, whose wheat fields hug the border fences, had their first likely encounter with MoT in February 2017. "The crops were ready for harvest, when the spikes suddenly lost their amber hue and appeared bleached," Mondal recalls. Soon, complaints of similar symptoms started pouring in from other bordering villages in Nadia and Murshidabad districts. Baidul Islam, a farmer from Majhardiar village in Murshidabad, narrates the ferocity of the infection. "One evening I noticed that some spikes had turned silvery white. I returned to the field the next morning to spray fungicide, only to find that the disease had spread to one-third of the crop on my 3 *bigha* land (one *bigha* equals 0.25 ha). Even fungicides were ineffective and the entire crop shrivelled up and died in just five days," says Islam.

The state's agriculture department sprang into action and directed farmers in the villages, which had reported wheat-blast-like infection, to set fire to the standing crops to prevent the fungal spores from spreading further; 400 ha of wheat fields were reportedly set ablaze. Since the fungus can survive on seeds for up to 22 months, the government also announced a "wheat holiday" for three years in the state and banned cultivation of the crop within 5 km of the border with Bangladesh. The Border Security Force was also instructed to keep a vigil on grain trading.



Farmers in the border villages of West Bengal are reluctant to grow wheat and are shifting to banana, maize and lentils since Bangladesh started reporting outbreaks of wheat blast disease in 2016

PHOTOGRAPHS: KA SHREYA / CSE

The restrictions took a substantial toll on the farmers. Though rice is the dominant crop of West Bengal, farmers in the border areas grow wheat in the winter or *rabi* season. In fact, the nine border districts of West Bengal are major wheat-producing regions in the state. In 2015-16, Murshidabad accounted for 35 per cent—the maximum—of the wheat area of West Bengal. In March 2024, when *Down To Earth* (DTE) visited some of the border villages, there was a significant shift in the crop pattern. The number of people migrating to work as labourers, too, had increased. "The government had assured free ration to those who had to burn down their crops. But only a few households in my village received food grains," says Mondal, who worked as a daily-wage labourer for a year to provide for his family. Officials with the agriculture department tell DTE that in most villages the ban was lifted in 2022. Gyanendra Singh, former director of the Indian Institute of Wheat and Barley Research, Karnal, says, "India has developed over two dozen wheat-blast-resistant varieties along with the International Maize and Wheat Improvement Center (CIMMYT), Mexico. These varieties are now being provided to farmers in West Bengal's border villages."

But Mondal has no plans of growing wheat. He has set aside half of his 6 *bigha* land for banana plantation and grows jute, maize and lentils on the remaining land.

In Majhardiar village, Islam and his brother had left for Kerala to work in a garment factory shortly after the ban was announced. Since the village has farms straddling the border fence, the government extended the ban in Majhardiar by another year. In 2023, as soon as wheat seeds became available in the market, Islam returned home. He and several other farmers in the village sowed wheat, but lost the crop to wheat blast-like symptoms. Islam now plans to migrate again.

INCHING CLOSER

So far, India has managed to thwart the fungus—at least, so it seems. But scientists warn that this may not last long. According to CIMMYT, MOT has an affinity for warm and humid weather. Its spore production increases if temperatures are between 15°C and 27°C and humidity is above 93 per cent. Foggy weather or rainfall then cause the spores to fall onto leaves or heads, causing blast infection. Usually, the timing of infection coincides with the reproductive stage of the crop, causing widespread losses.

Researchers from CIMMYT and other institutes in Germany, Bangladesh, Brazil and the US have modelled how wheat blast would spread under the changing climate that is characterised by both warmer and more humid conditions. They have found that the fungal disease could reduce global wheat production by 13 per cent by 2050. In their study paper published in the journal *Nature Climate Change* on February 1, 2024, the researchers predict that the disease would spread primarily in tropical regions, with substantial potential yield losses in South America, South Africa and South Asia—the major wheat-growing areas. The fungus would also penetrate countries that were previously untouched, and these include, Uruguay, central America, southeastern US, East Africa, India, eastern Australia. Climate in European regions closer to the Mediterranean may become conducive for the disease to spread, putting Italy, France and Spain at risk.

WHEAT BLAST COULD REDUCE GLOBAL PRODUCTION OF THE CROP BY 13% BY 2050. AFFECTED AREAS ARE ALSO SEVERELY IMPACTED BY CLIMATE CHANGE AND FACE FOOD CRISIS

What's alarming is that areas affected by wheat blast are also among those severely impacted by climate change, and where food security is already a challenge. For instance, wheat production in Zambia is rain-fed, grown primarily by small-scale and resource-poor farmers, who typically attain low yields. DTE visited Mpika district of Muchinga province, which reported wheat blast outbreak in 2018. Gertude Chonya, a small farmer from Mufubishi locality, tells DTE that the loss of wheat has directly impacted food availability and income. "We did not have flour for breakfast in the outbreak year and had to depend on *nshima* (porridge made from maize). Our income diminished as we could

Navigating the Climate Change Maze on the Way to Sustainability

Climate risk: The new critical for enterprise risk management

In an era defined by the ever-escalating impacts of climate change, businesses worldwide are confronting a dual imperative: meeting stringent regulatory compliances on ESG emissions and fortifying their operations to weather the storm of environmental volatility. The urgency to climate-proof operations is not merely a matter of compliance but a strategic initiative to ensure business continuity and resilience along their net zero journey.

Today, sustainability is also about climate resilience in addition to traditional parameters. Not only are the actions of enterprises affecting climate change, but the impact of climate change - in the form of increased severity and frequency of floods, rainfall, and cyclones – is also having a deep impact on the functioning of businesses.

At the heart of navigating climate change on the way to sustainability lies the need for Enterprise-wide Climate Change Risk Analysis and Adaptation Planning. Businesses can successfully plan and execute their net zero journeys by comprehensively evaluating risks ranging from extreme weather events to shifting regulatory landscapes, proactively devising tailored strategies to enhance resilience and safeguard operations.

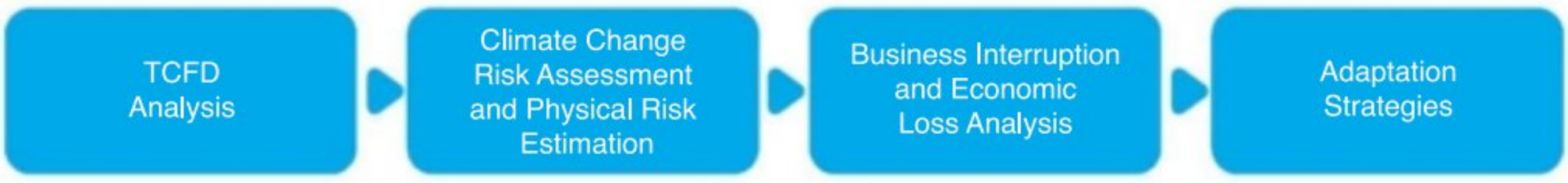
Building climate-ready operations

While global frameworks like the Task Force on Climate-related Financial Disclosures (TCFD) and Global Reporting Initiative (GRI) establish standards for climate risk reporting, they're just stepping stones to climate risk adoption. Beyond identifying risks, businesses should focus on mitigation planning and long-term sustainability in the wake of climate change.

Partnering with climate experts for the long-term sustainability of the business

By partnering with companies like RMSI, enterprises can transform their disclosure recommendations into detailed plans that mitigate risks and enhance sustainability. RMSI has three decades of climate change risk assessment and mitigation planning expertise to deliver ESG-aligned solutions. We identify and mitigate environmental risks, build resilience, and unlock long-term value, paving the way for a sustainable future.

RMSI's process for climate-proofing your operations



To simplify, let's explain this through an example of a steel manufacturer in the industrial sector.

RMSI recently conducted a Climate Change Vulnerability & Risk Assessment to help a global leader in steel production become resilient against floods. The critical activities started after TCFD analysis for the company highlighted flood as a major risk in one of their plants.

- A topographic survey ensured the development of a reliable terrain model and mapping out the plant's water run-off.
- Hydrological and hydraulic modeling was carried out, and flood hazard maps for 100 and 500-year return periods were prepared, considering projected changes in rainfall in the study area for climate change scenarios.
- Mitigation and adaptation measures were provided based on our analysis.
- The physical risk was estimated based on the flood hazard, and innovative approaches were applied to capture various business intelligence components.

By prioritizing a comprehensive climate risk analysis that combines in-depth surveys, detailed modeling, and cost-benefit assessments, a private enterprise can transform its facility from vulnerable to resilient. The recommendations and adaptation measures will ensure a business's long-term sustainability and build confidence for a successful net-zero journey.

RMSI

not sell wheat or make wheat fritters for sale," says Chonya.

A PERFECT PATHOGEN

As of now, no commercially available wheat variety offers complete resistance to wheat blast. A few varieties offer only moderate resistance. Since farmers rely heavily on fungicides to manage the disease, MoT is increasingly becoming resistant to those widely available arsenal. Paul Nicholson, professor at John Innes Centre, UK, a centre for research in plant and microbial science, explains what makes the fungus so invincible. "Diseases in wheat have been known to be around for thousands of years. Examples go back to Biblical times. But wheat blast is new and little is known about it," Nicholson says. Besides, MoT fungus is physiologically and genetically complex. So even after three decades, scientists do not fully understand how it interacts with wheat or which genes in wheat confer durable resistance to it.

According to CIMMYT, the blast grows well on several other plants and crops. So growing wheat on a rotational basis does not confer protection to the crop. Since the fungus also hitchhikes on seeds and crop residues, good management practices, such as screening seeds, certifying them for the fungus and quarantine measures, can help thwart its spread to other countries. But this is clearly not happening. Scientists have identified that the outbreak in Bangladesh followed a series of wheat shipments from South America. A similar route is responsible for the outbreak in Zambia.

▲ In West Bengal's Nadia and Murshidabad districts, agriculture officials claim that the government is supplying varieties that are resistant to wheat blast disease. But farmers still complain of wheat-blast-like infection in crops

Researchers worry that as the fungus spreads to wider geographies, it may evolve to become more virulent or infect other species. Pawan Kumar Singh, a senior scientist who heads wheat pathology group at CIMMYT, says, "There is no information yet on the *Triticum* pathotype jumping hosts in large scale in field conditions. But the consequences can be devastating if the disease undergoes cross-infection and spreads between two crops. The chances cannot be ignored as the pathotype evolves fast, leading to higher genetic diversity than its counterparts."

It could already be evolving. According to a July 2021 review article published in *Frontiers in Plant Science*, between 2017 and 2021, weather conditions in Bangladesh during the wheat growing season were cooler and drier, and did not favour blast infection and spread. Still, the disease did not remain confined to the initial eight affected districts, but spread to 14 new districts. Does this mean a plant pandemic is in the making? Read on.

DEADLY SPREAD

In a globalised world, plant pathogens are causing multiple outbreaks, hampering food security for millions

PATHOGENS ARE at an advantage in this era of unparalleled human movement, transportation and interaction. The COVID-19 pandemic has exposed this vulnerability of the globalised world. In just four months, the novel coronavirus (SARS-COV-2) travelled from China to 200 countries and killed more than 2 million people. Now, imagine a scenario where multiple pathogens make the rounds of the world and cause outbreaks simultaneously. The global food system faces this predicament.

"One can safely assume that multiple plant diseases are going to spread across the world because of globalisation and climate change impacts. This is devastating as climate change is already exacerbating the food crisis across the world," says Nick Talbot of The Sainsbury Laboratory, UK, that conducts research on plant diseases and resistance. What's alarming is that these pathogens are fast mutating to invade previously untouched geographies, infect new hosts and evade resistant varieties (see 'Fearsome eight', *p*32-33).

FUSARIUM WILT

Pushing bananas to verge of extinction

Caused by soil fungus *Fusarium oxysporum*, wilt infection has ruined banana plantations across the world for well over a century now. It has managed to wipe out almost all major resistant varieties developed so far.

Fusarium oxysporum was first reported in Central America in 1890. By 1960, it rooted itself in tropical America, the Caribbean and West Africa impacting 40,000 hectares

Maize lethal necrosis has no treatment and can cause up to 100 per cent yield loss

CONTINUED ON PAGE 34 >>

PHOTOGRAPH: TONY MALESI

FEARSOME EIGHT

The fear of plant pandemics rises as crop pathogens cause large-scale outbreaks simultaneously across countries

CASSAVA BROWN STREAK DISEASE

Caused by: Cassava brown streak virus/ Ugandan cassava brown streak virus

Cassava producers

00 Year of reported outbreak

South Sudan
Mid 2000s

Rwanda
Mid 2000s

D R Congo
Mid 2000s & 2022

Burundi
Mid 2000s

Zambia
Mid 2000s

Malawi
1950 & 2002

Mozambique
2002

Tanzania
1935, 1950, 1993-94, 2002, Mid 2000s & 2022

Comoros
Mid 2000s

Kenya
1950, 2002 & Mid 2000s

Uganda
1945, 1994, 2004 & Mid 2000s

FUSARIUM WILT

Caused by: *Fusarium oxysporum* fungus

Pakistan **2015**

India **2015**

China **1998-2001**

Vietnam **2017-2019**

Philippines **2001**

Jordan **2013**

Oman **2015**

Taiwan **1970**

Venezuela **2023**

Colombia **2019**

Mozambique **2013**

Papua New Guinea **2000**

Australia **1997**

Peru **2021**

Myanmar **2017-2019**

Thailand **2017-2019**

Laos **2017-2019**

Indonesia **1992**

Malaysia **1993**

Banana producers

00 Year of reported outbreak

CITRUS TRISTEZA DISEASE

Caused by: *Citrus tristeza virus*

Italy **2017**

Israel **1950**

West Africa **1959**

California, US **1959**

Brazil **1959**

India **2015-17**

Argentina **1963**

South Africa **1910, 1959**

SSA: Sub-Saharan Africa

Citrus producers

00 Year of reported outbreak

The disease has now spread worldwide, including to South, Central and North America, SSA and North Africa, Europe, West Asia, Indian subcontinent, East Asia, Southeast Asia and Oceania

RICE BLAST

Caused by: *Magnaporthe oryzae* fungus

China **1637 & 1980-81**

Korea **Mid-1970s**

Philippines **1960-70s**

US **1876**

Spread worldwide **1975-1990**

India **1960-61**

Thailand **1982**

Australia **2011 & 2024**

Rice producers

00 Year of reported outbreak

Source: Our World in Data, UN Food and Agriculture Organization, scientific reports

(ha) of then dominant variety Gros Michel. The threat was mitigated with a new resistant cultivar, Cavendish, that now represents the image of banana and provides half of the global supply. However, in the 1990s a new strain of the fungus, known as Tropical race 4 or TR4, emerged from Taiwan. It has proved lethal to over 80 per cent of the 1,000-odd banana varieties available worldwide, including Cavendish. Initially restricted to East Asia and some parts of Southeast Asia for two decades, the disease has aggressively hopped continents and spread to 20 countries, including India—the largest producer and consumer of the fruit. The TR4 Task Force, created by UN Food and Agriculture Organization (FAO) in 2013 to manage the outbreak, calls the strain "one of the most aggressive and destructive fungi in the history of agriculture and the world's greatest threat to banana production". The infection is particularly of concern for East African countries such as Burundi, the Democratic Republic of Congo, Rwanda, Tanzania and Uganda where banana is a staple food as well as cash crop. The region has the world's highest per capita banana consumption of 400 kg to 600 kg.

FUSARIUM WILT HAS PROVED LETHAL TO OVER 80% OF THE 1,000-ODD BANANA VARIETIES AVAILABLE WORLDWIDE, INCLUDING THOSE DEVELOPED FOR RESISTANCE

MAIZE LETHAL NECROSIS

Hits breadbasket of Africa

Despite suffering from food shortages, last year the Malawi government banned import of unmilled maize from neighbouring Kenya and Tanzania, and for a strong reason. Both countries are affected by maize lethal necrosis, which is difficult to contain. The country's agriculture ministry says that the disease has no treatment and can cause up to 100 per cent yield loss. The decision forced the World Food Program, which offers humanitarian assistance to those affected by conflicts in Malawi, to mill maize from Tanzania before supplying it.

The disease gains its virulence from the combination of two viruses—the maize chlorotic mottle virus (MCMV) and sugarcane mosaic virus (SCMV)—which get transmitted by insects and contaminated seeds. According to the Kenya Agricultural and Livestock Research Organization (KALRO), the disease was first reported in the country's Bomet county in 2011. It has since spread to 12 counties in the Rift Valley region, which is known as the breadbasket of Africa. Martin Mutai, a farmer in Bomet county, narrates the ferocity of the disease. "In 2014, I planted maize on my 0.5 ha farm. The crop stopped growing after a few weeks, despite regular rains in the region. Over the next few weeks the stalks shrivelled and blotches appeared on the leaves. Eventually, the entire crop withered away," says Mutai, adding that he did uproot sections of the affected plantation to spare the rest, but all was in vain.

"Only fall armyworms can ravage the plantation like that," says Paul Birir, another farmer from Bomet, who also lost his entire crop to the disease. "It has not spared anyone in the region," Birir adds.

COFFEE LEAF RUST

Puts a dent in export earnings

Caused by fungus *Hemileia vastatrix,* coffee leaf rust has been around for a century. It is now established in all coffee cultivation areas worldwide and causes large-scale outbreaks in Asia, the Americas and Africa. Kifle Belachew Bekele, secretary of the Ethiopian Coffee Science Society, tells *Down To Earth* (DTE) that the disease incurs 35-50 per cent yield loss, and the cost of control with fungicide is very high. However, there has been a surge in the incidence rate of the disease in recent years.

In Ethiopia, the leading producer of coffee in Africa, the disease incidence rate has increased by 35.3 per cent, according to a May 2023 study published in *Plant Health Cases*. Shafi Oumer, deputy director general at Ethiopian Coffee and Tea Authority, says the surge has put a dent on the country's annual exports and revenues. Ethiopia's coffee export fell short of its annual targets, US $1.8 billion, generating only $1.3 billion in 2023, says a report by the authority.

The disease is also showing a trend of moving from lowland to mid- and highland coffee growing regions, where it reduces the

SCHOOL OF WATER AND WASTE

AAETI

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LAKE REJUVENATION AND GROUNDWATER MANAGEMENT IN URBAN AREAS

ONLINE (BASIC): **JULY 16-31, 2024** | ONSITE (ADVANCED): **JANUARY 22-24, 2025**

Indian cities are no strangers to waterbodies. Every Indian city has its share of lakes, tanks, ponds, rivers etc. These are invaluable sources of water, food and livelihood; act as bulwarks against urban floods; and many have enormous religious and cultural significance. Rapid and rampant urbanisation has, however, spelt the death-knell for many of these waterbodies. While dead and dying waterbodies fail to absorb rainwater and recharge groundwater, cities are using up every drop as they suck the aquifers dry or bring in water from further and further away.

In an age which is increasingly feeling the brunt of climate change, one of the resources that would be severely hit is water. It is imperative for cities, therefore, to invest in rejuvenating their waterbodies and manage their groundwater more sustainably.

Centre for Science and Environment (CSE) invites you to apply for its two-part training programme on this subject. See details of the two parts below.

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Training duration: 16 HOURS (self-paced study and virtual sessions)

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- Introduction to the science of lakes and technologies to rejuvenate them
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PART B: ONSITE (ADVANCED)

Open only for Indian participants

JANUARY 22-24, 2025

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Venue: Anil Agarwal Environment Training Institute (AAETI), Nimli, Rajasthan

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» Part B – ₹ 28,000 (single occupancy accommodation); ₹ 25,600 (double occupancy accommodation).
Last date of application: January 10, 2025. Early bird discount available till December 31, 2024

- Residential fees (Part B) includes accommodation, food, training material, field visit and travel from CSE's main office at Tughlakabad Institutional Area to the training centre and back.
- Early bird entries can avail a discount of 10 per cent. Two or more participants coming from the same organisation can avail a total discount of 20 per cent.
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FOR FURTHER DETAILS, PLEASE CONTACT: TRAINING COORDINATOR

SWATI BHATIA, Deputy Programme Manager, Water, CSE

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Mob No: + 91 9911339540 / 9708887214

average annual yield by 49.5 per cent, according to the *Plant Health Cases* study. In 2012, Mexico, Brazil and Guatemala reported the disease for the first time. In Mexico, the disease wiped out 50 per cent of coffee production in three major coffee producing states Chiapas, Veracruz, and Oaxaca that contribute 80 per cent of total exports, states a June 2020 study published in *The Science of the Total Environment*.

CASSAVA BROWN STREAK

Creating hunger trap

In a way, cassava holds the solution to Africa's struggle with food insecurity, poverty and malnutrition. The tuber is a staple food in many African countries. It is drought-tolerant and grows well even on poor soil. However, cassava brown streak disease is fast eliminating that possibility. First spotted in Tanzania in 1935, the disease has spread from eastern Africa to central and southern Africa. Its spread has been particularly aggressive in recent years.

In Rwanda, export earnings from roots declined by 40 per cent from $7.9 million in 2016 to $4.7 million in 2017, largely because of a severe outbreak of the disease, states a November 2023 study published in *Plant Pathology*. Geofrey Ng'andu, agriculture extension officer of Kanchibiya district in Zambia, says the disease entered the country in 2017 and has since spread rapidly. "In 2022, about 500 ha was affected by the disease. In 2023, it increased to 700 ha. This year, close to 1,000 ha stands affected," says Ng'andu. Slyvester Mulenga, a farmer from Kanchibiya district, says, "We would eat maize mealie meal for three months in a year and cassava mealie meal for the rest of the year. It has been our staple food, but not anymore," he says. The disease infects 97 per cent of the plants and can lead to hunger and death of many cassava-dependent families, Mulenga says.

LATE BLIGHT

A persistent threat

Caused by fungus *Phytophthora infestans,* late blight is a potentially devastating disease of tomato and potato, that infects all parts of the plant—from leaves to stems to the fruit and tubers. The disease spreads quickly in fields and can result in total crop failure if untreated.

In India, a leading potato producer, the disease continues to cause outbreaks since the 1800s. The losses are more in hilly regions where the crop is grown under rainfed conditions. Joginder Singh, a potato farmer from Sehjo Majra village in Ludhiana district of Punjab, grows commercial varieties of potato on his 28 ha farm. He says the infection wiped out one-third of his crop in November and December 2023. He incurred losses worth ₹70 lakh. Another farmer from the village, Jatinder Singh, grew potatoes on 140 ha. But the tubers did not develop fully, making them unsuitable for commercial buyers. He says it would take him three years to recover the losses, that too if the weather does not turn against him.

CASSAVA HOLDS THE SOLUTION TO AFRICA'S STRUGGLE WITH FOOD INSECURITY AND POVERTY. BUT THE RAPID SPREAD OF CASSAVA BROWN STREAK DISEASE THREATENS ITS POTENTIAL

Originating from Mexico, the disease has spread to almost all potato-growing regions in the world. According to US-based organisation USABlight that monitors outbreaks of late blight, the disease is a major threat to global food security.

CITRUS TRISTEZA DISEASE

Economically damaging

Citrus tristeza disease, caused by a viral species of the genus *Closterovirus,* is an economically damaging disease that has changed the course of the citrus industry. First recorded in Argentina in the 1930s, and shortly after in Brazil and other South American countries, the virus eradicated 75 per cent orange trees in Brazil's Sao Paolo state alone in 1959. Similar devastations were also reported in South Africa, West Africa and California.

In the 1980s, infected citrus plants from endemic countries were shipped in vast numbers to unaffected countries, leading to a large-scale infestation and extending the pandemic. The disease is the prime reason for devastating global pandemic in orange, mandarin, grapefruit and lime orchards, crushing entire industries.

FORESTALL OUTBREAKS

As plant diseases spread across continents, a greater scrutiny is the need of the hour

A PLANT PANDEMIC could provoke a humanitarian crisis—a crisis that could deprive people of livelihood and lead to widespread hunger. The world has witnessed such crises in the past. Between 1845 and 1852, *Phytophthora infestans* wiped out potato crops in Ireland, resulting in the Great Famine and mass migration. The UK government estimates that 1 million people were affected either by disease or hunger. Similarly, during the 1943 Bengal famine, *Cochliobolus miyabeanus* that causes brown spot disease in rice led to the death of over 2 million people. In recent years, 400,000 coffee workers in central America lost their livelihood and had to migrate after coffee leaf rust disease infected plantations, states a 2021 study published in *Agricultural Sciences*. "The war between Russia and Ukraine has shown us how vulnerable we are to perturbations in the global supply of wheat and how shortages can lead to rapid increases in price affecting trade," warns Paul Nicholson, professor at the John Innes Centre in the UK.

However, averting the crisis seems difficult at a time when the food industry is in the pursuit of high-performing cultivars and industrial productivity. This has bereft the crops of genetic diversity that confers them resistance against pathogens.

Consider banana. There are over 1,000 edible varieties of bananas, some of which are far sweeter and nutritious than the Cavendish variety. But the quest of the industry to grow uniformly yellow bananas has resulted in plantations that are filled with genetically identical clones, produced from one mother plant in laboratories. In the absence of genetic diversity, these plantations get simultaneously wiped out in case of an infestation. This trait of banana failed Gros Michel and is now acting against Cavendish.

Cassava brown streak disease infects 97 per cent of the cassava crop on the field. Farmers in Africa say that the disease can lead to widespread hunger in the continent

PHOTOGRAPH: ANGELA RWABOSE

Similarly, soybean and wheat are extensively grown in high-density monocultures, and their yields are compromised by a plethora of pests and pathogens. Soybean rust caused by the fungus *Phakopsora pachyrhizi* and wheat blotch caused by the fungus *Zymoseptoria tritici* are among the most destructive diseases on these crops, and yield losses of more than 50 per cent have been documented during severe epidemics, according to a review article published in *Nature Reviews Microbiology* in May 2023.

An overhaul of the way we grow food is pertinent because plant pathogen loads and disease pressure are likely to change under future climate scenarios. Nick Talbot of The Sainsbury Laboratory, UK, says extreme weather events such as tropical storms have shown potential to spread diseases. Wheat blast outbreaks in Bangladesh, for example, have often followed tropical storms and heavy rains. A May 2021 study, "The persistent threat of emerging plant disease pandemics to global food security", published in *Agricultural Sciences,* notes that extreme weather events like hurricanes can transport pathogen spores over continents. It says Hurricane Ivan in 2004 caused soybean rust movement from Brazil to the US.

Another research, published in *Scientific Reports* in April 2024, concludes that a rise in global warming from 1.5°C to 4°C is expected to increase the risk of Pierce's disease (a bacterial disease that affects grapevines) epidemics in vineyards of southern Europe, particularly in France, Italy and Portugal. A 3°C increase indicates expansion of disease to the Mediterranean region and beyond. In a warming climate, wheat blast will spread to countries that so far remain untouched.

To aggravate the matter, elevated temperatures can suppress plant immunity, leading to increased pathogen infection, states the article in *Nature Reviews Microbiology*. For example, prolonged drought causes water stress in plants, which results in increased susceptibility to infection by pathogens. Climate change can also facilitate the emergence of new strains of pathogens, which in turn can break down resistance of the host plant, notes the article. Elevated carbon dioxide levels in the atmosphere are also seen to increase the severity of certain pathogens like powdery mildew that infects gourds.

Mitigating the future risks also requires effective monitoring and management of plant diseases. Scientists suggest taking a leaf out of the COVID-19 pandemic, by using genomic surveillance to help control the spread of diseases. For example, researchers have recently conducted a genomic surveillance of wheat blast fungus. In a 2023 study, published in PLOS *Biology*, they note that the technique enables rapid and accurate pathogen identification and allows tracing of the outbreak origin, which can direct preventive measures. Scientists from Bangladesh used a similar disease surveillance and monitoring mechanism, OpenWheatBlast, to share genomic data and analysis related to wheat blast and could track down its origin to South America.

SCIENTISTS SUGGEST TAKING A LEAF OUT OF THE COVID-19 PANDEMIC, BY USING GENOMIC SURVEILLANCE TO HELP CONTROL THE SPREAD OF PLANT DISEASES

The International Maize and Wheat Improvement Center (CIMMYT), Mexico, has also formed a Wheat Disease Early Warning Advisory System (Wheat DEWAS), which has introduced new analytic and knowledge systems capacity to one of the world's largest and most advanced crop pathogen surveillance systems. The project allows researchers to build an open and scalable system to prevent disease outbreaks from novel pathogen strains threatening wheat productivity and food security in South Asia and East Africa. Talbot says scientists in Japan, UK, and other countries are working on surveillance of the spread of wheat blast disease and identifying potential mutations. "There are about a handful of strains identified by scientists that work against the wheat blast. The Rmg8 gene developed is the strongest thus far. But more efforts are needed to identify resistance genes and add multiple protection layers to the crop to safeguard against wheat blast," he adds.

Coordinated effort and active surveillance are the only ways to beat pathogens in this warming and globalised world. DTE

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HIGH BURDEN

In 2021, cardiovascular diseases, along with respiratory infections and tuberculosis, accounted for 45% of all deaths in India. Air pollution was the primary risk factor contributing to the deaths

KIRAN PANDEY and **RAJIT SENGUPTA**

Cause of mortality is a single disease or injury, or an aggregation of diseases and injuries, leading to death. They are broken down into communicable, maternal, neonatal, nutritional diseases; non-communicable diseases; and injuries

Estimated deaths from all causes in 2021
11,744,496

00 Number of deaths by cause (India's share of global deaths)

Communicable, maternal, neonatal and nutritional diseases
3,689,755

- **552,102** (41%) Enteric infections
- **24,072** (11%) Nutritional deficiencies
- **404,005** (20%) Maternal and neonatal disorders
- **222,481** (10%) Other infectious diseases
- **2,487,095** (22%) Respiratory infections and tuberculosis

Injuries
931,280

- **460,492** (25%) Unintentional injuries
- **241,977** (19%) Transport injuries
- **228,810** (18%) Self-harm and interpersonal violence

Other COVID-19 pandemic-related outcomes
651,993

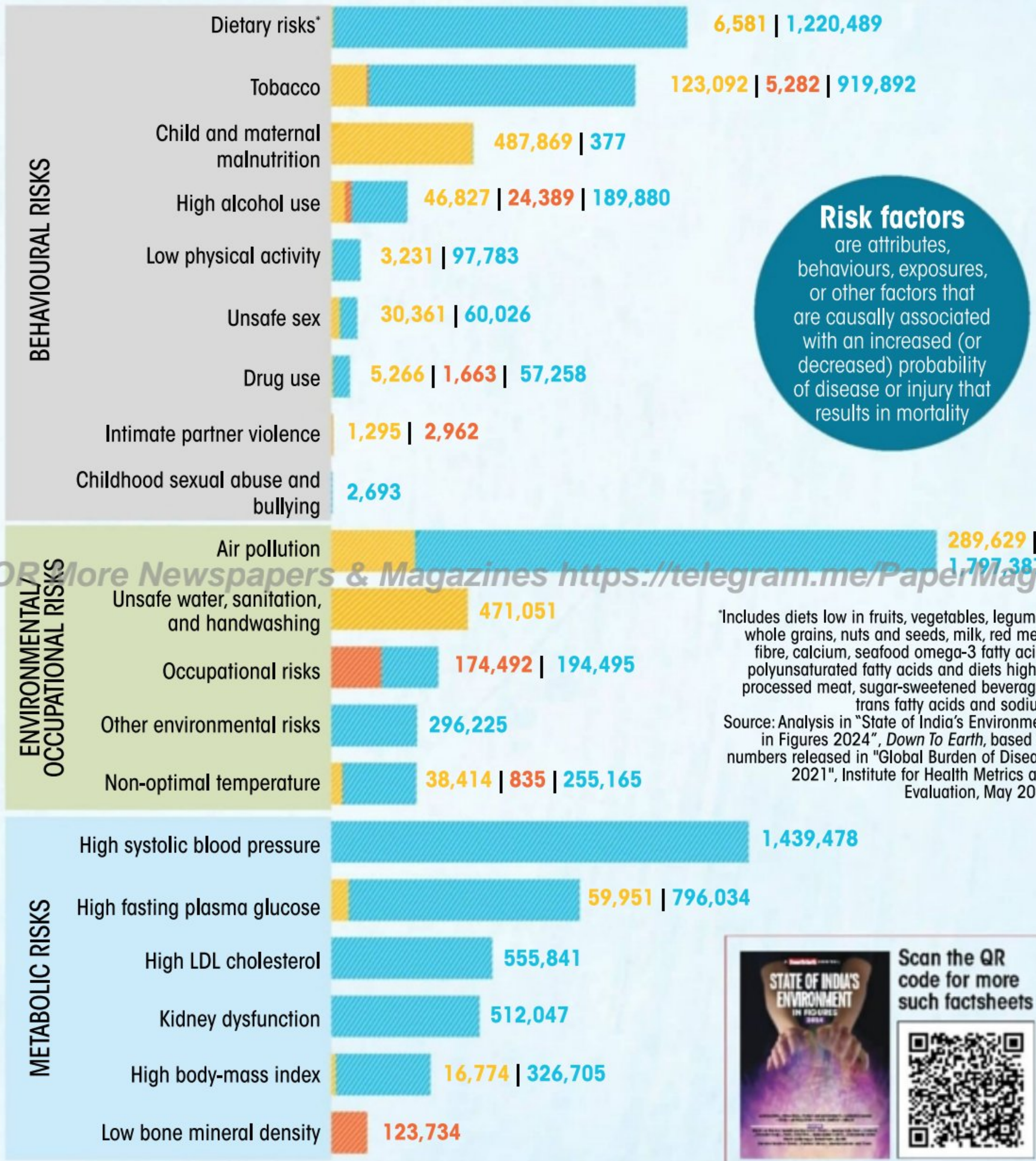
Non-communicable diseases
6,471,469

- **2,873,266** (15%) Cardiovascular diseases
- **1,332,263** (30%) Chronic respiratory diseases
- **507,140** (16%) Diabetes and kidney diseases
- **854,856** (9%) Neoplasms
- **210,112** (8%) Neurological disorders
- **693,832** (16%) Other non-communicable diseases

Other infectious diseases include HIV/AIDS and sexually transmitted infections, neglected tropical diseases and malaria.
Other non-communicable diseases include digestive diseases, mental disorders, musculoskeletal disorders, skin and subcutaneous diseases and substance use disorders.

Risk factors causing mortality

Exposure to air pollution, high blood pressure and poor diet, such as inadequate consumption of vegetables and fruits, are the primary risk factors contributing to diseases that cause deaths in India



Risk factors are attributes, behaviours, exposures, or other factors that are causally associated with an increased (or decreased) probability of disease or injury that results in mortality

*Includes diets low in fruits, vegetables, legumes, whole grains, nuts and seeds, milk, red meat, fibre, calcium, seafood omega-3 fatty acids, polyunsaturated fatty acids and diets high in processed meat, sugar-sweetened beverages, trans fatty acids and sodium.

Source: Analysis in "State of India's Environment in Figures 2024", *Down To Earth*, based on numbers released in "Global Burden of Disease 2021", Institute for Health Metrics and Evaluation, May 2024

India capitulates on key accord at WIPO

The WIPO treaty on genetic resources is historic, but it will override vital safeguards in India's law to prevent bad patents

AS AN international accord that has been in the works for a quarter century, the WIPO Treaty on Intellectual Property, Genetic Resources and Associated Traditional Knowledge agreed upon on May 24 is being hailed as groundbreaking. WIPO or the World Intellectual Property Organization, a UN agency with 193 members, described the treaty as historic. Perhaps it is.

For one, the agreement was finally reached in the face of opposition over decades from the usual suspects—the US, Europe and Japan and the powerful lobbies of industry groups affected by the demand, which was first put forth by Colombia in 1999. In that proposal, the Colombian delegation had asked WIPO to include in the Patent Law Treaty (PLT), which was then under discussion, far-reaching provisions linking patent applications with guarantees protecting a country's biological and genetic resources. The nub of the Colombian proposal was to ensure that the grant of patents or registrations related to such resources were legally acquired. To this end, Colombia suggested that every document should specify the registration number of the contract allowing access to genetic resources that have been used in the manufacture or development of products for which patents are being sought. Although the proposal was supported by several developing countries, it found no mention in PLT, signed in 2000, because it was opposed by the US and its allies.

There was opposition from powerful lobby groups such as the American Intellectual Property Law Association (AIPLA), Intellectual Property Owners Association (IPO), International Federation of Pharmaceutical Manufacturers and Associations (IFPMA) and so on. The heft of these organisations is palpable. IPO, for instance, is a big tent of diverse corporate interests from law firms, service providers and individuals in all industries and fields of technology that own intellectual property rights (IPRs). Over 450 organisations in 30 countries are its members.

Subsequently, WIPO set up the Intergovernmental Committee on Intellectual Property and Genetic Resources, Traditional Knowledge and Folklore (IGC), and consultations over the years have meandered on how patent law could prevent misappropriation of genetic resources and traditional knowledge and promote benefit-sharing. That is why there were emotional scenes at the conclusion of the treaty,

ILLUSTRATION: YOGENDRA ANAND / CSE

with representatives of the First Nation People viewing it as a singular victory.

Against this backdrop, the WIPO treaty could be seen as groundbreaking, as its chief Daren Tang claims, because it is the first time that genetic resources will be brought under the cover of IPR, and because it is the first WIPO treaty to recognise the rights of indigenous peoples and those of local communities in its provisions. "Through this we are showing that the IP system can continue to incentivise innovation while evolving in a more inclusive way, responding to the needs of all countries and their communities," said Tang.

Giving a clue to the nature of the treaty is the statement of the President of the Diplomatic Conference, Guilherme de Aguiar Patriota, who said it was "a very carefully balanced outcome" that "constitutes the best possible compromise and a carefully calibrated solution, which seeks to bridge and to balance a variety of interests, some very passionately held and assiduously expressed and defended over the course of decades." Thus, we have a treaty where enforcement of the key provisions or penalisation is not spelt out. In fact, there is nothing mandatory. The heart of the treaty is Article 3, which is the disclosure requirement. And the problems became clear immediately.

It says those claiming patents on inventions based on genetic resources or associated traditional knowledge have to make the following disclosures: If it is based on genetic resources, those applying for IPRs must disclose the country of origin. If the patent claim is based on associated traditional knowledge, they have to disclose the indigenous people or local community from which it was sourced. And herein lies the futility of the treaty: in both cases, if the sources are not available or known to the applicant, there is no problem at all. The applicant can give any source from where they have obtained the relevant resource or knowledge. All that is required is for the applicant to make a declaration to that effect, affirming that the content of the declaration is true and correct to the best of the applicant's knowledge.

To clarify: the source of genetic resources refers to research centres, gene banks, indigenous peoples and local communities, the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA), or any other ex situ collection or depository of genetic resources. The source of traditional knowledge associated with genetic resources means any source such as scientific literature, publicly accessible databases, patent applications and patent publications.

To compound the problem, there is no provision for penalties for non-disclosure. In fact, every effort appears to have been made to accommodate the concerns of those seeking patents. In case the information provided by applicants is incorrect, the State shall have to provide guidance to the applicants on how to meet this requirement and also afford them a chance to rectify the erroneous disclosure. The flexibilities do not end there. The State cannot revoke patents if the disclosure obligation is not met, except in cases where the information was withheld due to fraudulent intentions. Even in such cases, the treaty leaves it to the State to decide on the sanctions to be imposed. For countries like India, there is a problem: our patent law already mandates imposition of sanctions for non-disclosure. One such provision allows a pre-grant opposition to a patent application for non-disclosure of the source of origin, and even a patent that has been granted can be revoked on the same grounds. If such provisions cannot be enforced in India under the WIPO treaty, where does it leave us?

The WIPO Treaty on Intellectual Property, Genetic Resources and Associated Traditional Knowledge appears to have made every effort to accommodate patent-seekers

Yet, India is claiming the treaty as a victory of its making. A *Press Trust of India* (PTI) report quoted an unnamed official as saying, "The treaty also marks a big win for India and the global south which has for long been a proponent of this instrument." Experts warn that India may have to dilute some of its vital safeguards in the law that prevents wrong patenting.

The winners, clearly, are not those who have struggled for decades to get such a treaty. The other side has much more to celebrate. DTE @ljishnu

Palette

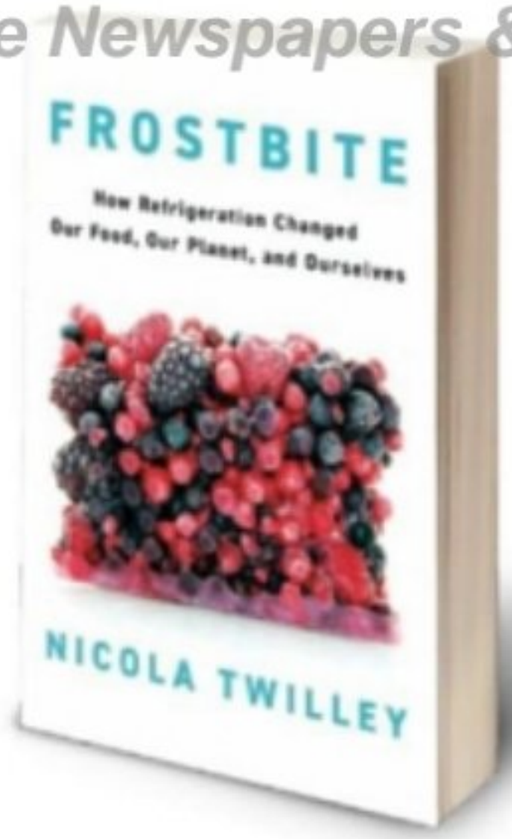
WHAT'S INSIDE

RECOMMENDATIONS

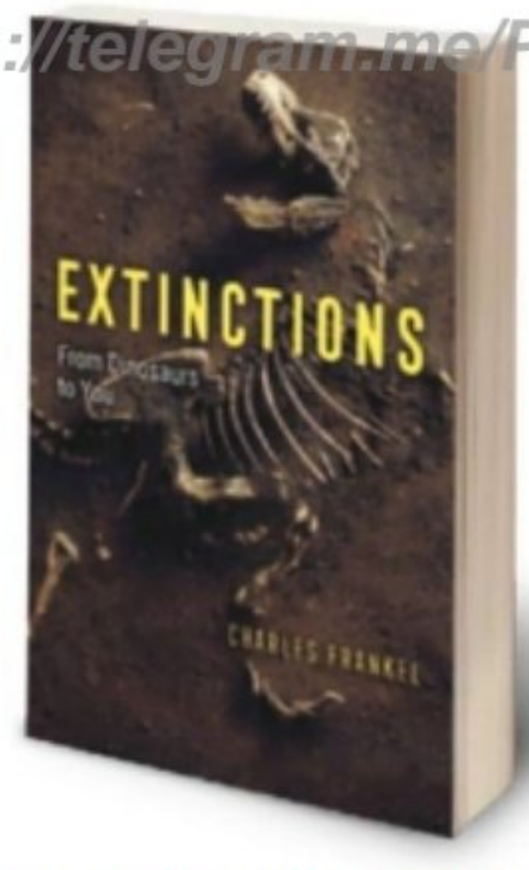
EXHIBITION

Witness the ecological impacts of human activity through "Weather Report", a new photography exhibit at the Experimenter-Hindustan Road art gallery in Kolkata. The exhibit by Tibetan visual artist Tenzing Dakpa is a culmination of his observations in Goa, his home for the past three years. The photographs being displayed in the exhibit include "Manifest", a series on the aftermath of forest fires in North Goa, believed to have been caused by human interventions to introduce residential projects in agricultural land and forests. The exhibition will be on display till July 27. For more details, visit *www.experimenter.in*.

BOOKS



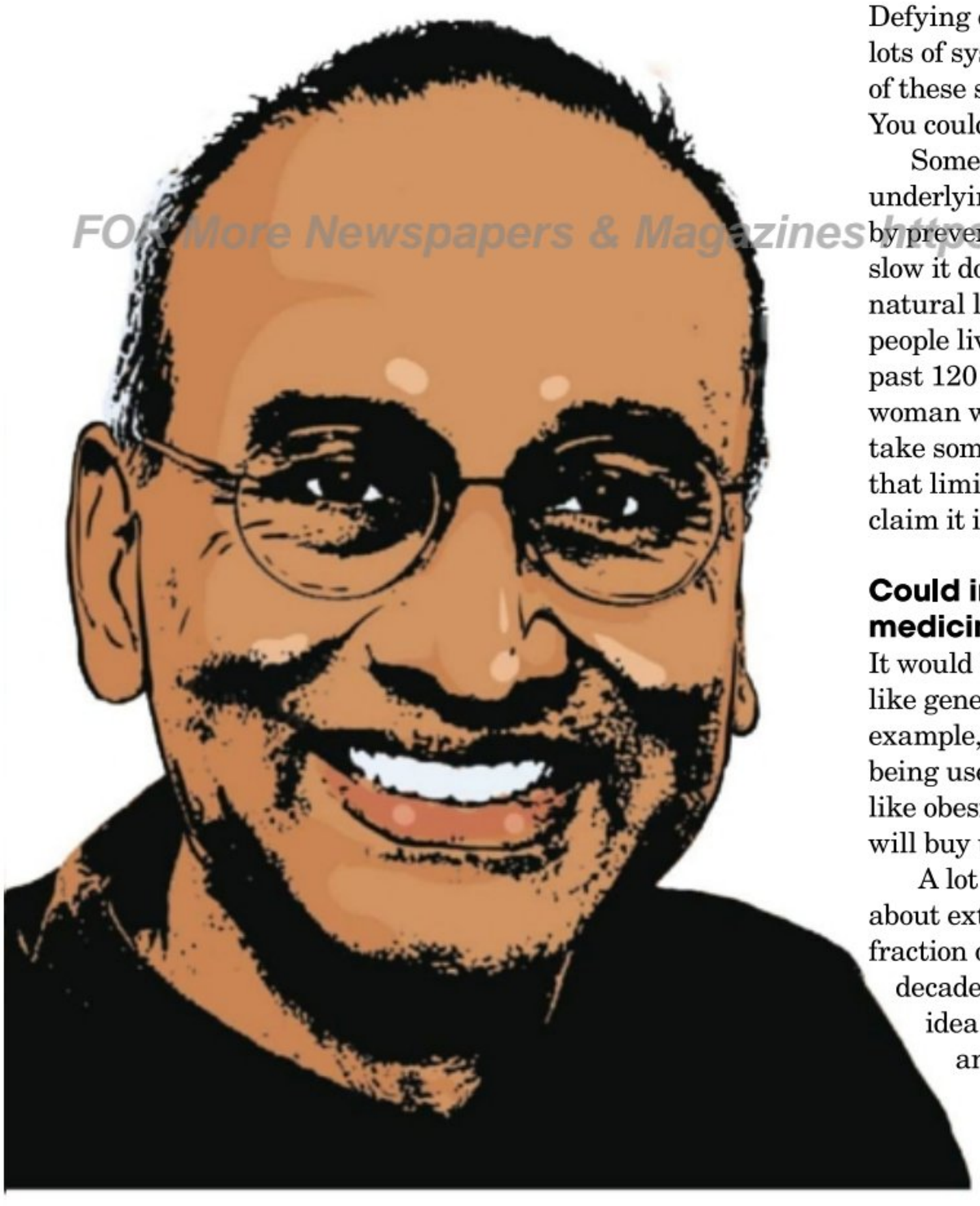
Artificial refrigeration has changed the way humans approach food. But little is known about the way this changes the dishes that we eat, and how they may impact our health. Further, with the industry contributing greatly to greenhouse gas emissions, it is important to understand whether we can move away from refrigeration and find greener alternatives. Journalist Nicola Twilley addresses these questions in *Frostbite: How Refrigeration Changed Our Food, Our Planet, and Ourselves*.



Mass extinction events are distinct milestones in the planet's evolution. Each such event has some lessons for humans that, if combined with advancements in climate research, could show a way to protect the future of the planet. In *Extinctions: From Dinosaurs to You*, science writer Charles Frankel explains how decoding the Earth's geological history and arresting the current path of destruction brought on by anthropogenic activities can ensure that the planet remains liveable.

'Fitness our evolutionary advantage, not longevity'

Nobel laureate **VENKI RAMAKRISHNAN**'s latest book, *Why We Die*, covers a journey that starts in the 1800s, when British biologists Charles Darwin and Alfred Wallace proposed natural selection, and continues to this day, as researchers investigate anti-ageing compounds. But how close are we really to cheating ageing and death? In an interview with **ROHINI KRISHNAMURTHY,** Ramakrishnan, who received the 2009 Nobel prize in chemistry, says the focus of research is on staying healthy for a bigger fraction of life. He also examines the causes of ageing, the drugs being explored to slow down this deterioration, the people involved in the research and a few controversial claims. Excerpts:



Can science help humans defy death?

Defying death is a tall order because it means that lots of systems need to be kept going. The breakdown of these systems is indeed the common cause of death. You could also die of an infectious disease or accident.

Some people feel that if you can address the underlying common causes, you could postpone death by preventing or slowing down ageing. But can we slow it down to an extent that we live well beyond our natural limit, which is about 110 years or so? Very few people live past 110, and only one person has lived past 120 [a record held by Jeanne Calment, a Frenchwoman who died in 1997 at the age of 122]. It would take some fundamental breakthroughs to go beyond that limit. I do not think it is as easy as some people claim it is.

Could improvement in health infrastructure or medicines push that limit beyond 110 years?

It would be very hard because there are other issues, like general frailty and tissue breakdown. For example, we have the drug semaglutide, which is being used to treat diseases that accelerate ageing, like obesity. But I do not know how much time that will buy us.

A lot of focus is on healthy ageing, which is not about extending life but staying healthy for a bigger fraction of your life, so that one does not spend two decades or so in really poor health at the end. The idea is to stay healthy so people can move around and be independent. My father, until he was

ILLUSTRATION: YOGENDRA ANAND / CSE

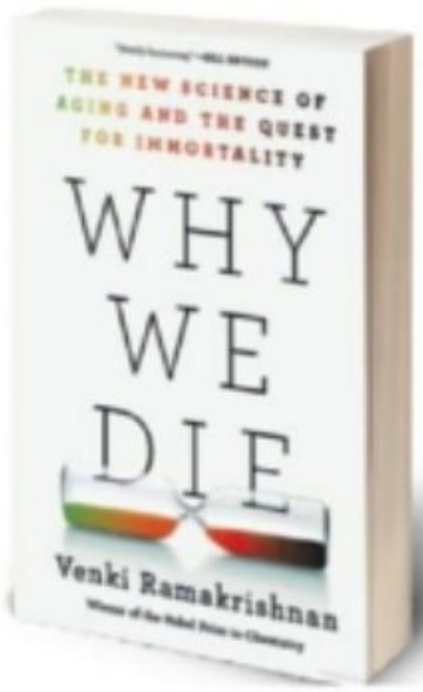
about 92, used to go on eight-mile (over 12 km) walks. He cooked and did laundry by himself. At 98, he still does these chores, but finds it hard to walk now. You can see a decline between 92 and 98, even in a relatively long-lived individual. So, the question is whether you can compress that period of decline so that you are healthy for a bigger fraction of your life.

Your book talks about the different factors involved in ageing—like genes and proteins—and how they interact with each other. Some funders want to hack ageing. Given the complexities of the human body, is this doable?

Quite a significant amount of ageing work is funded by technology billionaires. I joke that they like the party and do not want it to end. So, they want to fund ageing research to stay healthy and perhaps live longer. But it is a misguided notion because the human body is quite complicated and is not a computer.

Billionaires talk about hacking the code and solving ageing, but biology is complicated. We do know some of the major causes of ageing. And we know they are complicated; that they are not isolated processes, and that they all interact with each other. For example, damage at a molecular level will affect function at the cellular level, and then the organismal level. And that will feed back and affect things at the molecular level. So, it is a very complicated web of interactions.

The ageing research community loves rapamycin [initially developed to suppress the immune system during organ transplantation and being explored as an anti-ageing drug]. But it has the potential to make you more prone to infections. It is not clear that you would want to give this to a healthy population. We need to do proper clinical trials to see if it is efficacious in the long run, and has minimal side effects.



Why We Die: The New Science of Aging and the Quest for Immortality

Venki Ramakrishnan

Publisher: Hachette India

MRP: ₹699 | **Pages:** 320

And then there are other remedies that, for example, target senescent cells [cells that stop multiplying but are not dead. They then release chemicals that can trigger inflammation, a hallmark of ageing]. There is certainly a lot of very good science that suggests that we may make some big breakthroughs in ageing. And that is one of the reasons I was curious to write this book. But there is so much hype that solutions are around the corner. People who think it is going to happen anytime now, or in the next few years, may be disappointed. But I think in the long run, there may be some real breakthroughs.

How many years before we see a breakthrough?

Well, in science, it is very hard to define the "long run". It took 400 years to go from Newton's laws to satellites. But if you take penicillin, there are maybe 10 or 15 years from the discovery to use in humans. I would not want to hazard a prediction.

Is there a reason the book does not talk about gene therapy, an approach to treat or prevent disease by providing new DNA to certain cells or correcting them to slow down ageing?

I do not think gene therapy is a particularly useful target at the moment for anti-ageing. None of the researchers I have talked with or any prominent leaders in the field are advocating gene therapy as a recourse for ageing.

There is a genetic component to ageing, but in humans, it is complicated. There are multiple genes, each of which exerts an influence that causes ageing.

In simple systems, scientists have found, a single gene or a variant of a single gene in a worm can double its lifespan. But worms with this variant will not be able to survive in competition with normal worms. That means it is paying a penalty for that mutation. Yes, it can live longer, but maybe it cannot compete for food or reproduce or grow as well as the normal worms.

Evolution has selected us for fitness, which is the ability to pass on our genes. It has not selected us for living long. It is a calculated balance. If you tinker with the balance to live longer, you may have other side effects. For example, there is a gene called apolipoprotein (apoE) which has multiple variants. One of the variants is overrepresented in centenarians. The same variant also protects them against Alzheimer's disease. The reason they are living longer and not getting Alzheimer's may be related. Now, that same variant

could make them more prone to dying of COVID-19 or of certain kinds of cancer.

Targeting genes needs research, actual data, clinical trials, and so on. Gene therapy is not something I would advocate now. What I wanted to say in the book is there is a lot of exciting research happening in many areas. And the hope is that all of this will lead to better lives in old age. Whether it leads to longer lives, I am less sure. In the meantime, there are things we can do to stay healthier.

For example, I have said in my book that a trio of things can help. One is to eat in moderation and follow a healthy, nutritious diet. The second is to exercise regularly and the third is to sleep for at least seven or eight hours a day. It also is true that each of the three helps the other. For example, if you sleep you are also less inclined to overeat and more inclined to exercise. Similarly, if you exercise, you are also likely to sleep better because you reduce stress. This trio also could help you reduce your cholesterol, blood pressure, onset of diabetes, and the like.

You write about nutritional supplements being marketed as anti-ageing products without evidence. Do you see their sale being regulated?

You can buy things that lengthen your telomeres on Amazon [Telomeres are DNA sequences found at the end of chromosomes, which shorten with age. Shorter telomeres have been associated with increased incidence of diseases.] None of them have gone through clinical trials or approval. So, we do not know what the evidence is, including their long-term consequences. People have tried to regulate them but it is hard because many of them are ordinary nutrients and natural compounds found in plants. It would be hard to regulate, at least in countries like the US, which have libertarian attitudes. They do not like to interfere with the market too much.

If we eat fresh fruits and vegetables, we will get a lot of vitamins and minerals, and they are present in the amounts that we have naturally evolved to deal with. Pills concentrate ingredients that are found in nature and are present in huge amounts, equivalent to eating dozens of oranges. I am not sure that we need these nutrients in large amounts for beneficial effects.

A SIGNIFICANT AMOUNT OF AGEING WORK IS FUNDED BY TECHNOLOGY BILLIONAIRES. I JOKE THAT THEY LIKE THE PARTY AND DO NOT WANT IT TO END. SO, THEY WANT TO FUND AGING RESEARCH TO STAY HEALTHY AND PERHAPS LIVE LONGER

The book says that some anti-ageing industries have been around for nearly two decades but we have not seen breakthrough yet. Why?

It is very hard to do trials. With a disease, like COVID-19 or cancer or diabetes, you can have a potential drug candidate and you can do a clinical trial and very rapidly see if they are effective or not. For example, we can test if the cancer is growing or regressing.

With ageing, it is more difficult because it is a gradual and a slow process. And so it is very hard to do clinical trials. You can do trials in animals, but they do not necessarily translate to humans as many have failed in clinical trials. So, that is one problem.

The anti-ageing research community is trying to come up with good markers for ageing to see whether the treatment is having an effect. But to do that, you have to agree on the biomarkers and whether they represent ageing. Each person does not age in a unified way. Your liver may be ageing faster than your heart or your kidneys. So, you cannot ascribe necessarily a single number to your biological age [how old your cells are, which is different from chronological age]. This makes it complicated. However, longevity companies treating a particular disease of ageing are more likely to succeed because they at least have a target and can measure something.

Should humans live longer? Have we thought of the consequences of prolonging our lifespan?

If somebody came to you with a pill, and said: This will give you 10 years of extra life, and a healthy one, but you have to start taking it now and there are no or few side effects, what would you do? You would probably take it. I think that is just the reality of human nature. We do not want to die.

So, consequences for the individual and for society are different. This is a constant problem, including in terms of climate change. People drive and fly around because they want to go on a vacation. This is not good for the climate, but that is not stopping us from doing it. So, human behaviour is very complicated. We often do things that give us benefits, even if it costs society in the long run. This problem can only be solved socially with education and regulation. DTE @down2earthindia

Whether eaten as paan or added to healthy recipes like *rasam*, betel leaves impart beneficial analgesic and cooling properties

POWER OF PAAN

Betel leaves are not just an integral part of India's culture, but also hold many benefits. Add them to your list of healthy greens

VIBHA VARSHNEY

THERE WAS a time when heart-shaped leaves of betel (*Piper betle*) were served after dinner in nearly every household. *Panwaris*, or paan sellers, would set up shop on street corners and offer customised *beedas* (quids); or people would just buy the leaves and prepare them at home with ingredients such as areca nut, slaked lime, cardamom, cloves, fennel, saffron, coconut and *gulkand* (a sweet preserve of rose petals). A *beeda* after a meal was believed to aid digestion and freshen the breath.

It was so popular that people believed knowing the "correct" way to eat paan was the epitome of cultured life. The saying "*Bandar ko diya paan, lagaa roti sa chabaan*" (if you give paan to a monkey, he will eat it like a roti) is used to refer to a lack of finesse in behaviour.

However, think of paan nowadays, and it is likely to conjure an image of red spit-covered walls—a mess made by tobacco chewers who use betel leaves to wrap and flavour the intoxicant. Traditionally, the leaf would be chewed and swallowed, but when used with tobacco, the saliva has to be spat out. This practice is considered to have begun around the 16th century when tobacco was introduced in the country by Portuguese invaders.

The name "betel" was also first

PHOTOGRAPH: VIBHA VARSHNEY / CSE

used in the 16th century by the Portuguese, most probably derived from *vetila*—the Malay word for leaf. The Malayalam and Tamil names for betel leaf are also similar-sounding, *vettila* and *vettilai,* respectively. In Kannada, betel is *taamboola*, in Manipuri *kwa* and in Marathi *naagavaela*.

In modern times, the paan leaf has been combined with ingredients such as chocolate, strawberry and chillies. In one fancy version, paan is set on fire—one of its ingredients, clove, catches fire easily—before the quid is swallowed. Betel leaf flavour is also incorporated into hard candy and ice cream along with traditional sweets such as *petha* and *barfi*.

The leaf imparts beneficial analgesic and cooling properties. In the ancient medical texts of Charaka and Sushruta Samhita, betel leaves are prescribed with spices to aid digestion, remove phlegm and make the mouth fragrant, says a 2011 article published in *Asian-Agri History*. In Uttar Pradesh, a new mother is traditionally fed a betel leaf toasted with ghee and wrapped around almonds for 15 days after childbirth, to help in her recovery. A decoction of the leaves is also added to her bath water. A warmed leaf soaked in mustard oil is applied to the chest area to relieve coughing and difficulty with breathing. Heated leaves are also applied on the abdomen to relieve constipation.

The leaves are also noted for their antimicrobial activity. Reviewing articles on the plant published in 2010-20, researchers from Indonesia note that betel leaf extract, essential oil and isolates could inhibit microbial growth. They can kill Gram-negative bacteria like *Escherichia coli* and *Pseudomonas aeruginosa*, Gram-positive bacteria such as *Staphylococcus aureus* and *Candida albicans,* as well as disease-causing fungi. The review, published in the journal *Molecules* in 2021, notes that using betel leaf extract and essential oil with antibiotics (streptomycin, chloramphenicol and gentamicin) increases their antibacterial properties.

P betle is a woody, evergreen creeper, native to Southeast Asia. Based on the shape, size, brittleness and taste of the leaf blade, the vine is classified into pungent and non-pungent varieties. Its flowers and seeds are a rare sight because cultivated vines are mostly male plants selected for vigorous growth and leaf production. Some 100 varieties are found across the world, of which 40 are in India, says a 2022 article in the *Journal of Cellular and Molecular Medicine*. Sri Lanka, Thailand and Bangladesh are other major betel leaf growers, as per the Agricultural and Processed Food Products Export Development Authority (APEDA), Delhi.

In India, the plant is grown in 10 states (Assam, Andhra Pradesh, Bihar, Gujarat, Odisha, Karnataka, Madhya Pradesh, Rajasthan, West Bengal and Maharashtra). The country exported over 3,440 million tonnes of betel leaves in 2022-23, worth ₹49.68 crore, says APEDA. Four varieties are recognised by the Geographical Indication registry—Maghai paan from Bihar; Mahoba Desawari paan that grows in Mahoba district of Uttar Pradesh and Chhatarpur in Madhya Pradesh; Authoor betel leaf of Tamil Nadu; and Banarasi paan from Varanasi. But the future of this creeper is uncertain due to climate vagaries (see 'Loss of a legacy', *Down To Earth*, March 16-31, 2023). Just this year, the crop was destroyed in Mahoba due to extreme cold. Let's hope the after-dinner treat does not become a lost recipe. DTE @vibhavarshney

RECIPES

PAAN RASAM

INGREDIENTS

Paan leaves: 2
Tomato: 1
Arhar dal: 1 tbsp
Fennel seeds: 1/2 tsp
Coriander seeds: 1/2 tsp
Black pepper: 1/2 tsp
Cumin seeds: 1/2 tsp
Tamarind pulp: 1 tbsp
Whole red chilli: 1
Mustard seeds: 1/2 tsp
Ghee: 1 tsp
Jaggery: 1 tsp
Salt to taste

METHOD

Roast the fennel, cumin and coriander seeds with pepper, and grind coarsely. Boil the *dal*, tomato and paan leaves. Grind the spices, boiled leaves, *dal*, tomato, tamarind pulp, salt and jaggery in a mixer. Add water and boil again. In a pan, heat oil, add mustard seeds and chilli; use it to temper the *rasam* and serve it hot.

PAAN BARFI

INGREDIENTS

Paan leaves: 6
Gulkand: 1 tbsp
Dry rose petals: 1 tsp
Khoya/mawa: 250 g
Sugar: 1 tbsp
Ghee: 1 tsp
Dry fruits (assorted, chopped): 1 tbsp

METHOD

Grind and strain the paan leaves, saving the extract. Heat the ghee in a pan and add the dry fruits. Add *khoya, gulkand,* paan extract, sugar and mix well. Grease a plate with ghee and transfer the *barfi* mix and spread. When cool, garnish with crushed rose petals and cut into squares.

It's debt *v* development

WITH BARELY six years remaining to meet the UN Sustainable Development Goals (SDGs) of 2030, the world has hit a wall: countries are drowning in unprecedented levels of debt. Debt servicing is a key expenditure for many nations, keeping them from funding developmental activities like education and health.

According to the Institute of International Finance, the global debt (including borrowings of households, businesses and governments) has reached US $315 trillion in 2024. This is three times the global gross domestic product (GDP). World Economic Forum President Børge Brende qualifies this burden: "There are about 8.1 billion of us living in the world today. If we were to divide that debt up by person, each of us would owe about $39,000."

While debt, or borrowing, is an established way to fund personal, institutional and national expenditures, it has reached an unmanageable level where the borrowers divest much of the revenues for just servicing their debt, primarily the interest. Of the total global debt, household debt stands at $59.1 trillion; business debt at $164.5 trillion; and public debt (government borrowings) at $91.4 trillion. Many compare this level of debt to that experienced during the Napoleonic wars some two centuries ago.

The mounting public debt is a concern and warrants dire warning from international agencies because it restrains public spending on development sectors. On June 5, the UN in a new assessment report, "A world of debt 2024: A growing burden to global prosperity", says that the level of public debt has not just reached a historic level but also threatens development spending, particularly that of the developing and poor countries.

Global public debt (both domestic and external borrowing by governments) saw a steep hike of $5.6 trillion from the 2022 levels to reach $97 trillion in 2023. Developing countries share 30 per cent of the total global debt. But the debt growth rate of developing countries is twice that of developed countries.

Debt becomes a risk when a country does not have the capacity to repay. In such a situation, it has to divert funds for servicing its debt while slashing budgets for development programmes. Starkly, countries that have the least capacity to repay are also the ones doing it the most. The latest UN assessment says in 2023 developing countries spent $847 billion in debt-interest payment, which is a 21 per cent increase over 2021. For these countries the interest rate is also higher, up to four times that of the US.

This shows up in their accounts. For instance, in Africa, where debt is rising fast, the number of countries with debt-to-GDP ratio above 60 per cent has risen from six to 27 in 2013-23. Some 27 African nations fork out 10 per cent of government funds for debt-interest payment.

The impact on development spending is glaring. The UN report says that 3.3 billion people currently reside in countries where debt-interest payment exceeds spending on either education or health. In Africa, the per capita spending on debt-interest is $70, which is higher than the per capita expenditure on education ($60) and health ($39).

The world is spending more and more on loan payment leaving less and less resources for development

The growing public debt for developing countries could be a direct fallout of the changing profile of development aid. First, the aid has fallen in the last two years. Second, concessional loans are replacing the aid, thus adding to developing countries' debt. In 2012, the share of loans in aid to developing countries was 28 per cent, which rose to 34 per cent in 2022. Third, the support to reduce debt among developing countries in terms of relief and other actions has also dried: from $4.1 billion in 2012 to $300 million in 2022.

It is clear that the global debt has become a trap. Among reasons for not meeting SDGs, high debt is emerging as the most prominent one. But it can be fixed if the world negotiates a debt waiver deal, as is being discussed. DTE @richiemaha