

1-15 JULY, 2024

Down To Earth

FORTNIGHTLY ON POLITICS OF DEVELOPMENT, ENVIRONMENT AND HEALTH

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EERIE WINDS

Climate change is slowing down wind circulations, with planet-wide repercussions



HEAT STRESS

Insurance schemes to cover milk production losses

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Nations, private firms must adhere to rules of exploration

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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



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

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A matter of life and death

WE KNOW that climate change impacts weather, which in turn devastates lives and livelihoods. But what we don't discuss enough is how these extremes in weather impact human health. In this season of despair, when temperatures spiralled out of control, we learnt how heat could kill. We also learnt how the rise in minimum temperature—night-time heat—could be the cause of human death. It is critical that we join the dots of what seems like a faraway crisis of a changing climate to what it can do to our health.

This year, the world has seen scorching temperatures. And this heat has taken lives—in Delhi, when I write this at the end of June 2024, it is estimated that some 270 people have died because of extreme heat. But I repeat this number with caution. We really don't know how many have died, because heat is an exacerbating factor to existing health ailments like cardiovascular or kidney diseases. Many more may have succumbed to heat this summer, but doctors would have written it down to underlying conditions. We know that the most vulnerable are those exposed to heat because of their work conditions—from construction workers to farmers. It is also the poor, who do not have access to electricity and so, cannot use appliances to cool down their bodies. But their deaths are not recorded as heat stress; only that they are either poor, or old and died of “unknown causes”. Heat is not listed in the notified diseases of the country, which also means that it is not required to be recorded or to provide information for further action. So, we must recognise that we know little about the health burden and deaths because of the ferocious burn we have seen of late.

However, research is now pointing to the dynamics of deadly heat. First, it is now being understood that the rise in night-time heat is the cause of maximum mortality. A 2022 paper in the British medical journal *The Lancet* found “that the relative mortality risk on days with hot nights could be 50 per cent higher than on days with cooler night temperatures.” The reason, the authors explain, is that heat affects sleep; does not allow the body to repair itself; and this, in turn, exacerbates the health stress. Second, we know that evaporation is the method for our bodies to cool down; but this becomes ineffective when humidity increases beyond 75 per cent—also known as wet bulb phenomenon. So, thermal discomfort is what needs to be understood, not just temperatures.

The worry is that we are seeing an increasing trend

in all three killer factors, particularly in urban centers. Here, temperatures are rising beyond human tolerance; humidity is increasing; and so is the night-time heat. A recent report by my colleagues at the Centre for Science and Environment tracked heat trends across major cities of India and found that ambient air temperatures are increasing in cities, as against the average for the country. Then Hyderabad, Delhi, Mumbai, Kolkata and Chennai are seeing a more humid summer—5-10 per cent increase in the last decade (2014-2023) as compared to 2001-2010. Only Bengaluru has not shown any increase in summer humidity level and this needs further investigation.

Then, the report finds that cities are not cooling down at night—across all climatic zones. It notes that during summers of the decade of 2001-10, night temperatures dropped by 6.2°C to 13.2°C from the day-time peak. But in the last 10 summers, this difference between day and night temperatures (maximum and minimum) is decreasing. Hyderabad is down by 13 per cent; Delhi by 9 per cent and Bengaluru by 15 per cent. Kolkata, which already had the dubious distinction of a smaller difference between day and night temperatures, is now worse, because of higher humidity levels.

We know that all this is part of that double-whammy we see in our world. On the one hand, there is a warming Planet—this year has broken all previous high temperature records. Worse, there are changes afoot in the way the weather behaves in terms of erratic rain, intense heat and changes in wind patterns. All this makes heat more stressful; more deadly. On the other hand, our cities are seeing a dramatic change in micro-climate—the heat island effect is amplified as concrete takes over open and green spaces; traffic and the use of energy for cooling add to the heat being trapped in the air.

This summer has taught us new lessons in heat stress. The fact is, climate change will throw us many such surprises in terms of impacts on human health. Even now, this science is not understood. What climate change will do is bring the impacts closer to our bodies and our health. This is why planetary health is about human health. It is time we made this connection. It is time we understood why climate change is an existential crisis; it is literally about life and death. **DTE**

Planetary health is about human health. It is time we made this connection

 @sunitanar

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Engage



Space sector must focus on sustainability

This is with regard to the cover story “100 m walk for Pragyan, giant leap for India” (16-30 December, 2023). The Chandrayaan-3 mission created a platform for India to showcase its supremacy and innovative capability in the field of space science, as it set foot on the untouched south pole of the moon. The Chandrayaan-3 mission was launched at one-fifth of the budget that US space agency NASA has spent on its VIPER mission to study the moon, which will be launched in 2024.

The so-called “space race” between countries should not be about cutting budgets and capturing the unseen, but about attaining sustainability in the result. The idea of “supremacy” that motivates countries to launch regular space missions has blurred the insights which may help us build a sustainable future on this planet. Space junk and debris, though not a serious threat at present, may expand to cover every landmass on the earth in the future, signifying our vulnerability. Though projects to clean up space debris, such as the India Space Research Organisation (ISRO)’s Project NETRA and SPADEX and NASA’s ElectroDynamic Debris Eliminator (EDDE), have been announced with the best intentions, they also indicate a lack of foresight among countries, in terms of the risks that space projects carry. A similar situation can be seen in cases where developing countries suffer due to climate hazards that the rich nations have caused, in their race to

develop and rapidly urbanise. Ultimately, the weakest parties face the impacts of unsustainable development.

Before we consider colonising the moon, we should concentrate on grabbing the free-flowing metal pieces that hover over us like swords. In order to attain sustainability in the space sector, there is a need for greater collaboration among global space research institutions and sharing of project ideas, resources, machines, budgets and information. Why should we launch multiple projects, when we are all looking for the same results? No conference and convention can be termed useful unless it promotes an ideal of universal cooperation and responsibility. “Many countries, one space mission” should be the idea behind space research, to help create harmony among countries.

VIVEKA VARDHAN NAIDU BHYRIPUDI
VIA EMAIL

Myriad uses of pumpkin

I was delighted to read “The yellow in the rainbow” (1- 15 May, 2024). In Assam, pumpkin is known as *rongalao* (*ronga* means red and *lao* means gourd). In Assam, each part of the gourd is used in different recipes. Besides the pumpkin, its flower and the soft first part of the gourd are consumed, while the leaves are used to prepare a saag. The stems are used in mixed vegetables and in dal to enhance taste; the shell and the seeds of pumpkin are also fried for consumption. Some people use the seeds after de-shelling to prepare *pakodas*. Thus, pumpkin as a vegetable adds variety to the daily food plates of Assamese people.

MONIMALA DEVI
CHABUA, ASSAM

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Digest

WHAT'S INSIDE

Maharashtra family strives to save native maize variety **P8**

Over 500 districts see high temperatures in April-May **P9**

Panama evacuates low-lying island amid rising sea levels **P10**

1,000 WORDS

VIKAS CHOUDHARY



The 4.64 sq km Central Ridge Reserve Forest in Delhi has an estimated 120-150 golden jackals (*Canis aureus*), says a study by the School of Human Ecology, Dr B R Ambedkar University, Delhi. Through three surveys in 2018-23, the researchers determined that Central Ridge has 26-32 golden jackals per sq km. The high population density indicates that the animal is able to adapt to an urbanised area and coexist with other species, says the study published in July 2024. It suggests that protection measures may be needed to ensure the animal continues to thrive.

FOR MORE PHOTOS, SCAN



Sole saviour

KUSUM AND Narayan Gaikwad are likely to be remembered for long in their village, Jambhali, in Kolhapur district of Maharashtra. For the past five decades, they have been the sole cultivators of *kabburi makka*, an indigenous variety of maize. While all other families in the primarily agrarian village cultivate hybrid maize, Kusum Gaikwad sows seeds of the off-white *kabburi makka* twice a year. After harvest, she pulls out four ears of corn, ties them up with other maize and hangs them from the roof of their house to preserve the seeds for a year. The rest of the maize is used to make porridge and flatbread for the family, neighbours and friends.

Kabburi makka was earlier cultivated in the villages of western Maharashtra and northern Karnataka, where people believed it was more tasty and nutritious than other maize varieties. But like several native crops, it began to vanish after the advent of the Green Revolution and the push for hybrid crop varieties. "Farmers began cultivating the hybrid varieties in the early 1970s, and the traditional ones were abandoned over the next two decades," says Kusum Gaikwad. The primary reason behind the shift, she says, was that hybrid maize could be harvested in three months, while traditional varieties took four-five months to grow. Today, many of her neighbours are able to grow 2,000 kg of high-yielding hybrid maize crops, as against 1,000-1,500 kg of traditional varieties. "Both hybrid and native varieties sell for ₹20 a kg; so there is no incentive to retain traditional crops," she says.

Prasant Mohanty, executive director of Nirman, a non-profit working on ecological farming and sustainable livelihoods across the country, says, "In many areas, the hybrid varieties have completely replaced the traditional seeds because of government maize programmes. Hybrid maize also has a market." Daisy John, a

For five decades,
one family in
Maharashtra has
preserved a
traditional corn
variety that may
soon go extinct

SANKET JAIN

Kusum Gaikwad of Jambhali village, Kolhapur district, Maharashtra with a porridge made from indigenous *kabburi makka* variety of maize



researcher with Delhi-based non-profit Public Health Foundation of India, adds, "Farmers are dependent on the hybrid varieties because they are not getting enough money for the traditional crops, which have longer crop cycles."

But the loss of native crops also led to disappearance of traditional meals like *kabburi makka* porridge and flatbread, says Kusum Gaikwad. "The porridge can be made using the hybrid maize, but it does not taste good and even lacks essential nutrients," she says. Further, she says, as her neighbours began to cultivate more hybrid maize, their dependence on pesticides and fertilisers increased. Knowing that this would harm the soil health in the long term, Kusum and Narayan Gaikwad decided to keep cultivating native varieties. They set aside 0.4 hectares (ha) of their 1.3 ha for *kabburi makka*, along with native varieties of emmer wheat, sorghum, pearl millet, rice and vegetables. The rest of the land is used for their primary crop, sugarcane.

"We do not grow *kabburi makka* for profit, but it has helped us survive for several decades when we did not have access to irrigation facilities. The variety, like other native maize crops, grows well with just rainfall," says Kusum Gaikwad.

Now, the Gaikwad family strives to revive widespread cultivation of *kabburi makka*. They often distribute seeds in their and nearby villages along with dishes made from them to encourage other farmers to grow them.

Farmer Supriya Kagwade from Khochi village, 32 km from Jambhali, has been inspired by Kusum's initiative of preserving the traditional seeds. For the past five years, she has been making *kabburi makka* porridge for her family.

"While everyone loves eating it, unfortunately, no one is interested in preserving the seeds. But the Gaikwad family is working hard to save *kabburi makka*," she says.

EXTREME WEATHER

Boiling summer for India's districts

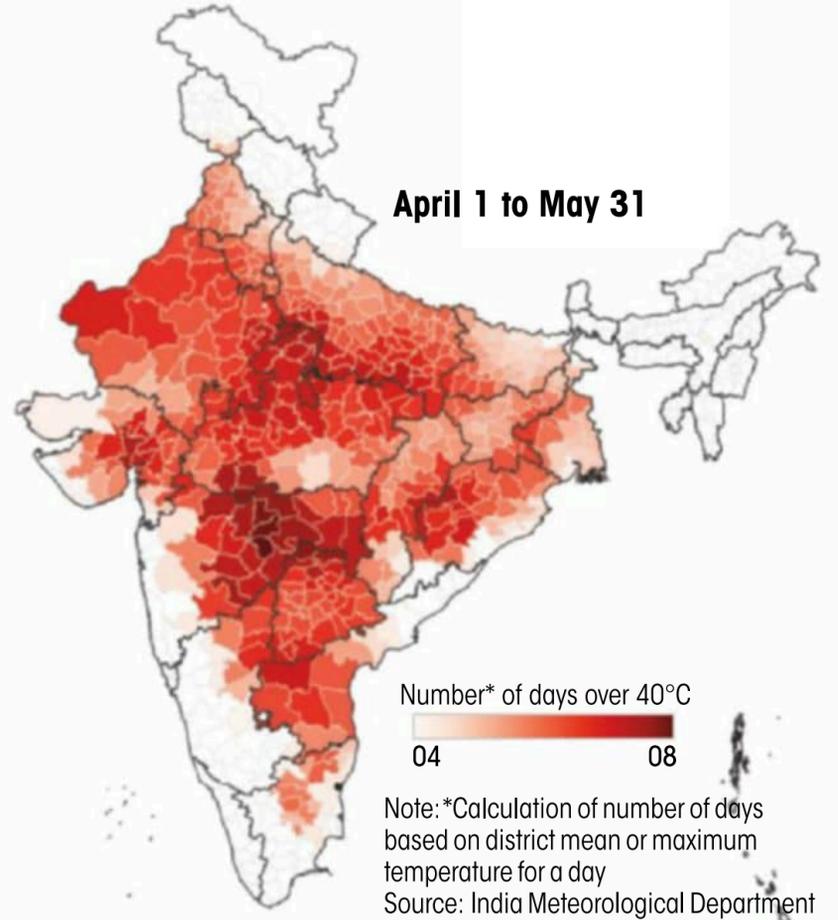
MORE THAN 500 of 741 districts across India reported temperatures over 40°C at least once between April 1 and May 31, 2024. Hingoli, Washim and Akola districts from Maharashtra had the highest count of such days, with Hingoli reporting higher mercury levels on 48 of the 61 days.

Granular analysis shows the heat stress was more profound in the southern districts in April. Kurnool district and the Rayalaseema region in Andhra Pradesh, in particular, were the most-affected during the

month. Overall, 418 districts had reported at least one day when maximum temperature was above 40°C.

In May, the heat stress gradually shifted to the western and west-central districts in Rajasthan and Madhya Pradesh. Burhanpur and East Nimar, both in Madhya Pradesh, reported the maximum number of days (30) when temperatures were above 40°C.

Cumulatively, during May, 490 districts across the country reported at least one day with mercury levels above the 40°C threshold.

**POLITICS**

Elections indicate green focus weak across nations

PROVISIONAL RESULTS of the elections to the European Parliament, released on June 9, indicate major gains for right-leaning political parties who have spoken against the EU's "Green Deal" environmental policies. At the same time, parties in favour of sustainable measures saw heavy losses, at a time when the EU is due to set an ambitious target for 2040 to help the bloc become net zero by 2050. Other recent elections too indicate a potentially weaker climate focus. For instance, Mexico in the first week of June elected Claudia Sheinbaum, a climate scientist, as its first woman President. While Sheinbaum promises to accelerate energy transition, she is expected to largely continue her predecessor's environmental measures, seen as inadequate to help Mexico meet its global commitments. Similarly, in South Africa, President Cyril Ramaphosa secured a second term in early June, but his party African National Congress (ANC) lost majority and entered an alliance. While ANC has pledged clean energy, its alliance partners have not focused on climate goals, bringing to question the new government's green ambition.

HEALTH

West Bengal sees human cases of avian influenza

THE WORLD Health Organization (WHO) on June 11 confirmed a human case of avian influenza, also called bird flu, in a four-year-old child in West Bengal. The child, who displayed symptoms of respiratory distress and was hospitalised multiple times between January and May, was reported to have contracted the low pathogenic avian influenza A (H9N2) virus, said WHO. The child has received treatment and discharged from hospital, with no reports of further human transmission, said the global health agency, adding that the infection was likely due to contact with poultry. This is the second case of human H9N2 infection reported in India, with the first case recorded in 2019. Also in June, WHO confirmed that Australia's first human case of bird flu is likely to have come from India. The patient in Australia, a two-year-old child, had travelled to Kolkata in West Bengal in February. Later in March, after returning to Australia, she was hospitalised and found to have contracted the H5N1 strain of bird flu virus—a highly pathogenic subtype that has been in global circulation since 2020.

BITS GLOBAL

About 300 families in Gardi Sugdub, Panama, evacuated the low-lying island in early June over concerns of the rising sea levels. The evacuation of Gardi Sugdub, traditionally home to Panama's Guna community, is a first for the country. While the evacuated families have been moved to a housing project near the country's mainland, around 200 households have opted to continue living on the island. This is despite warnings from the government that the island may soon be washed away by rising waters.



New Zealand on June 11 scrapped a plan to impose tax on greenhouse gas emissions from livestock. The plan to impose duties on enteric fermentation of livestock, which releases potent greenhouse gas methane, was introduced in 2022 and met with many protests from farmers. The government has now said that a new legislation would be introduced in June to remove the agriculture sector from any emissions pricing plan.

Chemical and manufacturing groups in the US filed a lawsuit against the government on June 10, over a drinking-water standard to clean up so-called "forever chemicals". The new standard, rolled out in April, would require municipal water systems to remove six per cent and polyfluoroalkyl substances (PFAS) from tap water supplied to households. The suing groups claim the standard underestimates the costs to the agencies responsible.

Nearly 32,000 hectares have been destroyed by wildfires in Brazil's Pantanal wetland from the start of the year till June, at a time when the country is under widespread drought. Pantanal, the world's largest tropical wetland, is home to jaguars, giant anteaters and giant river otters. The blaze warrant concern particularly as Brazil's wildfire season starts in July, said media reports.

BITS INDIA

Farmers in Maharashtra blocked a highway in Latur district on June 10, in protest against delay in distribution of drought subsidies and other relief measures. The farmers, who belong to Renapur *tehsil* that has been declared drought-affected by the state government, claimed to have completed formalities to avail relevant subsidies but were yet to receive any relief. They warned of bigger protests in the future.

Municipal Corporation of Gurugram on June 13 launched a 24-hour helpline to ensure cleanliness in the city. The helpline came a day after the Haryana government declared a municipal solid waste exigency in Gurugram amid reports of untreated waste affecting environment and public health.



India ranked 129 out of 145 countries in the World Economic Forum's "Global Gender Gap Report 2024", released on June 12. The country closed 64.1 per cent of its gender gap in 2024, says the report, slipping two places from its 2023 ranking. The country now stands below Bangladesh, Nepal, Sri Lanka and Bhutan among Asian countries.

Madhya Pradesh on June 11 said preparations are complete at the Gandhi Sagar Wildlife Sanctuary in Chenpuriya to bring in more cheetahs from Africa as part of India's project to reintroduce the animal. The state says the prey base has been increased at Gandhi Sagar, and officials from Kenya and South Africa have visited the area.

IN COURT

SUPREME COURT

■ The apex court censured Himachal Pradesh for refusing to release more water to Delhi. The court directed the hill state in May to release 137 cusecs of surplus Yamuna water via Haryana, which the state claimed it had done. However, Himachal Pradesh later said it did not have surplus water.

HIGH COURTS

■ The High Court of Kerala has directed constitution of a committee to curb pollution in the Periyar river of the state. The court was hearing a case alleging dumping of toxic industrial waste in the river.

■ The High Court of Gujarat told the state government to set up a fact-finding committee to investigate a fire that broke out in Rajkot in May. The fire, which killed 27 people, broke out in a game zone that was allegedly operating without a license for years.

■ The High Court of Uttarakhand has warned owners of brick kilns in the state to comply with laws regarding minimum wages to be paid to workers. The court was hearing a petition claiming the government's orders in 2019 and 2024 to revise minimum wages for workers in brick kilns had not been met.

So far...

Number of cases on environment and development tracked from January 1 to June 13, 2024

NATIONAL GREEN TRIBUNAL	SUPREME COURT	HIGH COURTS
214	40	56

FOR DETAILED VERDICTS, SCAN



Note: The National Green Tribunal and Supreme Court benches were on summer break in June

THE/NUDGE Prize

DCM SHRIRAM
FOUNDATION

Making the AgriWater Sector More Investable is Critical to Solving India's Water Crisis

If India wants to avert a severe water crisis, making agricultural water use more efficient and sustainable is essential, given that the sector consumes 78% of the country's water resources. We also face the added challenge of dealing with a fragmented landscape dominated by smallholder farmers who own less than 2 hectares of land and struggle to make ends meet.

Many promising startups are building innovative solutions and services for these smallholder farmers, incubated by initiatives such as the DCM Shriram AgWater Challenge, run by The/Nudge Prize. However, Agricultural Water (AgWater) startups face significant challenges in securing timely investments.



Cost of Customer Acquisition

Agriculture has a smaller share of investment compared to sectors like e-commerce or technology, and within this, agricultural water accounts for an even tinier slice. The complexity of problems and solutions involved deter investors, but the biggest roadblock is the difficulty in customer acquisition, which tends to be slow and expensive. Whatever investments are made in this sector tend to go towards micro-irrigation, as the government subsidises around half the cost of installation of drip and sprinkler systems, making customer acquisition cheaper. However, this advantage is not extended to other innovative AgWater solutions.

Pathways to Solutions

Solving the problem requires a multi-dimensional approach. Startups need to look beyond the technology itself and create innovative business models that reduce risk for investors. For example, Irrigation as a Service (IaaS) is a model that is particularly attractive to

investors, with the promise of recurring revenue and predictable monthly earnings, which make customer acquisition easier. Companies like AgriRain use this model, ensuring continuous cash flow and long-term customer relationships.

In contrast, other segments such as sensors and automation, represented by companies like Bharat Rohan and Intech Harness, have not received funding proportional to their potential. The initial investment required from farmers for these technologies is high, and the complexities involved in customer acquisition pose significant hurdles. Companies are trying to address this by shifting to a service-based model, but need more support to make that transition. Biologicals, like those developed by EF Polymer and the Centre for Environment Concerns (CEC), which improve soil water retention and reduce the number of irrigation cycles in a year, face hurdles but have potential due to their geographic scalability and ease of transportation and distribution.

However, the problem is too big and widespread to be solved solely by startups. To overcome these challenges, a shift in investment strategy is essential. Investors need to take a long-term view of the ecosystem impact rather than focusing solely on immediate returns. Traditional funders and impact investors must recognise the broader benefits of investing in AgWater solutions. This includes potential improvements in agricultural productivity, sustainable water use, and enhanced soil health.

Patient capital and philanthropic funding play crucial roles in this scenario. They provide the necessary runway for startups to develop and prove their solutions. As Kanishka Chatterjee from The/Nudge Prize explained, "Philanthropic capital acts

as the bridge to ensure great tech-first ideas don't die out before they get the chance to prove their worth." Some investors such as Social Alpha, Villgro, Caspian & Acumen are already following this path.

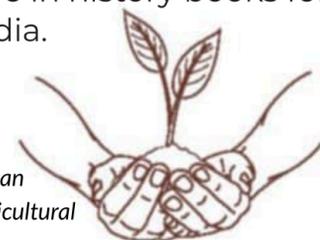
By supporting growth-stage AgWater startups, these initiatives help mitigate the high risks and long customer acquisition cycles that often deter traditional investors. This approach not only aids in the survival of these startups but also fosters innovation and resilience within the sector.

A Hopeful Outlook

While the challenges are significant, the commitment from organisations like DCM Shriram Foundation offers a beacon of hope with their efforts to provide gap funding. As more investors recognise the potential of AgWater solutions, we can expect to see increased funding and innovation, leading to more sustainable and efficient water management practices.

Failing to address these investment potential issues can severely hinder our progress in water conservation. Without adequate funding, more organisations may divert into broader agricultural technologies to attract funding, leaving the specific challenges of water management unaddressed. This stagnation can lead to a continued reliance on less efficient methods, exacerbating water scarcity and reducing agricultural productivity.

Startup investing is about improving returns while reducing risk, but the cost of inaction can be much higher for the entire economy and country. Investors who take a long-term view and focus on impact investing have a chance to feature in history books for transforming India.



"This article is one part of an 8-part series covering agricultural water utilisation in India."

ON THE evening of April 29, T Subaida from Adikat-tukulangara village in Kerala's Alappuzha district discovered her only Jersey cow dead in its shed. Initially suspecting poisoning from grazing on nearby vacant land, a post-mortem revealed the cow had succumbed to heat stroke. The loss had a huge financial impact on Subaida, who relied on selling milk to sustain her household during non-farm seasons.

In contrast, livestock farmer Mali Ram Sharma from Ghinoi village in Jaipur, Rajasthan, feels more secure despite the unusually hot April and May. "For the first time, I have taken out insurance this year, which promises fixed compensation if the milk production of my livestock dips due to high temperatures," says Sharma. Noticing a steady decline in milk yield during the peak summer months over the past five years, Sharma decided on insurance. "A cow in my village usually produces 20 litres of milk a day. In the current heat, the yield has dropped to just 16 litres," he says, adding that his insurer, a private Patna-based agritech company called DeHaat, which started cattle insurance for the first time this April, will calculate the compensation amount in mid-July.

India is experiencing intense heat stress this year, with the India Meteorological Department (IMD) reporting heatwaves in 14 states and Union Territories in April, and in 24 in May. Unusual temperatures have become a recurring problem for the country, which has recorded 12 of its warmest years since 1901 in the past 15 years.

Heat stress has harmful consequences for animal health and

Insured against heat

States and private firms are implementing insurance schemes to protect livestock rearers against milk production losses caused by heat stress

**SHAGUN IN JAIPUR AND
KA SHAJI IN THIRUVANANTHAPURAM**

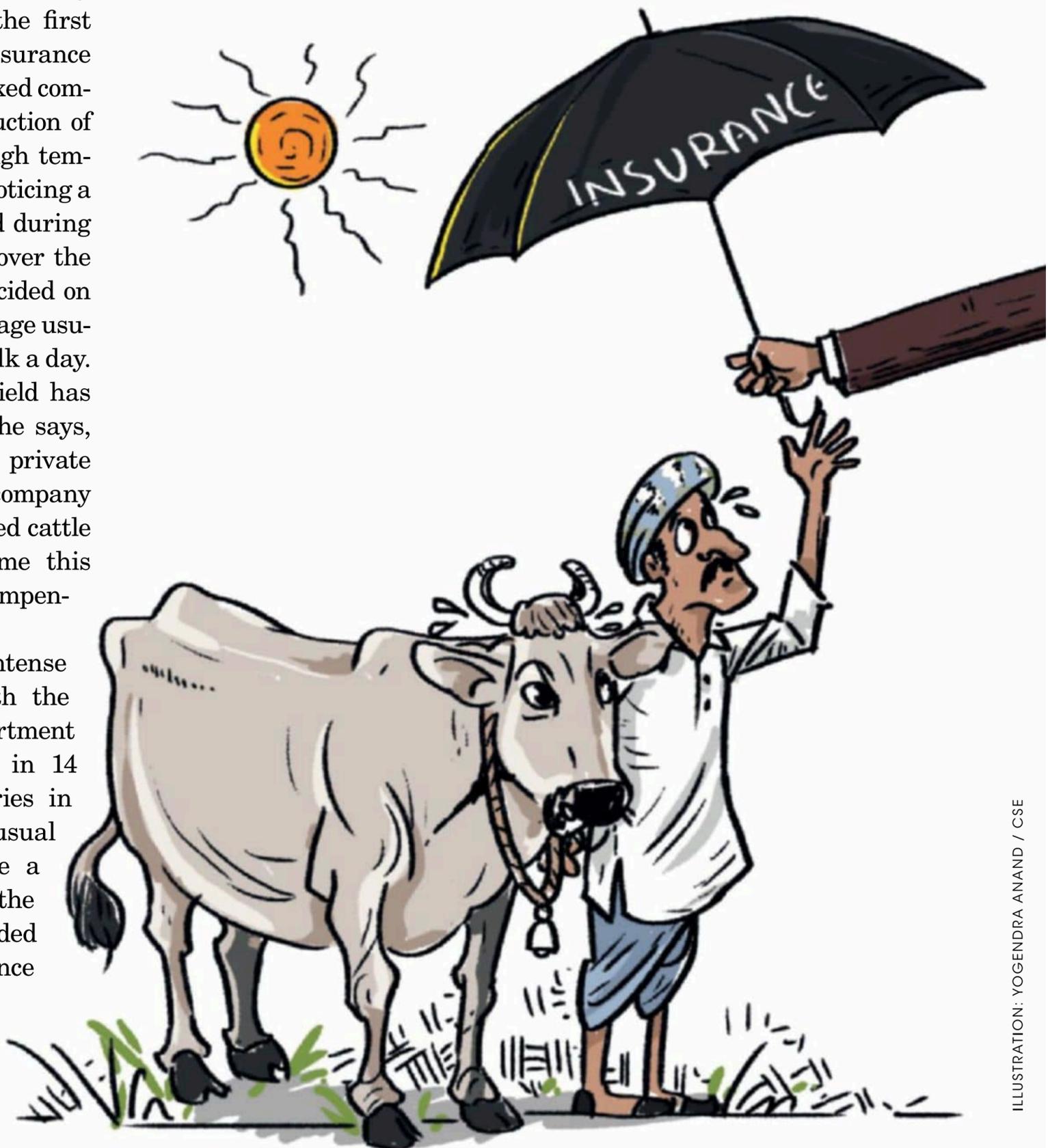


ILLUSTRATION: YOGENDRA ANAND / CSE

productivity. Animals have a thermal comfort zone optimally suited to their physiological functions. When temperatures exceed this threshold, it leads to heat stress, metabolic disorders and immune suppression among livestock. Dairy cows are particularly susceptible. A March 2022 study in *The Lancet* notes that cattle can experience thermal stress at temperatures above 20°C. It estimates rising temperatures could reduce milk production in India's arid and semi-arid regions by 25 per cent by 2085.

Given the crisis, private and government players are gradually introducing insurance schemes. The initiatives are in their early stages and limited to specific districts. The current schemes are all parametric, meaning insurance is based on the occurrence of a specific event, with compensation amounts tied to the event's magnitude rather than the actual losses incurred.

TOO HOT TO HANDLE

India, the world's leading milk producer, heavily relies on its dairy sector, employing over 8 million people, most of whom are small and marginal farmers. These farmers face substantial financial losses as milk production declines due to heat stress. In Kerala, the first state to roll out a livestock insurance scheme in 2023, the typical summer decline in milk production has worsened, with farmers reporting a drop of up to 45 per cent this year compared to the usual 15 per cent.

Officials from the Kerala Co-operative Milk Marketing Federation, known as Milma, tell *Down To Earth* (DTE) that the federation typically sells 1.7 million litres of milk daily. However, this April and May, it faced a shortfall of 0.65 million litres, which it supple-

mented by sourcing milk from cooperatives in Maharashtra and Karnataka. In collaboration with the Agriculture Insurance Company of India, Milma launched the Saral Krishi Bima in select districts last year. Under the scheme, farmers receive ₹200 per cattle if the temperature in the *taluka* exceeds a set limit for six days, with higher payouts for longer durations (see 'A safety net for livestock' p14). The threshold is fixed for each *taluka*, based on historical maximum temperature data from the past 45 years. "We take a weighted average, with higher weight given to the last five years' data," says Balachandran M K, head of growth for Asia at IBISA, an international non-profit that helped design the scheme. The premium is ₹110 per cattle,

INDIA CURRENTLY HAS THREE CATTLE INSURANCE SCHEMES WHERE COMPENSATION IS TIED TO THE MAGNITUDE OF HEAT STRESS EVENT RATHER THAN THE ACTUAL MILK PRODUCTION LOSS INCURRED

partially covered by Milma (₹53) and the remaining by local milk producer unions. This year, over 84,000 cattle were insured under the scheme.

K G Kannadas, a dairy farmer in Palakkad district enrolled under the scheme, says that despite measures to keep his cowsheds cool, such as installing fans, the stress on the cows has been unprecedented. "Without insurance and governmental support, no dairy farmer can survive," says Kannadas.

The Kutch Milk Union in Gujarat has also rolled out a similar scheme for its members, offering a compensation of up to ₹2,000 in case of extreme heat for a premium of ₹100 per cattle. Private agritech company DeHaat has introduced cattle insurance schemes in select

districts in Rajasthan, Madhya Pradesh, Uttar Pradesh, Bihar, Maharashtra and Jharkhand. The scheme offers free and paid versions, with compensation amounts based on temperature thresholds.

LIMITED RESPITE

Though much needed, the current insurance schemes are far from perfect. In Kerala, for instance, the scheme runs only for two months, from March 1 to April 30, despite the heatwave continuing well into May. K S Mani, chairperson of Milma, says that the expectation was for the heat situation to subside by early May, with intermittent heavy summer rains bringing relief. "The climatic situation has worsened this May. However, we have no funds to extend the insurance for

one more month. The facility ended on April 30 and will resume on March 1 next year for another two-month term," he says.

Meanwhile, DeHaat provides insurance only to farmers who purchase the company's fodder. "We had to authenticate that only dairy farmers who sell milk can buy the insurance; otherwise, a farmer with one animal for personal use would also buy it. Our reach is limited to our network, but selling insurance is tough because we are not an insurance company," says Digvijay Singh, head of dairy input at DeHaat.

The current schemes also do not factor in humidity. "When we talk about heat-induced stress in dairy cattle, it is a combination of temperature and humidity. We lack good data sets to measure humidity.

Once we have that, we can improve the product,” says Balachandran.

India must also learn from global experiences. Kenya was among the first countries to roll out a livestock insurance programme in 2015, when the country was reeling under a drought. The scheme had to be discontinued in 2021 because of the rising compensation demands that made it unfeasible. The country paid a cumulative compensation of 1.2 billion Kenyan shillings (US \$8.8 million) between 2015 and 2021, before replacing the scheme with DRIVE, a financial savings programme for pastoralists. It has a minor insurance component.

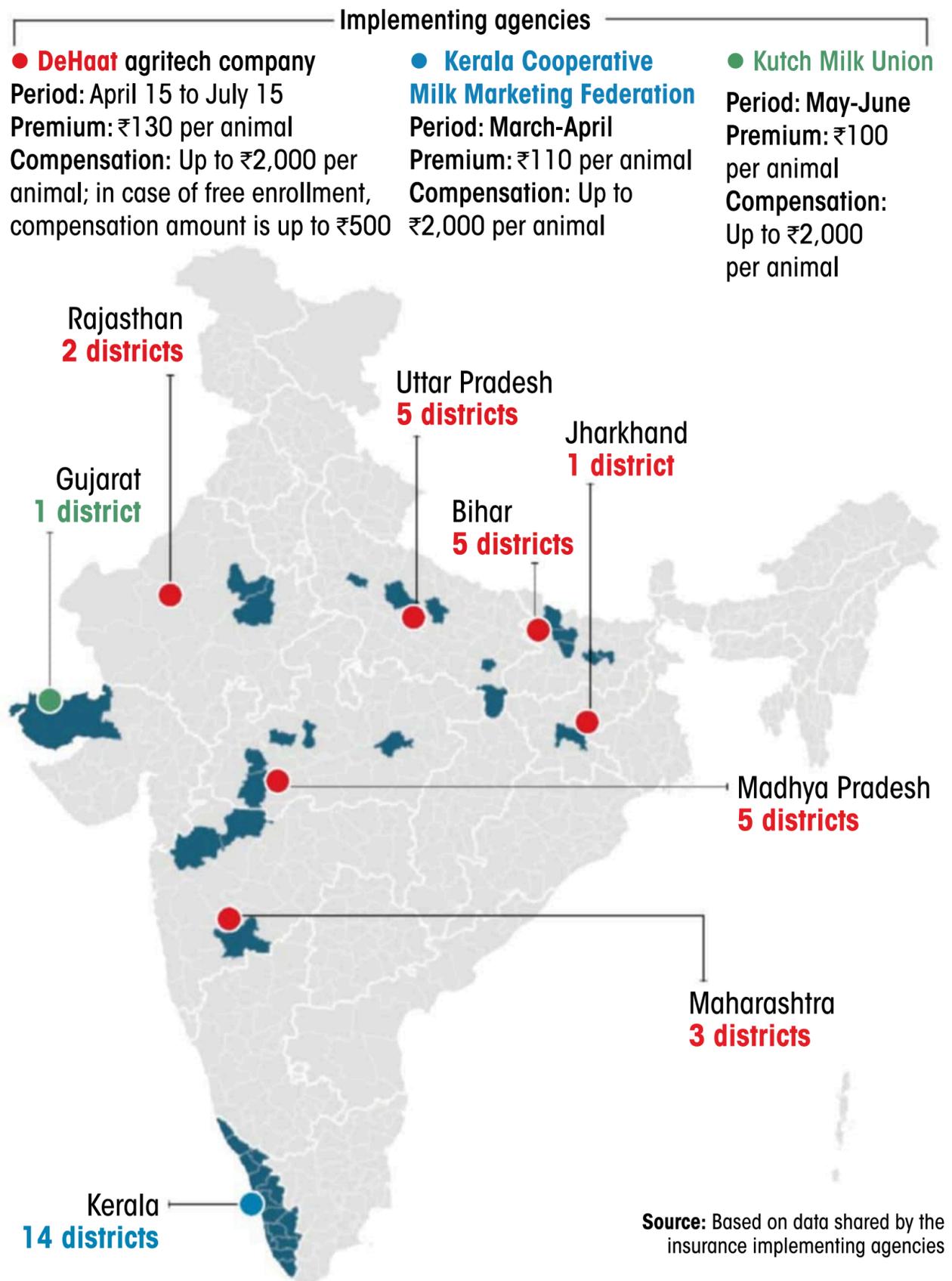
Europe has also rolled out its Heat Stress Protect programme for dairy farmers, and it is much more holistic than the schemes currently in India. It covers economic losses, including milk production and quality, reproductive efficiency, cow health and labour losses.

BEYOND INSURANCE

While the importance of insurance programmes will grow, India also needs to look at other solutions to make cattle resilient to external heat. “Insurance is a disaster relief mechanism. We need preventive solutions like improving infrastructure and practices so that farmers do not have to rely solely on insurance,” says Nirmita Chandrashekar, senior programme manager at SELCO Foundation, a non-profit that offers cooling solutions to livestock rearers. One of the solutions could be the introduction of hydroponics (the technique of growing plants using a water-based nutrient solution rather than soil) at dairy farms to improve feed quality and animal health, which enhances resilience to heat. An advisory issued on April 16 by Abhijit Mitra, Animal Husband-

A safety net for livestock

Three agencies have rolled out insurance schemes for cattle in 36 districts across 8 states



ry Commissioner, Union Ministry of Fisheries, Animal Husbandry and Dairying, highlights the importance of high-quality nutritional feed for supporting immune systems and resilience against heat.

“We also need to look at infrastructure improvements. For instance, in north Karnataka, we can use thermal wraps under roofs for insulation. In areas with higher

temperatures and humidity, we can introduce polyurethane foam panels, which drop temperatures by 4°C,” says Chandrashekar. These solutions need to be integrated into government schemes like Rashtriya Gokul Mission and National Programme for Dairy Development to help build the resilience of farmers to multiple shocks, she adds. **DTE**

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Online Training on

UNDERSTANDING ENVIRONMENTAL LAWS FOR BETTER ENVIRONMENTAL MANAGEMENT



DATE
**23RD JULY TO
4TH AUGUST 2024**



COURSE
DURATION
13 DAYS



PLATFORM
**ZOOM AND
MOODLE**

The Water Act, 1974, the Air Act, 1981 and Environment Protection Act, 1986 enacted in order to prevent and control damages to the environment. In today's scenario, there is a dire need of a strong environmental regulatory framework. India does have a comprehensive system of regulations to protect its natural environment and the health of its people. Government in the last few decades has shown keen interest in protecting and promoting the environment and consequently enacted various Environmental Laws. The understanding of different environmental laws is important in preventing environmental damage and ensuring effective management of the environment and its multiple ecosystems.

There also seems to be a gap between the available regulations or laws and the basic enactment or application of the laws into the real time scenarios. To address this gap, the Centre for Science and Environment is organizing a 13 days online training course on "Understanding Environmental law for improving environmental management".

This comprehensive online training will cover the relevant issues, recent advancements and significance of environmental laws.

PARTICIPANT FEES



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per participant for Indian nationals



US\$ 50

per participant for foreign nationals

PARTICIPANTS WILL BE AWARDED A CERTIFICATE OF PARTICIPATION ON SUCCESSFUL COMPLETION OF THE PROGRAMME

COURSE COORDINATOR

SHOBHIT SRIVASTAVA

Programme Manager

Industrial Pollution Unit

Centre for Science & Environment

Email: shobhit.srivastava@cseindia.org

Mobile: +91 9711049558

MODE OF TRAINING

The course is designed in a manner to help the participants in attending this course along with their regular work and study the course material at their own convenience. Recorded sessions will be uploaded on the training platform for the participants to study. Live online sessions will be organized with experts for Q&A and further discussions.

LEARNING FROM THE PROGRAMME

- Understanding of the environmental governance structure of the country, major institutions and their implementation statistics
- Learning about laws and rules waste management,
 - Environmental Protection Act
 - Air act
 - Water Act
 - Solid Waste and Plastic waste Management rules
 - Hazardous Waste Management rules
 - E-waste management rules
- Overview of the obligations of industry and individuals under various environmental laws and regulations and how to meet these obligations;
- Role of National Green Tribunal (NGT), environmental courts and public interest litigation (PIL)
- Understanding of international treaties and agreements Government of India subscribes to the impact of non-compliance with such agreements on business.

WHO CAN APPLY?

- Industry professionals; Environment Consultants; Environment Engineers
- Researchers and academicians
- Students aspiring to work in environment field



Israeli firm SpaceIL's Beresheet lander took this picture moments before it crashed on the moon. The spacecraft carried a payload of Arch Mission Foundation, in which the US-based non-profit had secretly loaded tardigrades

Ground rules

IN 2018, Swarm Technologies, a US startup, launched four small satellites into space on an Indian rocket that carried 31 payloads. The start up had been denied a licence by the US government because the satellites were too small to be tracked in space. The firm put its satellites on the launch anyway.

In February 2019, Israeli private company SpaceIL and space agency Israel Aerospace Industries launched Beresheet—the country's first lunar mission and the first attempt by a private firm to land on the moon. The spacecraft crashed on the moon in 2019. Four months later, it emerged that Arch Mission Foundation, a US non-profit, had secretly sent a payload of

Space agencies and private players must adhere to exploration norms to ensure integrity of space research

ROHINI KRISHNAMURTHY
DELHI

microscopic eight-legged animals called tardigrades on Beresheet. Tardigrades are the sturdiest organism on Earth. Though experts say that these organisms cannot reproduce or establish a colony in

the absence of liquid water and oxygen, their presence on lunar soil has raised ethical questions.

The incidents show not just the private sector's increasing involvement in space exploration, but also its willingness to circumvent, even break, the basic governing principles. One of the most important principles is safeguarding the solar system from contamination by Earth life, and Earth from possible extraterrestrial life forms, as enshrined in Article IX of the Outer Space Treaty (OST), a legally binding agreement in force since 1967. A total of 116 nations have ratified OST and are now responsible for ensuring that private organisations within their territories adhere to

PHOTOGRAPH COURTESY: SPACEIL

the principles of planetary protection. Planetary protection is also important to track the microbial population on a spacecraft because microbes might mutate due to evolutionary pressure exerted by space conditions. This can increase their pathogenic potential, which has repercussions on astronauts' health (see 'Space profoundly alters microbes' on p18).

A Planetary Protection Policy, developed by a 26-member panel comprising scientists and representatives of 12 space agencies, exists since the 1960s and was last updated in 2021. The policy is the only internationally-agreed stand-

ard available for reference and use by countries. The panel works under the Committee on Space Research (COSPAR), a scientific body set up by Paris-based non-profit International Council of Scientific Unions (now International Science Council) in 1958. The panel helps spacefaring nations and private players comply with OST. It has classified space missions into various categories, corresponding to the level of scientific interest in the origin of life and concerns that contamination can compromise future investigations or the safety of Earth (see 'Threat categorisation').

The problem, however, is that

the planetary protection policy is not legally binding. Nations have not incorporated it into national law; nor is there a mechanism to ensure compliance with the policy by states and private players. "COSPAR planetary protection policy should be used as a guide for what best practice looks like but if the space agency of the country in question has its planetary protection policy, then it would use that to comply with Article IX of OST," Thomas Cheney, assistant professor at the Northumbria Law School, UK, tells *Down To Earth* (DTE). But only three agencies—European Space Agency (ESA),

Threat categorisation

COSPAR has categorised space missions based on the threat of contamination they pose to celestial bodies and to Earth (upon their return). Countries or private companies exploring space are not mandated to follow these contamination guidelines, but they usually do so voluntarily

Category	Definition	Celestial bodies included	Contamination guidelines
I	Orbiter and flyby missions to asteroids thought to pose no contamination risk	Undifferentiated, metamorphosed asteroids	No guidelines to be followed by the exploring agency
II	Flyby, orbiter and lander missions with remote chance of contaminating celestial bodies. This means the target body lacks the environment where terrestrial organisms could survive and replicate, or have a very low likelihood of such transfers	The moon, Venus and comets	The agency should document the organic products that may be released into the target bodies by the spacecraft's propulsion system
III	Flyby and orbiter missions that carry a significant chance of contamination due to the presence of environments where terrestrial organisms could survive and replicate, and there is some likelihood of transfer to those places	Flyby or lander missions to Mars; to Jupiter's moons Europa, Ganymede and Callisto; and to Saturn's moons Titan and Enceladus	Missions should provide an organic inventory, build and test spacecraft in cleanrooms (which are environments with controlled degrees of contaminants) and use sterilisation techniques to prevent microbial contamination from Earth during space exploration.
IV	Lander missions to Mars and icy worlds that carry significant chances of contamination	Mars, Europa, Enceladus	Samples brought to Earth will have to be contained. If any sign of the existence of a non-terrestrial replicating entity is found, it must remain contained unless treated by an effective sterilising procedure.
V	Earth-return mission (Unrestricted)	Venus and the moon are categorised under unrestricted since they are deemed to have no indigenous life	
	Earth-return mission (Restricted)	Mars, Enceladus and Europa	

INTERVIEW

'SPACE PROFOUNDLY ALTERS MICROBES'



Karthik Raman



Pratyay Sengupta



Shobhan Karthick MS

During microbial tracking missions on the International Space Station in 2015-16, US space agency NASA found that the spacecraft's microbial population included 13 strains of *Enterobacter bugandensis*—a pathogenic bacterium that had been first detected on Earth only in 2009 and designated a separate species in February 2016. A study on the 13 strains, published in *Microbiome* in March 2024, found them to be distinct from their terrestrial counterparts. **Karthik Raman**, professor; **Pratyay Sengupta**, scholar under Prime Minister's Research Fellows scheme; and **Shobhan Karthick**, undergraduate student, Department of Biotechnology, Indian Institute of Technology, Madras, authored the study in collaboration with Jet Propulsion Laboratory, NASA. In an interview with **Aditya Misra**, they say that evolutionary pressure exerted by space conditions drives microbes to develop new strategies for survival and potentially increases their pathogenicity. Excerpts:

Is there information on how *Enterobacter bugandensis* (*E bugandensis*) reached ISS? What are our learnings from the incident?

E bugandensis likely reached ISS via astronauts, new equipment, supplies, or onboard experiments, as ISS is a hermetically sealed spacecraft where microorganisms can only be introduced through such vectors.

The study of *E bugandensis* on ISS reveals significant insights into microbial adaptation and persistence in extreme environments. It highlights the unique genomic alterations and resistance mechanisms of this multidrug-resistant bacterium, distinct from terrestrial strains. The research provides valuable information on the prevalence, distribution, and colonisation patterns of microbes in closed environments, emphasising the importance of advanced analytical techniques like metabolic modelling to understand microbial interactions. By identifying genes specific to ISS and antibiotic resistance genes, the study aids in developing targeted antimicrobial treatments and strategies for microbial management in both space and healthcare settings.

How do extreme environments (microgravity, radiation and increase in carbon dioxide levels) affect microbial behaviour, biology?

Extreme environments such as microgravity, elevated radiation and increased levels of carbon dioxide profoundly affect microbial behaviour and biology, driving adaptation and evolution in unique ways. In microgravity, microbes experience changes in gene expression, virulence and biofilm formation, which can enhance their resistance to stress and antibiotics. Elevated radiation levels on ISS induce DNA damage, leading to the activation of SOS response systems. Genes like LexA, which are rare on Earth but prevalent in space strains, regulate this response, helping bacteria like *E bugandensis* repair DNA damage and survive. Additionally, toxin-

antitoxin systems are more prominent in space, playing critical roles in stress response, plasmid maintenance and biofilm production, thereby increasing bacterial resilience and virulence.

Microbes also evolve unique genetic adaptations to survive the harsh conditions of space. For example, the BvgAS two-component regulatory system, a master virulence regulator in *Bordetella* species, and the Colicin-E2 immunity protein in *E coli* enhance bacterial defence mechanisms in space. Specific genes such as the inner membrane protein YbjJ in *Bacillus cereus* and ATP-dependent zinc metalloprotease FtsH-4 in *Acinetobacter pittii* are exclusively found in ISS strains, suggesting they provide an adaptive advantage in the space environment. These genetic changes underscore the significant evolutionary pressure exerted by space conditions, driving microbes to develop new strategies for survival and potentially increasing their pathogenic potential. Understanding these adaptations is crucial for developing countermeasures to protect astronaut health during long-term space missions.

How is astronauts' immune system altered during space voyages?

Astronauts' immune systems undergo significant alterations due to several factors. Disrupted sleep patterns and altered circadian rhythms negatively impact immune function. Exposure to space radiation directly damages immune cells and increases stress hormones, further suppressing immune responses. The microgravity environment alters the distribution and function of immune cells and impairs lymphopoiesis [production of white blood cells], leading to changes in acquired immunity. These combined effects result in astronauts being immunocompromised, making them more susceptible to infections and illnesses.

What is the microbial landscape on ISS?

The microbial landscape on ISS and other spacecraft is diverse and dynamic, comprising millions of bacteria and fungi present on surfaces and in the

air. These microorganisms originate from various sources, including the crew, cargo and the environment. Commonly identified microorganisms on ISS include *Staphylococcus* species, such as *Staphylococcus aureus*, which can cause human infections, and *Malassezia* species, which are prevalent fungi. Other notable bacteria include *Pantoea* spp, which are generally harmless, as well as *Klebsiella* species like *K aerogenes*, *K pneumoniae* and *K quasipneumoniae*, which are associated with human infections. *Serratia marcescens*, an opportunistic human pathogen, has also been found on ISS and the Mir spacecraft. These microorganisms can contaminate equipment and surfaces, posing potential health risks to the crew and affecting spacecraft systems.

In microgravity, microbes experience changes in gene expression, virulence and biofilm formation, which can enhance their resistance to antibiotics

Your study says *E bugandensis* coexisted and helped other microorganisms survive on ISS.

E bugandensis coexisted with and supported the survival of many microorganisms on ISS through complex metabolic interactions. To explore these interactions, we constructed 47 genome-scale metabolic models and simulated them in relevant media. We used the Metabolic Support Index (MSI), a measure that predicts the metabolic benefit a microorganism gains when in a community compared to being in isolation, to assess the interactions among 957 identified microbial communities. Our findings revealed that *E bugandensis* provided notable metabolic benefits

(in terms of MSI) to several Gram-positive microorganisms, including *Staphylococcus saprophyticus*, *S hominis* and *S epidermidis* during several flights. Interestingly, *E bugandensis* did not derive significant metabolic benefits from any coexisting organisms, suggesting it maintains metabolic competitiveness and potentially acts as a metabolic support hub within these communities. This dynamic underscores the interdependence among microorganisms on ISS and *E bugandensis*'s role in fostering a viable microbial ecosystem in the unique environment of space.

(For complete interview, visit www.downtoearth.org.in)

Japan Aerospace Exploration Agency (JAXA) and NASA —have developed their own internal planetary protection policies, aligned with COSPAR's. Space agencies that are a part of the COSPAR Planetary Protection Panel—JAXA, NASA, ESA, Indian Space Research Organisation (ISRO), Russia's ROSCOSMOS, Canadian Space Agency, China National Space Administration, German Aerospace Center, UK Space Agency, French Space Agency, Italian Space Agency and UAE Space Agency—"have indicated that their space missions are following the requirements", astrophysicist and chair of COSPAR Panel on Planetary Protection Athena Coustenis tells DTE.

COMPANIES DIFFER

Private players, however, do not appear too keen on planetary protection. For instance, Elon Musk, the founder of SpaceX, a company that designs, manufactures and launches rockets, and has expressed interest in colonising Mars, is on record saying he has no great attachment to the planetary protection protocols, arguing that there is no life on the Red Planet. "There is a distinct possibility that those looking to explore other celestial bodies for commercial reasons will eschew the restrictive requirements of the COSPAR planetary protection policy in favour of a more relaxed approach to planetary protection," states a 2020 paper in *Frontiers in Astronomy and Space Sciences*. SpaceX is already building the next generation of fully reusable launch vehicles capable of carrying humans to Mars and beyond.

Given these challenges, COSPAR

held its first-ever International Planetary Protection Week, a series of events hosted by UK-based Open University and funded by the UK Space Agency, in London on April 22-25, 2024. Representatives from 11 space agencies, including ISRO and NASA, participated during the discussions. The event also had a goal of getting private players more involved in planetary protection. "We are trying to get an understanding of the needs of industries, and what they need from COSPAR in terms of policies. We want to listen to those new stakeholders so we can make better policies," Silvio Sinibaldi, Planetary Protection Officer for ESA,

THE PANEL ON PLANETARY PROTECTION SHOULD EXPAND ITS ROLE BY ENSURING MONITORING AND COMPLIANCE. THIS WOULD REQUIRE THE INCLUSION OF LEGAL AND POLITICAL EXPERTS CAPABLE OF ASSESSING DOMESTIC REGULATORY PROCESSES AND FORMULATING SOUND RECOMMENDATIONS

tells DTE. The panel is working to make the policy more readable. It is also explaining the rationale behind the guidelines in the document, making it more self-explanatory to help stakeholders (including the private players) implement the policy. The update could be out later this year. Another policy on exploration of icy worlds could be released next year. Icy worlds are icy bodies of the outer solar system (such as Jupiter's moons Ganymede and Europa, as well as Saturn's moons Enceladus and Titan) where there is scientific interest in exploring the potential for life.

AGENCIES MUST ABIDE

Cheney does not see problems with private players, yet. "Non-governmental missions are not yet going to celestial bodies in which planetary protection is a particular worry as the Moon is essentially considered dead and therefore not a 'risk'," he says. The law expert, however, expresses concerns over the capacity and willingness of national regulators to undertake adequate regulation going forward.

"Beresheet-like incidents could escape oversight, not because space-faring governments are opposed to planetary protection in theory, but because they have not taken the steps necessary to incorporate COSPAR policies into national law," he

says. In a blog posted on Open University's website, Cheney writes that nations can, through legislation, create a legal obligation for companies and other entities to abide by the policy. The 2020 paper in *Frontiers in Astronomy and Space Sciences* makes a case for states to take a proactive role by requiring "environmental impact assessments" or similar measures as part of their national licensing process.

Others hope to see more radical changes. Kathryn Gundersen, commercial litigation associate at global law firm White & Case, New York, recommends that the Panel on Planetary Protection expand its role by ensuring monitoring and compliance. But this would require the inclusion of legal and political experts capable of assessing domestic regulatory processes and formulating sound recommendations, she writes in the *New York University Journal of International Law and Politics*. **DTE**  @down2earthindia



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BRACE FOR STILL WINDS

Wind circulations are slowing down across the globe. It may not be immediately apparent in terms of wind speed, which is a local phenomenon. But scientists say global stilling of wind affects almost every aspect of our lives—from unpredictable rainfall to excess heatwaves to frequent or missing storms. It even affects wind energy production and the aviation sector. Evidence shows a clear connection between global warming and wind stilling. Could this be the missing piece in climate models?

A report by **Akshit Sangomla**



PHOTOGRAPHS: KA SHREYA / CSE

IMAGINE A world without wind. A world where the sea breeze no longer caresses the cheek, kites do not fly, trees do not sway and their leaves do not rustle, pollens and seeds do not travel far and wide, weather does not change and the rain-bearing clouds do not visit dry lands. Since wind carries rain around and redistributes temperature, a windless planet would be a land of extremes—areas around the equator would become intensely hot and the poles would freeze solid. Ecosystems would change, some might even disappear. Local accumulations of noxious gasses, say, carbon dioxide in case of a wildfire, would take a long time to dissipate. Ocean currents would not churn up to bring nutrients to the surface or help ships sail along.

Such a scenario may sound like an unused plot line from a post-apocalypse novel, particularly at a time when disasters like storms, cyclones, heatwaves and hurricanes are intensifying. But the fact is that large-scale wind systems, which facilitate the movement of air around the planet, are slowing down.

In 2021, from summer into autumn much of Europe experienced a “wind drought”, as wind speeds slowed by 15 per cent below the annual average or even more. According to *Yale Environment 360*, an American online magazine, it was one of the least windy periods in the UK in the past 60 years. In 2010, a study published in science journal *Nature* also highlighted that annual wind speeds dropped by 5-15 per cent in large parts of Europe, central Asia, eastern Asia, and North America. The most pronounced effect was seen across Eurasia. Global mean annual wind speed decreased significantly at a rate of 2.3 per cent per decade during the first three decades, beginning from 1978, the analysis showed.

In 2019, another study in *Nature Climate Change* found that the stilling has reversed after 2010, and that the global wind speeds over land have recovered. Despite conflicting data, the Intergovernmental Panel on Climate Change (IPCC), a UN-



backed body that assesses scientific opinion on global climate, has forecast slowing winds for coming decades. Average annual wind speeds could drop by 8-10 per cent by 2100, says the IPCC Sixth Assessment Working Group 1 Report, released in 2021.

What could be the reasons for this wind stilling and where is it happening? Should we be worried about this new phenomenon? Let's start with some basic science.

WORLD WIDE WINDS

Wind, by definition, means air in motion. Primarily, this movement of mass of air is caused by the uneven absorption of solar



radiation by Earth's surface. For example, sea breeze occurs because the land heats up and cools down faster than water. During the day, when the land heats up, air above it becomes warm, less dense and rises up, creating an area of low pressure underneath. Since the air above the sea is still cooler and denser, it flows inland to balance the disparities in air pressure as well as temperature. As the warm air reaches higher altitude, it cools, becomes dense and descends towards the ground. Now imagine this circulation pattern at a global scale.

Because of the curvature and tilt of Earth, different parts of the planet heat up

^
The intensity of tropical cyclones is increasing. Scientists link this to weakening trade winds

differently. Tropical areas around the equator, for example, receive more solar heat than the poles, and the warm air mass above them starts rising up and then moving towards the poles. But Earth's rotation, which is fastest at the equator and sluggish near the poles, adds complexity to the global atmospheric circulation. Instead of circulating in a straight pattern, the air current gets deflected towards the right in the Northern Hemisphere and towards the left in the Southern Hemisphere, resulting in curved paths. This apparent deflection, known as Coriolis effect, and the differen-

CONTINUED ON PAGE 28 >>

UNEASY PATTERNS

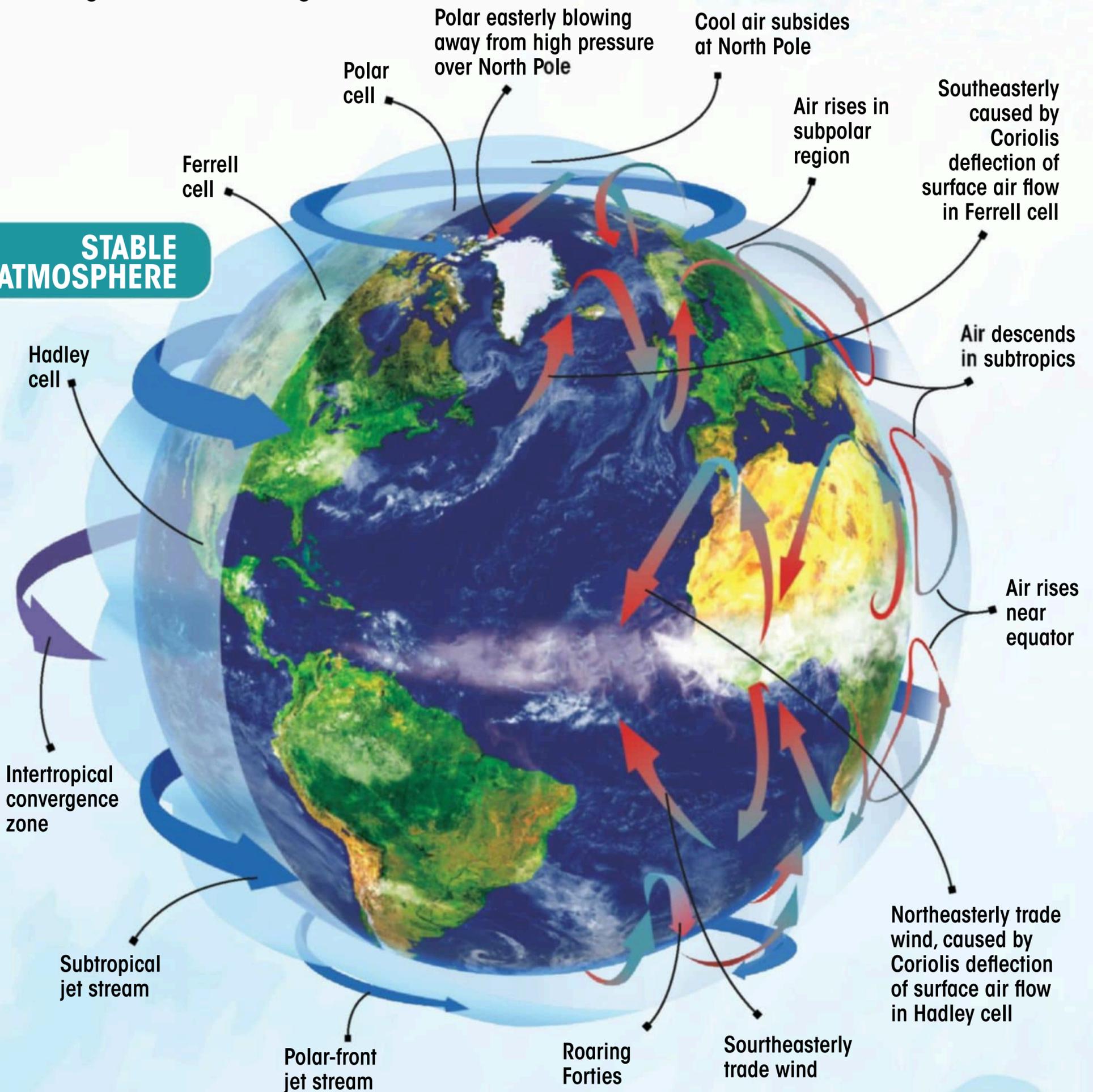
All the three near-surface wind systems—Hadley cells along the equator, Ferrel cells in mid-latitudes and polar cells—show signs of weakening. Jet streams, which are a byproduct of the three wind systems and move at about 10 km above the surface, meander in large waves, but some of their fast-moving winds are moving faster

HADLEY CELL

This wind circulatory system, located along the equator, is the strongest of the three wind systems. Warm air rises from the equator, the hottest place on Earth, and sinks at 30° north and south latitudes, creating the Hadley cell. The wind belt associated with this cell comprise the trade winds, which have shaped the world's geography and history. Trade winds bring copious rainfall to the equator region, making it the wettest place on Earth. Known for their consistency in force and direction, trade winds and associated ocean currents help sailors hasten their voyages.

CHANGES: Trade winds are now becoming weaker. This would result in reduced rainfall in tropical areas, make heatwaves severe and hurricanes frequent and intense.

STABLE ATMOSPHERE



POLAR CELL

In the polar regions, the cold and dry air sinks, creating a high pressure region. These cold winds known as polar easterlies blow along the surface to reach 60° north or south latitudes, where they become warm, rise up and flow back towards the poles, forming the polar cell. It is the smallest and the weakest of the cells, but without it the polar regions would freeze solid as it brings warmer air.

CHANGES: Polar easterlies, the prevailing wind belt in the cell, are weakening, leading to decrease in evaporative heat fluxes in Antarctica.

FERREL CELL

Ferrel cells lie in between the Hadley and polar cells, and are formed by parts of the rising air at 60° north or south latitudes and sinking cold air at 30° north or south latitudes. The wind belt associated with these cells is the westerlies, which balance the energy distribution between low- and high-latitude regions and govern sub-tropical ocean gyres (large ocean circulations) that transport heat, nutrients and oxygen from one part of the ocean to the other.

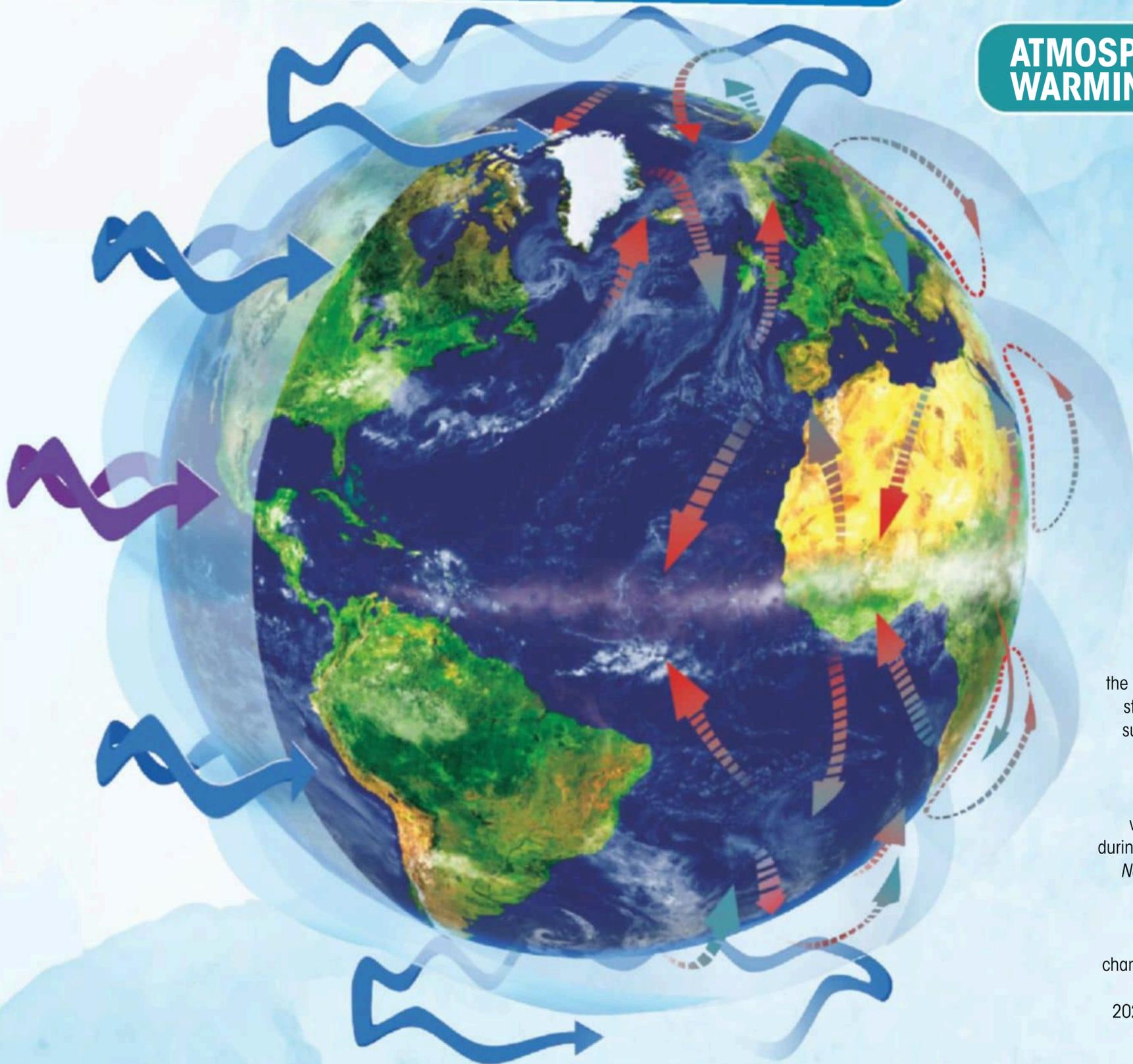
CHANGES: Westerlies are weakening. In northern hemisphere, this could hasten the collapse of Atlantic Meridional Overturning Circulation that brings warm water northwards. Its pole-ward shift could reduce precipitation in mid-latitude regions. In southern hemisphere, westerlies can bring carbon-dioxide-rich deepwater to the surface in southern oceans, adding to global warming.

JET STREAMS

These are fast-flowing west-to-east bands of winds in the middle to upper troposphere. They exist because of density gradients between tropical warm moist air and polar cold and dry air. There are four different jet streams encircling the planet. Two are over the North (Arctic) and South (Antarctica) Polar regions, while the other two are in lower latitudes and are known as subtropical jet streams. Jet streams act as the conveyor belt for weather systems across the world.

CHANGES: With equatorial air warming faster than the polar air in the upper atmosphere, some winds in jet streams are moving faster. Strengthening of subtropical jet streams in winters is making western disturbances frequent in western and central Himalayas. Polar jet streams are becoming wavier, blocking weather patterns in mid-latitude regions, causing simultaneous floods and heatwaves.

ATMOSPHERE IN WARMING WORLD



Sources: "Human influence on the recent weakening of storm tracks in boreal summer", *npj Climate and Atmospheric Science*, April 2024; "Poleward and weakened westerlies during Pliocene warmth", *Nature*, January 2021; "Fast upper-level jet stream winds get faster under climate change", *Nature Climate Change*, November 2023; interactions with scientists

tial heating of the globe are responsible for the three distinct atmospheric circulation systems in each hemisphere—the Hadley cell, Ferrel cell and the polar cell that occur at low altitudes or in the lower troposphere, which is the lowest layer of the atmosphere—and the resultant jet streams that blow horizontally through the upper layers of the troposphere, about 10 km from the surface (see ‘Uneasy patterns’, p26). Together, these wind systems govern weather conditions and shape lives across the globe.

DISTINCTION BRINGS DIVERSITY

The Hadley cell is created by the warm air currents that rise near the equator and flow towards the poles. Since the currents cannot reach as far, they sink at about 30° north or south latitudes and gradually start moving towards the equator to replace the warm air rising there, creating a closed circulation or cell. Because of the Coriolis effect, wind within this cell blows from northeast to southwest in the northern hemisphere and from southeast to northwest in the southern hemisphere.

This strongest wind system in the lower layers of the atmosphere is responsible for trade winds, or tropical easterlies as they are sometimes called, which have shaped the world’s geography as well as history. Since rising warm air carries a lot of moisture evaporated from the warm tropical oceans, trade winds bring copious amount of rain to the equator region, making it the wettest place on Earth. Known for their consistency in force and direction, the trade winds and associated ocean currents have helped early sailors from Europe and Africa make their journeys to the Americas. Even now, commercial ships use the trades to hasten their voyages.

In the polar regions, the cold and dry air sinks, creating a high pressure region. These cold winds known as polar easterlies blow along the surface to reach 60° north or south latitudes, where they become warm and rise up creating a low pressure region. The rising air flows back towards the poles, forming the polar circulation or polar cell.

TEMPORARY WIND SYSTEMS LIKE MONSOONS, STORMS AND TROPICAL CYCLONES OCCUR WITHIN THE LARGE PERMANENT WIND SYSTEMS OF HADLEY CELL, FERREL CELL, POLAR CELL AND JET STREAMS, WHICH ARE NOW UNDERGOING CHANGES

It is smallest and weakest cell, but without it the polar regions would freeze solid. The polar cell brings colder air to southern latitudes, where it interacts with warmer air to form various weather systems and take back warmer air to the polar regions.

In between the Hadley and the polar cells, lies the Ferrel cell—between 30° and 60° north or south latitudes. These cells are formed by parts of the rising air at 60° latitudes and the sinking cold air at 30° latitudes. Within this cell, the prevailing winds are westerlies that blow from southwest to northeast in northern hemisphere and from northwest to southeast in southern hemisphere. Since air mostly sinks around the 30° north or south latitudes, most of the world’s deserts occur in these regions.

While all these wind circulations occur between the lower and upper layers of the troposphere, in the upper layers of troposphere there are west-to-east fast-flowing bands of winds known as jet streams. These are narrow strong winds that move in a meandering manner and act as a conveyor belt for weather systems. “Jet streams exist because of density gradients between tropical warm moist air and polar cold and dry air,” explains Osamu Miyawaki, climate scientist at the National Center for Atmospheric Research, US. There are four different jet streams encircling the planet. Two of these are over the North (Arctic) and South (Antarctica) Polar regions, while the other two are in lower latitudes and are known as subtropical jet streams.

Temporary wind systems such as monsoons, western disturbances, storms and tropical cyclones occur within these large permanent wind circulations and due to their interactions with each other or the oceans. *Down To Earth* spoke to scientists and analysed scientific papers to understand the kind of changes these wind systems are undergoing. Indications are that all the three near-surface wind circulations are showing signs of “stalling”, while some fast streaks in the jet streams are moving faster. And the impact of these changes is palpable across the globe.



INTEGRATED ONLINE AND ONSITE TRAINING ON ENVIRONMENTAL IMPACT ASSESSMENT

CSE is conducting an integrated online and onsite training programme on EIA. The training programme will comprise of two parts: Basic learning (online platform) and Advanced learning (at our residential campus). The course is designed to provide an overall understanding of the EIA process which includes theoretical knowledge via lectures from experts and firsthand experience through group exercises, discussions and case studies.

PROGRAM DESIGN

PART A

BASIC LEARNING (ONLINE)

- Includes sessions on methodology for preparing an EIA, approach for baseline data collection, identification and assessment of impacts along with the Environmental Clearance process.
- Conducted on Moodle Platform where participants will be provided with pre-recorded reading / audio-visual training material which they are expected to self-study as per their convenience. The course material will be for the duration of 2 hours/day

PART B

ADVANCED LEARNING (ONSITE)

- Includes practical experience on assessing impacts for different sector projects.
- Developing Environmental monitoring & management plans;
- Reviewing of EIA reports;
- Understanding the intricacies of the EIA system;
- Working on case studies through group exercises and role play;
- Discussion and knowledge sharing with experts;
- Conducted at CSE's residential campus, Anil Agarwal Environment Training Institute (AAETI) in Tijara, Alwar, Rajasthan.

COURSE FEES

PART A

INR 3000 (Indian participants)
USD 100 (Non-Indian participants)

PART B*

INR 25,600/- (double occupancy)
INR 28,000/- (single occupancy)

* Fees includes accommodation, food, training material and travel from Delhi to the training center and back.

COURSE DATES

ONLINE PART

June 18-27, 2024
January 14-23, 2025

ONSITE PART

September 17-20, 2024

February 18-21, 2025

WHO CAN APPLY

Industry professionals; environment consultants; environment engineers; researchers; academicians, civil society and students aspiring to work in the field of environment.

SPECIAL DISCOUNT

Full waiver on online fees for participants applying for onsite programme.

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THE NEW EXTREME EVENT

Wind circulations are slowing in a warming world, adding to the frequency and intensity of extreme events

ON MAY 29, 2024, just as large parts of northern and central India were in the grip of extreme heatwave conditions, the Mungeshpur automatic weather station of the India Meteorological Department (IMD) in north Delhi recorded 52.9°C. It was dubbed as the highest-ever maximum temperature recorded in the country. While the weather agency promptly

refuted the reading, explaining that the anomalous temperature “could be due to error in the sensor or the local factor”, several other weather stations in Delhi and the National Capital Region that day recorded between 45.2°C to 49.1°C. Gujarat and Rajasthan suffered the worst, with 12 and 11 days of heatwaves, respectively, between May 16 and 26. Several cities



shattered their all-time heat records for May. This includes Chandigarh, where temperature soared to 46.7°C on May 29, breaking its record of 46.5°C in May 1988.

Heatwaves are usual in these parts of the country during the summer season. “But the excess heat that made them punishing this year came from the warm winds blowing in from the Arabian Sea,” says Raghu Murtugudde, professor of climate studies at the Indian Institute of Technology, Bombay and emeritus professor at the University of Maryland, US. According to research published in *Earth Science Reviews* in March 2022, the Arabian Sea has warmed by 1.2°C to 1.4°C in the past few decades. Usually, the ingress of warm winds from the Arabian Sea on the west is opposed by the strong trade winds from the northeast. But this year, it was different.

The excess heat that made heatwaves punishing this year, came from the Arabian Sea, which has warmed by 1.2°C to 1.4°C in the past decades. Usually, this warm wind gets opposed by the strong trade winds blowing from northeast. But this year, it did not happen



Rei Chemke of the Weizmann Institute of Science, Rehovot, Israel, suggests that one possible reason for this year’s unusual heatwaves in India could be the weakening trade winds in the Hadley Cell. Chemke, along with Janni Yuval of the Massachusetts Institute of Technology, US, has analysed sea surface atmospheric pressure data over the tropical ocean, which is directly related to the strength of trade winds. “We got measurements of sea level pressure from ships to say something about the Hadley Cell strength,” says Chemke. Their findings, published in *Nature* in April 2023, confirms the weakening of the Hadley circulation and trade winds.

According to Chemke, weakening trade winds could also be the reason behind humid heatwaves experienced by eastern and southern India earlier in April. Humid heatwaves, characterised by the combined effect of temperature and humidity, are usually experienced by areas along the coast. But this April, places far from the coast also experienced the condition. The reasons for the condition were the warmer than usual Bay of Bengal and Arabian Sea. It led to copious amounts of moisture above the seas, which were then brought inland by strong winds. “Two huge anticyclones over the Arabian Sea and the Bay of Bengal, brought winds onshore to Odisha and West Bengal and to the Konkan region of Maharashtra,” says K J Ramesh, a climate scientist and former director-general of IMD. Anticyclones are regions of high atmospheric pressure where the winds blow in a downward sinking motion, compress and heat up. “Winds from these anticyclones were pumping moisture from the sea onto land, increasing the relative humidity levels even in the interior regions,” Ramesh says. It would not have happened had the trade winds been able to dislodge the anticyclones, says Chemke.

Citing the weakening of the trade winds in the ocean basin as the reason, the National Oceanic and Atmospheric Administration (NOAA) of the US and Met Office of the UK have predicted a hyper active hurricane sea-

'LOCAL WINDS GETTING STRONGER'

Global warming has decreased the pressure gradient between polar regions and equator, says **U C MOHANTY**, emeritus professor at Indian Institute of Technology, Bhubaneswar

How is global warming disrupting the wind systems?

If the atmosphere is the first blanket on Earth then, the emissions of greenhouse gases and the warming it is causing is creating a second blanket on top. This second layer is mostly water vapour, which is also a greenhouse gas. Warmer atmosphere holds more moisture, which results in a cycle we now find ourselves in. This has increased the average global temperature by 1.2°C in the past 180 years or so.



Winds flow because of the force generated by the pressure differences. If the pressure gradient is higher then the winds will be stronger, and vice versa. With excess warming, the larger pressure gradient between the polar regions and the equator has decreased, which slows down winds, but locally winds can become stronger. The Intertropical Convergence Zone winds have become stronger locally, which has repercussions in terms of

extreme weather events. This has been seen particularly in India, as the overall monsoon rainfall is not changing much but the number of heavy rainfall events is increasing. In the core monsoon region, which is mostly the central part of the country, it has been observed that light and moderate rains are decreasing while the heavy rains are increasing. Tropical cyclone numbers may not be increasing but their intensity is rising due to the winds inside them getting stronger mainly from the excess moisture.

How can we better measure winds to understand them and get to know how they are changing with the changing climate?

Winds are measured using ground-, air- and space-based instruments such as anemometers, radiosondes, doppler weather radars and satellites, but all of them have not been able to generate accurate profiles of winds as yet. This is especially true for tropical regions and oceans. Measurement of winds in these regions is especially difficult because the variations of temperature and pressure are slow. If we increase the network of our observation instruments on ground, we may be able to create accurate profiles of winds and changes.

son in the North Atlantic Ocean basin. "The upcoming Atlantic hurricane season is expected to have above-normal activity due to a confluence of factors, including near-record warm ocean temperatures in the Atlantic Ocean, development of La Niña conditions in the Pacific, reduced Atlantic trade winds and less wind shear [change in direction and speed of winds], all of which tend to favor tropical storm formation," says NOAA on its website. Meteorologists at NOAA predict that there could be up to 17-25 named tropical storms with wind speeds more than 63 km per hour. Of these, eight to 13 storms are forecast to intensify into hurricanes with wind speeds more than 119 km per hour; four to seven may turn into major hurricanes of categories 3 (178-208 km/hr), 4 (209-251 km/hr) or 5 (over 252 km/hr).

JET STREAM: FASTER YET WAVIER

The prediction is disastrous for the US, which faces an extremely busy storm and tornado season this year. A tornado is a narrow, violently rotating column of air that extends from a thunderstorm to the ground. With wind speeds in the range of 100-320 km per hour, it can tear homes, destroy bridges, send vehicles flying and claim lives. According to NOAA's storm prediction centre, 570 preliminary tornadoes were reported in May 2024 alone—the highest for the month on record and more than double the average between 1991-2020. April witnessed 384 tornadoes, second-most on record.

While scientists are yet to identify the reasons behind this year's tornado rampage, they have long known that the strength of jet streams is one of the ingredients that factors into tornado formation. And now there is evidence that the fastest jet stream winds, or jet streaks, are accelerating.

In December 2023, Osamu Miyawaki, scientist with the US National Centre for Atmospheric Research, along with Tiffany Shaw, professor of geophysical sciences at the University of Chicago, US, published a research paper in *Nature Climate Change* that says for every 1°C rise in global temperatures the fastest jet streaks will get



SCHOOL OF WATER AND WASTE

AAETI

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Dates: August 21-23, 2024 | **Last Date to Apply:** August 10, 2024

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

Almost 80 per cent of drinking water supply in India's rural areas comes from groundwater sources. Since the 1960s, the country has seen numerous programmes for supply of drinking water; the latest programme of these is the Jal Jeevan Mission (JJM), which claims to reach 190 million households. But every new scheme is accompanied by stories of slippages. In all the six programmes that came before JJM, it has been observed that the sources are not protected or recharged; as a result, sustainable and safe supply of water has remained a dream.

The country cannot take the chance of repeating the same mistake – a good understanding of planning and designing of groundwater recharge structures is the need of the hour. Centre for Science and Environment (CSE) has designed a training course that aims to answer this need. We invite applications for our three-day residential training programme on planning and designing of groundwater recharge structures using advanced geospatial tools to make groundwater sources sustainable, with a specific focus on rural areas of India.

The training programme will leverage CSE's expertise, experience and content to help participants understand concepts of water conservation and scientific approaches for planning rainwater harvesting and groundwater recharge systems which would augment water sources in rural areas.

Who would benefit from this training programme

Engineers, architects, planners, researchers, academicians, civil society members and students aspiring to work in the field of environment

Course content

- State of groundwater management in India – with specific focus on rural areas
- Planning of groundwater recharge systems in different hydrogeological regions
- Mapping of local aquifers using different software tools
- Introduction to basic concepts of geospatial tools to map potential groundwater recharge zones
- Designing different groundwater recharge structures in various hydrogeological regions
- Preparing cost estimates of different types of groundwater recharge structures
- Monitoring impacts of groundwater recharge systems
- Field visit

Training fees

₹28,000 (single occupancy accommodation);

₹25,600 (double occupancy accommodation)

Early bird entries (till July 25, 2024) 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.

FOR MORE INFORMATION CONTACT TRAINING COORDINATOR

Vivek Kumar Sah, Programme Officer, Water Programme, CSE

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'AEOLUS 1 DATA IMPROVED FORECASTS BY AN INCREDIBLE 5 PER CENT'

Launched in 2018, the satellite-based wind observation technology provides vertical profiles of winds which were not available earlier, says **THORSTEN FEHR**, head of the atmospheric section at the European Space Agency

How did the Aeolus 1 satellite project come about?

The scientific project to study winds from space was given to the European Space Agency (ESA) in 1999. The idea was to put a laser in space and study the scattering pattern of laser pulses, which are dense and sharp light pulses, when they bumped into particles and air molecules. We mainly use ultraviolet pulses for this purpose generated by a UV Light detection and ranging (LiDAR) device. This gives us the movement of air molecules in space. With this data you can retrieve winds in clear air that are not connected to any patterns or features in the atmosphere. This was to be a science mission, and not an operational mission, and we wanted to see if we can build and demonstrate the technology to monitor and study winds. The satellite was launched after almost two decades.

Why was it important to study winds through a satellite?

We launched the Aeolus 1 satellite in 2018 with the objective of retrieving clear air wind data. We wanted an observational system that could provide the vertical profiles of winds which was not available until that moment. Before that, what we were using as wind data was more to do with moving patterns in the atmosphere such as cloud patterns. In this, you take the images of cloud patterns at different times and try to gauge how the clouds are moving and get the data on wind from that. You can also retrieve wind data from humidity and temperature patterns in the atmosphere. However, these measurements are always related to certain phenomena and you had to make certain assumptions about the heights at which these were occurring, such as the stratification of the moving clouds. The dream of the wind community was to have a tool in space that can measure winds in clear air without any patterns of clouds or other phenomena.



What is being measured by the Aeolus 1 satellite?

The satellite is not measuring full wind vectors but only the vertical direction of wind vectors. It was shown in studies before that this information is enormously valuable as we do not have the vertical profile of winds from ground-based instruments such as radiosondes (balloon mounted wind measuring instruments). These

radiosondes are not uniformly spread around the world especially in tropical areas and in areas above the ocean and in polar regions. Wind information from these crucial regions was lacking before.

Where has the data from Aeolus 1 been used and what has been the response to that?

The technology of Aeolus 1 had some issues and the quality of data was not as per our expectations. We were able to measure winds from the scattering of air molecules with a possible error margin of six to seven metres. For the winds that are scattered by small particles in the air the uncertainty was 3-4 m. Initially we were disappointed. Our data has been used by the European Centre for Medium-range Weather Forecasts (ECMWF) and the National Centre for Medium Range Weather Forecasts (NCMRWF) in India and despite the problems, our data was able to significantly improve the weather forecasts by 5 per cent. The weather agencies said that usually their improvements are incremental and on a much smaller scale and they were happy with the improvement brought about by Aeolus. These improvements were particularly in the tropical areas, oceans and the polar regions where there was a lack of wind information earlier. There have also been studies from the US where data from Aeolus 1 has improved the forecasts of hurricanes.

2 per cent faster and this would be 2.5 times the acceleration of an average jet streak. “Jet streaks becoming faster has been reported before but what we have found is that this change is multiplicative,” says Miyawaki, who ran tests with models of Earth’s climate to arrive at the conclusion. Jet streams derive their strength from the contrast of temperatures and moisture between the equator and the polar regions. Greenhouse warming is accentuating this contrast in the upper layer of the troposphere where jet streams prevail. This means, at the highest levels of the atmosphere, tropics are getting hotter much faster than the polar regions. Further, for every degree rise in global temperature, the moisture content increases by 7 per cent, making the relationship multiplicative, Miyawaki says, adding that polar easterlies are also decreasing in strength as the contrast between the lower troposphere over the equator and the polar regions decreases.

“As the differential warming of the equator and the polar regions increases, the contrast of temperature and moisture in the segment of the atmosphere where jet streams flow also increases. This makes localised jet stream winds or jet streaks flow faster,” says Shaw, adding that the fastest jet stream winds usually occur during the winter season in the northern hemisphere. Could this then be the reason for the increasing frequency of tornadoes in the US? Miyawaki says the possibility cannot be ignored.

These changes in the behaviour of jet streams could also be the reason behind the shift in the pattern of western disturbances—extra-tropical storms that travel along the subtropical jet, bringing the majority of seasonal and extreme precipitation to the Hindu Kush, Karakoram and western Himalaya in the winter months. These moisture-laden storms are vital for the region’s water security and agriculture. However, western disturbances now appear more frequently during the summers than before. An analysis by Kieran M R Hunt, meteorologist at the National Centre for Atmospheric Sciences, University of Reading, UK, shows

WINTER WESTERN DISTURBANCES HAVE INCREASED SIGNIFICANTLY OVER THE WESTERN AND CENTRAL HIMALAYA AND THE HINDU KUSH IN THE LAST 70 YEARS. THIS TREND IS ATTRIBUTED TO STRENGTHENED SUBTROPICAL JET STREAMS

that winter western disturbances have increased significantly over the western and central Himalaya and the Hindu Kush in the last 70 years. They are also becoming far more common in May, June, and July, months where they were previously rare. For example, western disturbances have been twice as common in June in the last 20 years than during the previous 50. This, Hunt attributes, to a strengthening of the subtropical jet stream and its delayed northward retreat, which had historically occurred before the onset of summer monsoon.

The result of this changed behaviour of subtropical jet streams does not augur well. Interaction of western disturbance-induced rainfall with the Indian summer monsoon has resulted in catastrophic events like the 2013 Uttarakhand floods that killed over 6,000 and the 2023 floods in Himachal Pradesh that killed over 100.

FERREL, POLAR CELLS ALTER

One change in the global atmospheric circulation that is clearly evident is the shifting of westerlies, primary winds in the Ferrel cell that controls weather systems in middle latitudes. Scientists say over the past 50 years, the westerlies have weakened and shifted polewards. “The sub-tropical ocean gyres which are large ocean circulations that transport heat, nutrients and oxygen from one part of the ocean to the other are expanding which could be because of the poleward movement of the westerlies in both hemispheres,” says Jordan T Abell, paleoclimate scientist at Lehigh University, US, who is investigating if this poleward movement is in response to rising concentration of carbon dioxide (CO₂) in the atmosphere.

For this, Abell and other researchers have analysed dust cores drilled out from the bottom of the oceans and found that the westerlies were weaker and located more towards the polar regions during the warm Pliocene period (Ice Age that extends from 5.33 million to 2.58 million years ago), than during glacial periods. The scientists looked at the Pliocene as that was the last time CO₂ was as high as today and temperatures were

ENERGY ANGLE

Change in wind patterns have a direct bearing on the generation of wind energy

THE CHANGING patterns of winds have a major impact on the generation of wind energy, which is crucial to reduce greenhouse gases (GHGs) from the burning of fossil fuels for electricity generation. This makes the relation between wind energy and climate change bidirectional. The slowing down of winds in many regions has created a scare in recent years. In September 2021, the contribution of wind energy to UK's energy mix fell to only 2 per cent. This was when northwest Europe was undergoing reduced wind speeds of up to 15 per cent which was known as a wind drought. The reason was the warming of the Arctic and the reduced temperature and pressure difference between the Arctic and the southern latitudes. A 10 per cent wind speed decline could lead to a reduction in wind energy output of 30 per cent, according to Paul Williams of University of Reading, UK. A 2010 research paper in *Nature Geoscience* found that between 1978 and 2010, land-based wind speeds across the world have decreased by 2.3 per cent per decade. A later study by the Climate and Environment Sciences Laboratory of France and the European Centre for Medium-Range Weather Forecasts found that over Asia, moderate to strong winds had decreased in speed most rapidly, largely due to changes in atmospheric circulation. An International Energy Agency study from 2022 portends that under low GHG emissions scenario, 11 per cent of global wind power plants may experience a 5 per cent decrease in average wind speeds by 2100. Under a high emissions scenario this could be 18 per cent.

a bit warmer and winds slower.

Changes in the westerlies could impact carbon cycle in the southern hemisphere as they cause upwelling—bring deep water to the surface in the southern ocean. Deep water has a lot of nutrients and CO₂ in it. So if the westerlies become weaker and move toward the poles, it may enhance the upwelling of carbon-rich deep water in the southern oceans, releasing more CO₂ into the atmosphere and thus contributing to global warming, they state in the research paper published in *Nature* in January 2021.

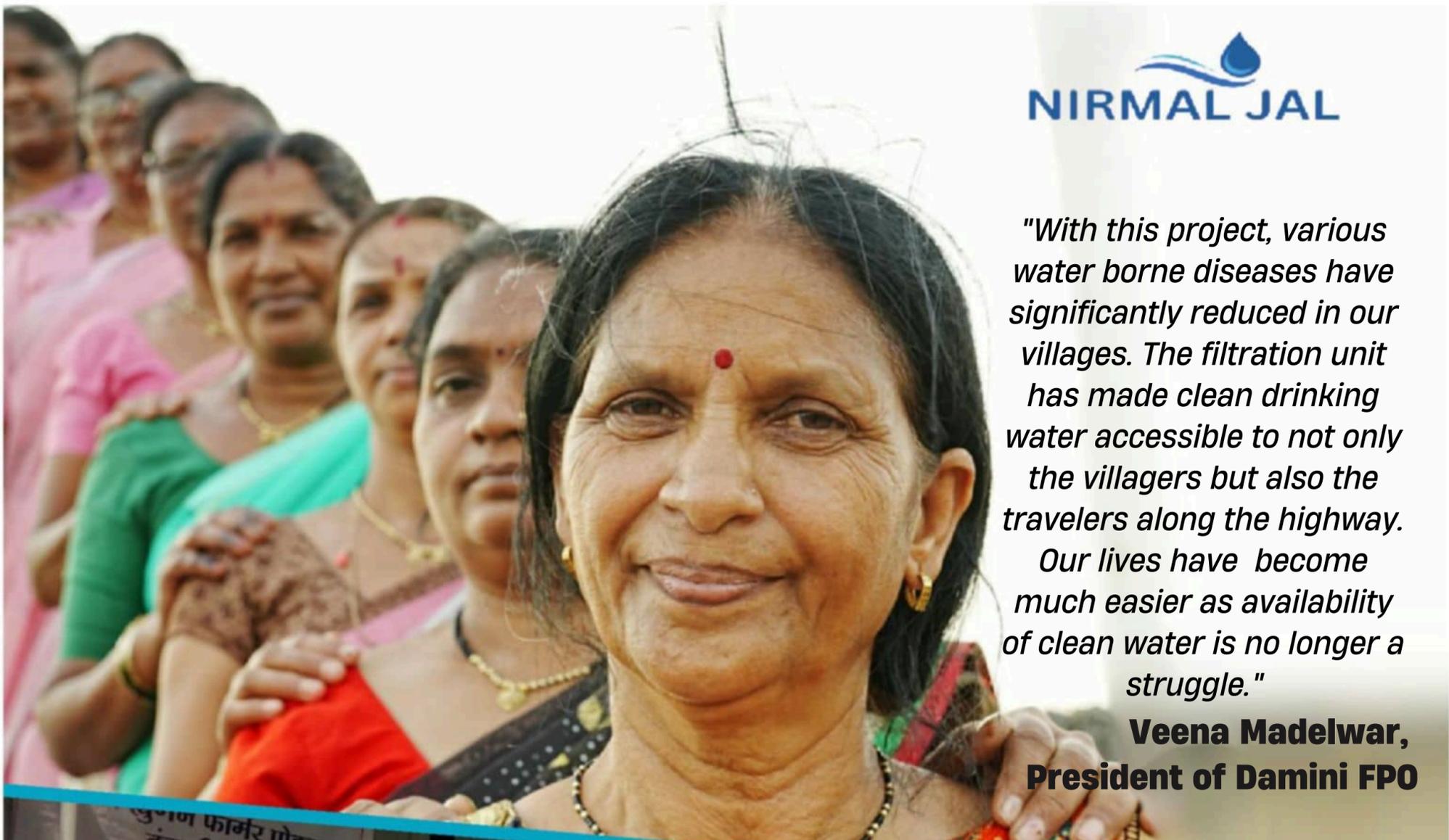
In another study, published in *Atmospheric Research* in June 2022, researchers from China and Sweden write that a poleward shift of moisture-bearing southern hemisphere westerlies may lead to reduced rainfall and frequent droughts in southeast

Australia, stronger winds in New Zealand, warmer and higher sea levels in the Tasman Sea, faster ice retreat in Patagonia, demise of the sub-Antarctic glaciers, and increased warm and salty water transport from the Indian Ocean to the South Atlantic.

In the northern hemisphere, the change in strength and location of westerlies could impact the Atlantic Meridional Overturning Circulation (AMOC), which transports heat between the equator and Arctic regions during its long north-to-south cycle within the Atlantic Ocean, and thereby influences both weather and climate. Without this heat exchange, extreme cold winter would intensify disproportionately over regions like the US. In fact, AMOC is already slowing down. It could collapse between 2025 and 2095, says a July 25, 2023 paper published in *Nature Communications*. Based on the current rate of emissions, the collapse is likely to occur in the 2050s, the paper notes. If this prediction comes true, AMOC would be the first to collapse of the 16 climate tipping elements, which can experience large, long-term irreversible consequences with a small change. The scientists point out that the addition of more fresh water in the North Atlantic Ocean due to increased precipitation and rapid melting of the Greenland Ice Sheet as the reasons for the slowing down of the AMOC but the slowing winds over the surface of the ocean which drive the AMOC can become an additional, but currently less studied, factor in its complete collapse.

Depending on the strength of westerlies and how wavy they are, cold air outbreaks could happen in lower latitudes and warm air can reach up to the poles, causing melting events. Since embedded in the westerlies are low-pressure systems that are the major source of precipitation in the mid latitudes, its pole-ward shift would have knock on effects on the regions, known for most of the world's agricultural capacity.

Miyawaki says winds in the polar cell, known as polar easterlies, are also decreasing in strength as the contrast between the lower troposphere over the equator and the polar regions decreases.



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CATCHING THE WIND

Wind is the missing piece of the climate change puzzle. But lack of data makes it difficult to model wind systems

GLOBAL TERRESTRIAL stilling, as the decrease of wind speed observed near Earth's surface is known in scientific parlance, is a term that sounds deceptively calm. While scientists have discovered the phenomenon only recently—in the 2000s, as per some estimates—it has already caused lasting changes to global weather patterns.

Consider Europe. The region has been experiencing heatwaves and droughts in some part or the other since 2017. One possible reason for this build-up of hot and dry conditions could be the weakening of storm systems that bring cold and moist air from the ocean to land in a west to east direction. Using climate models, Rei Chemke of the Weizmann Institute of Science, Rehovot,

Israel, and Dim Coumou, professor of climate extremes and societal risks at Vrije Universiteit Amsterdam, Netherlands, have analysed how storms have behaved since the pre-industrial era. Chemke's analysis, published in *Nature* in April 2024, shows that warming has weakened summer storms in the northern hemisphere between 30° and 60° latitudes.

Another such impact of changing winds is the record low sea ice extent in Antarctica since 2016. In 2023 the icy continent experienced its lowest sea ice extent at 16.98 million sq km, a staggering 1.46 million sq km below the long-term average. A study by the British Antarctic Survey and the National Center for Polar and Ocean Research, India, in April 2024 found that



changes in wind patterns played a role in the slow expansion of ice during winter time and in some cases even led to the retreat of ice. Scientists have observed the eastward shift of the Amundsen Sea low pressure region which has created strong northern winds across the Weddell Sea region. The temperatures remained high due to anomalous northerly winds and forced the ice edge to remain south of its normal position. In the Ross Ice Shelf, a strong atmospheric block pattern in the Antarctic jet stream caused strong northerly winds, increasing temperatures and affecting the expansion of ice. The West Antarctic Ice sheet, where the Weddell Sea and the Ross Ice Shelf are located, is a climate tipping point.

BUT WIND DATA ELUDES

A study by researchers from North Carolina State University and Duke University in the US highlights the importance of wind in future climate projections. The scientists attempted to model the complicated warming pattern in tropical Pacific, with eastern and

▲
A surprising impact of changing winds has been the record low sea ice extent witnessed in Antarctica since 2016. In 2023, the icy continent experienced its lowest recorded sea ice extent

western Pacific waters warming and central Pacific close to the equator showing a slight cooling effect. For this, they fed historical data into current models but could not reproduce the observed pattern. “These models simulate the atmosphere and the ocean’s response to what we call ‘external forcing,’ which are things like greenhouse gases and aerosols in the atmosphere,” Sarah Larson, assistant professor of marine, earth and atmospheric sciences at North Carolina State University and coauthor of the study, was quoted by the university’s news portal. The researchers then ran two models—one in which winds changed in response to external forcing, and one “decoupled” model, in which the winds replicated those prior to the industrial revolution and did not change in response to forcing. In the model where winds changed, warming trends followed those observed trends. “We know that wind is the key, but this finding points to an urgent need to better simulate equatorial oceanic processes and thermal structures to create more accurate models,” Larson said.

Scientists *Down To Earth* spoke to say accurate climate projection is difficult as there is only 40-50 years of data for the winds. “We do not fully understand what is happening to winds flowing over land surfaces as we are not able to correctly model winds at the smallest of scales,” says Tiffany Shaw, professor of geophysical sciences at University of Chicago, US. Chemke explains, “If you go through the literature you find more studies on the impacts of human emissions and warming on the thermodynamic processes like warming of land in general or of the Arctic in specific, sea ice loss and sea level rise.” The reason for this is the signal of global warming is much more clear for these processes. For winds and wind systems the signal is not that clear as it is naturally a very noisy system.

Some scientists like Jordan T Abell, paleo-climate scientist at Lehigh University, US, have therefore relied on proxy data sets such as dust cores from the ocean beds. “But such data sets can only go so far in informing us about the past and indicating how the

TURBULENCE AHEAD

Clear air turbulence will become stronger as fast jet stream winds become faster due to global warming

ON MAY 21, 2024, Singapore Airlines flight number SQ321 encountered sudden and severe turbulence on its route from London to Singapore, killing one person and injuring 71 others. Turbulence on flights can occur due to various reasons, the most common being storm systems along the route, which are visible to the pilots. For such turbulence, pilots can steer away from the storm and alert the passengers to fasten their seat belts. The other cause for turbulence could be something known as clear air turbulence which occurs due to the disturbances in jet streams. Aircraft tend to follow the jet streams to reduce fuel consumption. Flights that go towards the east get faster and use less fuel but this gets negated by any flights that go west, which are opposing the jet streams in their route. Faster the jet stream winds, the greater the energy to stir up air, which is then experienced as turbulence. Projections says clear air turbulence will become stronger and more energetic as fast jet stream winds (jet streaks) become faster because of a warming atmosphere. In the upper layers of the troposphere where jet streams exist, the warming is greater over the tropical regions compared to the poles. This increases the density gradient between the two latitudes, increasing the speeds of jet streaks. A 2023 paper in *Nature Climate Change* says for every 1°C rise in global temperature, the fastest jet streaks will get 2 per cent faster and this would be 2.5 times the acceleration of an average jet streak. With further warming, the jet streaks may fasten further increasing the possibility of air accidents.

future may look like. As you go further back in time we have less and less of these proxy records,” Abell adds.

Though computational progress is being made in the study of winds with improving climate and weather models, including with the help of graphical processing units, machine learning and artificial intelligence, the fundamental problem of understanding wind systems and how they are going to change in the future boils down to long term and accurate datasets.

“Obtaining a good data of winds is a problem, because we need it continuous in space and time. We release a balloon into the air to measure wind speeds at a specific location but they are sporadic in space and time. You cannot really calculate the wind pattern from that,” says Chemke. Satellite measure-

ments of winds over some regions such as the Indian Ocean region are also difficult to find. “There are not many satellite observations of wind or many related factors over the Indian Ocean region. This becomes a problem for monitoring and tracking of tropical cyclones in the region,” says Roxy Mathew Koll, climate scientist at the Indian Institute of Tropical Meteorology, Pune. For instance, to have a near real-time image of the entire cyclone is still quite difficult. “We generally can view and analyse half or three-fourths of a cyclone. This leads to an inability of forecasting rapid intensification of cyclones and also maximum wind speeds, both parameters that are required for providing accurate early warnings to the people in the path of cyclones,” explains Koll.

This is also a problem with forecasting monsoon rainfall over India. The analysis of the movement of the monsoon winds is still not accurate which makes it challenging to predict the distribution of rainfall and occurrence of extreme rainfall events. “For better predictions one needs at least three satellites watching the Indian Ocean region. One of satellites of the Indian Space Research Organisation (ISRO), SCATSAT-1, does observe and record wind vector data but we are not able to access this data for analysis currently. ISRO does not have a readily available provision for access to data on winds,” highlights Koll.

Satellite-based wind observation started with experimental Aeolus satellite launched by the European Space Agency in 2018. The data from the satellite did improve predictions for Europe and US, says Shaw. Then US space agency NASA launched Cyclone Global Navigation Satellite System (CYGNSS) to monitor winds inside tropical cyclones. “Other avenues for collecting data on winds are being tried out such as measuring surface air pressure with the help of satellites that can give an indication of wind intensity and direction. But to be able to predict how winds are going to change with warming, more measurements over long term periods are required and we are beginning to do that only now,” says Shaw. [DTE](#) [@down2earthindia](#)



INTEGRATED ONLINE AND RESIDENTIAL TRAINING

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.

TRAINING PROGRAMME DESIGN

PART A: ONLINE (BASIC) **JULY 16-31, 2024**

Last date to apply: **JULY 10, 2024**

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

Platforms: **ZOOM AND MOODLE**

COURSE CONTENT

- Status of groundwater and lakes in urban India
- Traditional methods of harvesting rain
- Existing policies and legal framework related to groundwater and lake management
- Aquifers, methods of recharging groundwater in different hydrogeological regions and monitoring of groundwater
- Introduction to the science of lakes and technologies to rejuvenate them
- Success stories from the Global South on groundwater recharge and lake rejuvenation

PART B: ONSITE (ADVANCED)

Open only for Indian participants

JANUARY 22-24, 2025

Last date to apply:
JANUARY 10, 2025

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

COURSE CONTENT

- Use of advanced tools to develop groundwater contour maps
- Aquifer mapping at city and regional levels
- Technologies to restore lakes and their catchments in different hydrogeological regions
- Monitoring the quality and quantity of groundwater and lakes
- Site visits to examine successful implementation of groundwater management and lakes restoration

TRAINING FEES

- » Part A – ₹ 3,000 (for Indian participants); US \$100 (for foreign participants).

Last date of application: July 10, 2024.

- » 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.
- Special discount: Full waiver on online fees for participants who also apply for residential training.

WHO WILL BENEFIT FROM THE TRAINING

Engineers, architects, planners, researchers, academicians, civil society members and students aspiring to work in the field of environment



FOR FURTHER DETAILS, PLEASE CONTACT: TRAINING COORDINATOR

SWATI BHATIA, Deputy Programme Manager, Water, CSE

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Mob No: + 91 9911339540 / 9708887214



Water tankers can be seen across Sangam Vihar, especially in lanes far from Mehrauli-Badarpur Road

LOCAL SOLUTIONS

The solution to Sangam Vihar's water supply, sanitation and stormwater problems could lie in decentralised management, suggests a Centre for Science and Environment survey in the unplanned settlement

UMRA ANEES AND DEPINDER KAPUR DELHI

WATER SCARCITY is a way of life for the more than one million residents of Sangam Vihar in Delhi. Located in the national capital's Southeast district, Sangam Vihar is one of the most densely populated unauthorised settlements in the city. Once or twice a week, water tankers can be seen navigating the lanes of the 13 blocks that comprise the settlement. One such tanker arrives in block L, the largest block of Sangam Vihar, and stops outside a lane so narrow that only bicycles can go through it. As the tanker waits, residents emerge with large

PHOTOGRAPHS: CSE

buckets and drums in hand. Women, some followed by their children, walk up to 1 km to the tanker to fill water for their families' drinking and domestic needs. They usually make multiple trips to collect enough water until the next time the tanker arrives. Only a few pockets of Sangam Vihar, mostly in blocks adjacent to the Mehrauli-Badarpur Road, get water every other day through a Delhi Jal Board (DJB) pipeline from the Sonia Vihar water treatment plant.

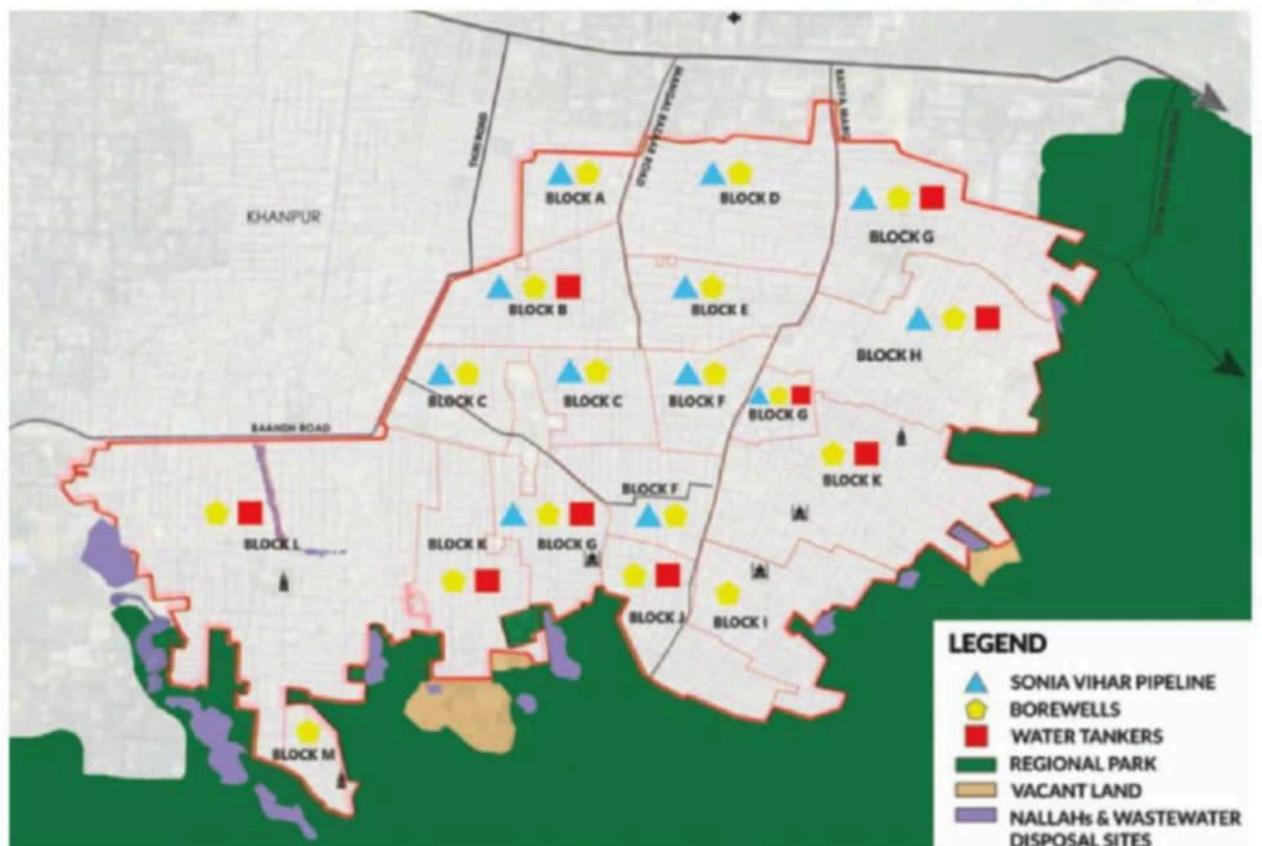
Sangam Vihar is a stark example of the increasing number of unplanned and informal settlements in the Global South. A 2022 report by the UN Human Settlements Programme (UN-Habitat), says that in 2020 roughly half the urban population in sub-Saharan Africa and Central and South Asia lived in informal settlements. Most lack basic water and sanitation.

The situation is exacerbated with the impacts of climate change. For instance, during the 2023 monsoon season, when Delhi received unprecedented rainfall, residents of Sangam Vihar reported accumulation of stormwater in the narrower inner streets reaching up to their knees. Water also entered houses built below the street level and led to skin infections.

Without ensuring access to safe water and sanitation to people in unplanned settlements like Sangam Vihar, the world cannot make its cities "water sensitive" and "climate resilient", or achieve Sustainable Development Goals (SDGs) by 2030. But so far, solutions are lacking. Consider Delhi's latest Master Plan for 2041. It has proposals to augment water supply, treat and reuse wastewater and improve water management systems. However, it does not feature

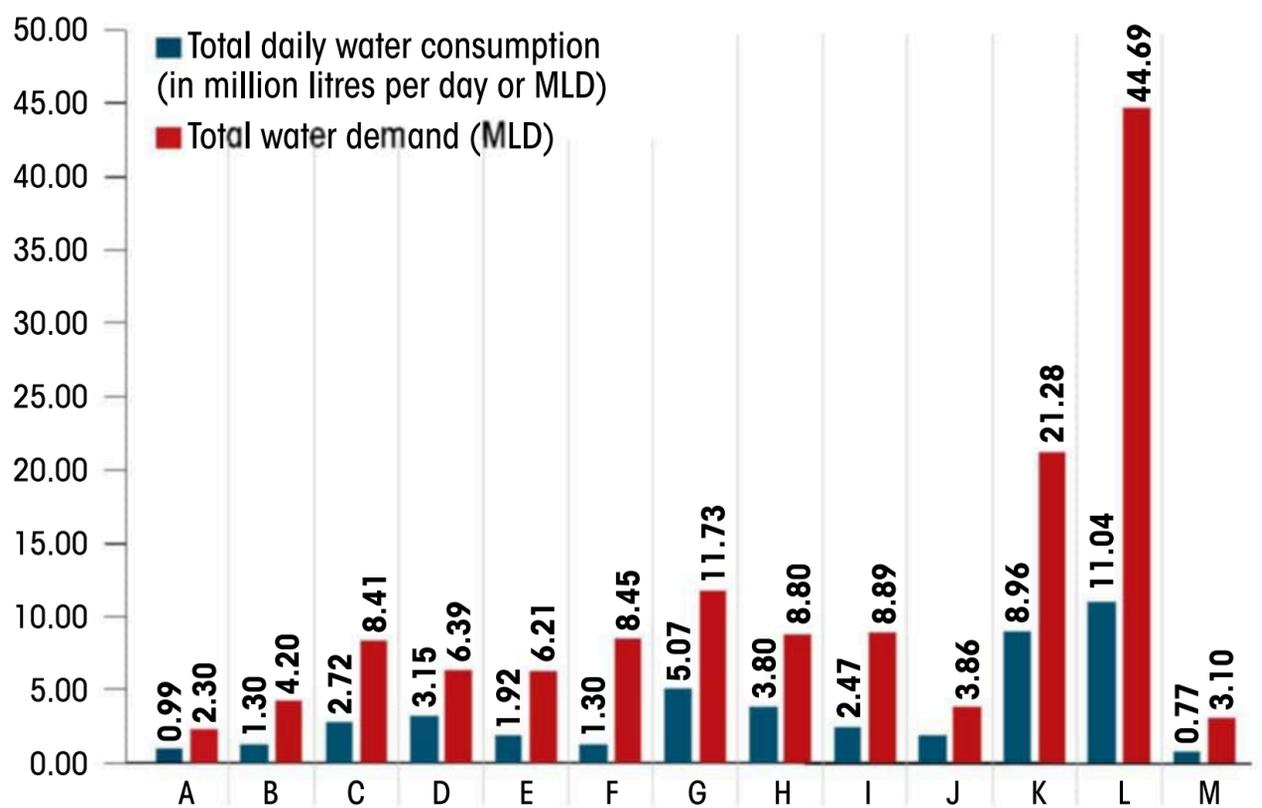
Scramble for supplies

Sangam Vihar's million-plus population depends on the Delhi Jal Board pipeline in Sonia Vihar, tankers, borewells and RO drinking water



Note: Packaged drinking water is purchased by nearly every block and hence has not been marked separately

Despite the availability of multiple water sources, total consumption is far less than demanded in all of Sangam Vihar's 13 blocks, labelled A-M



Note: Source: "Water and Wastewater Visioning for Large, Dense Unplanned Urban Settlements in an Era of Climate Risk", Centre for Science and Environment, May 2024

any solutions or strategies for unplanned settlements. Ideally, solutions for these settlements would involve retrofitting infrastructure for water supply, sanitation and stormwater collection and drainage. To determine whether this is a

feasible solution for an area as dense as Sangam Vihar, and to show the impacts of inadequate planning so far, researchers with Delhi-based think tank Centre for Science and Environment (CSE) conducted extensive surveys in the

settlement in 2023 and early 2024.

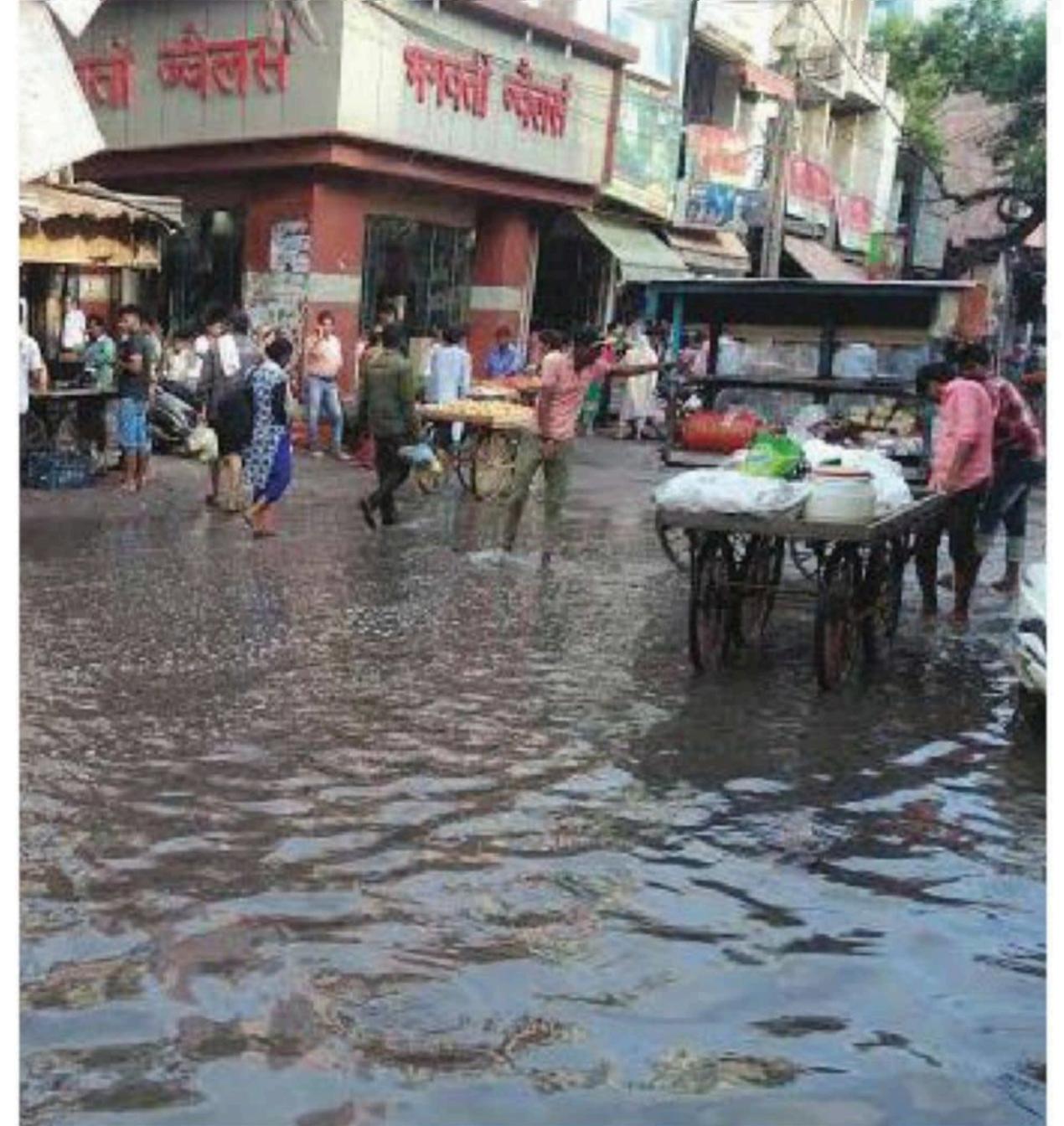
Sangam Vihar is bound by the Mehrauli-Badarpur Road on the north and Asola Wildlife Sanctuary on the east and southeast. The open forested areas also have small lakes and waterbodies. For its surveys, CSE covered the 5 sq km radius of the settlement, comprising 13 blocks (named A to M). Choosing a total sample size of 222 households, the researchers conducted multiple field surveys and held 22 focus group discussions with residents, experts and local authorities to establish the water and sanitation situation.

INADEQUATE SUPPLIES

The million-plus population of Sangam Vihar sees a water supply of 45 litres per capita a day (LPCD), finds CSE's analysis, published in May 2024. In comparison, the Union government's Central Public Health and Environmental Engineering Organisation (CPHEEO) suggests a supply of 150 LPCD in metro cities (with full sewerage systems coverage), 135 LPCD in non-metro towns (with sewerage systems coverage completed or being contemplated) and 70 LPCD in other towns and cities. However, DJB has proposed to lay out a water supply network in the area through five projects, and in 2022 initiated sewer line construction that so far covers roughly half the 13 blocks.

Taking CPHEEO's recommended 135 LPCD as benchmark, CSE estimated the daily water demand for the study area to be 138.3 million litres per day (MLD). Therefore, the total gap in water supply is around 92.9 MLD, which varies depending on block size and population density (see 'Scramble for supplies', p43).

To meet the extensive water demand, there are a range of sourc-



Stormwater and domestic wastewater from Sangam Vihar's households get collected in open drains and can stagnate on the road during periods of heavy rainfall

es for potable and non-potable water, including DJB and private tankers, the DJB pipeline and borewells. But distribution varies. For example, blocks closer to Mehrauli-Badarpur Road, such as A, D, E and a few parts of G, get more than 70 per cent of the water from the DJB pipeline. Blocks I, F, L and M that are farther from the main road—and comprise low-income households—see scanty water supply.

Community borewells are more frequently available. But here too, distribution varies. For example, in some areas of block K, borewell water is available every alternate day, while in others it is only supplied every 15 days or even once a month. In terms of cost, most families pay less than ₹400 per month, while a few report the cost to be ₹400-800 a month depending on demand and use.

Due to the irregular supply, residents prefer to store water in

overhead tanks (80 per cent), underground tanks and drums.

For potable water, 80 per cent of residents in the study area depend on RO (reverse osmosis)-purified water, purchased in bottles and cans from public distributors, with costs ranging ₹400-800 and up to ₹1,200 a month in some cases.

During the survey, the researchers noted the mention of "water mafia" in Sangam Vihar, which indicates unauthorised control and exploitation of water resources, leading to additional financial burdens for some households. The surveys revealed that DJB tankers were directly sent to a few powerful personalities in the locality, who would then sell the water to residents for ₹15-20 per bottle. A few residents from blocks M, B, K, I and L stated that some borewells are controlled by private parties, who supply water whenever required for ₹100-300 per visit.

STEP UP To enhance your Green Footprint

#GreenForGood



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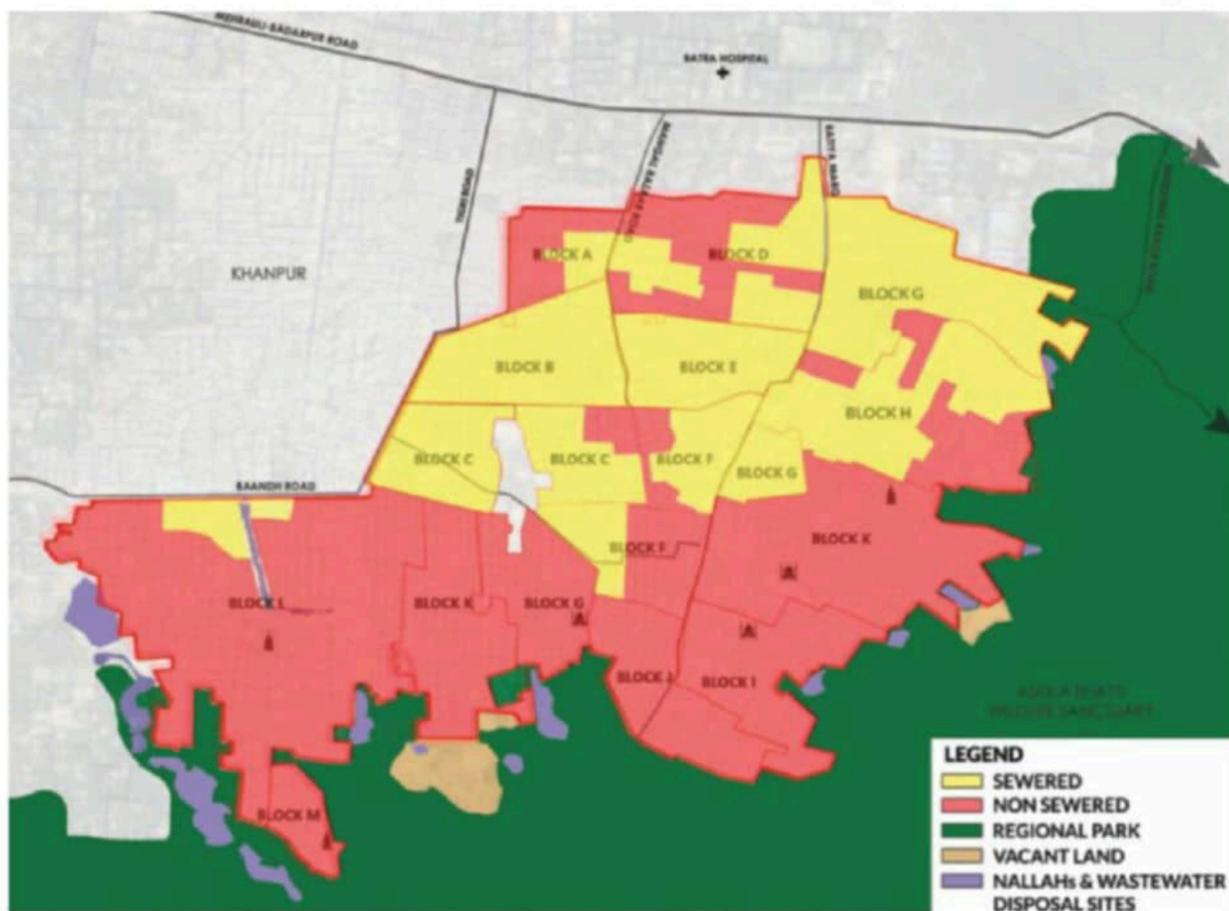
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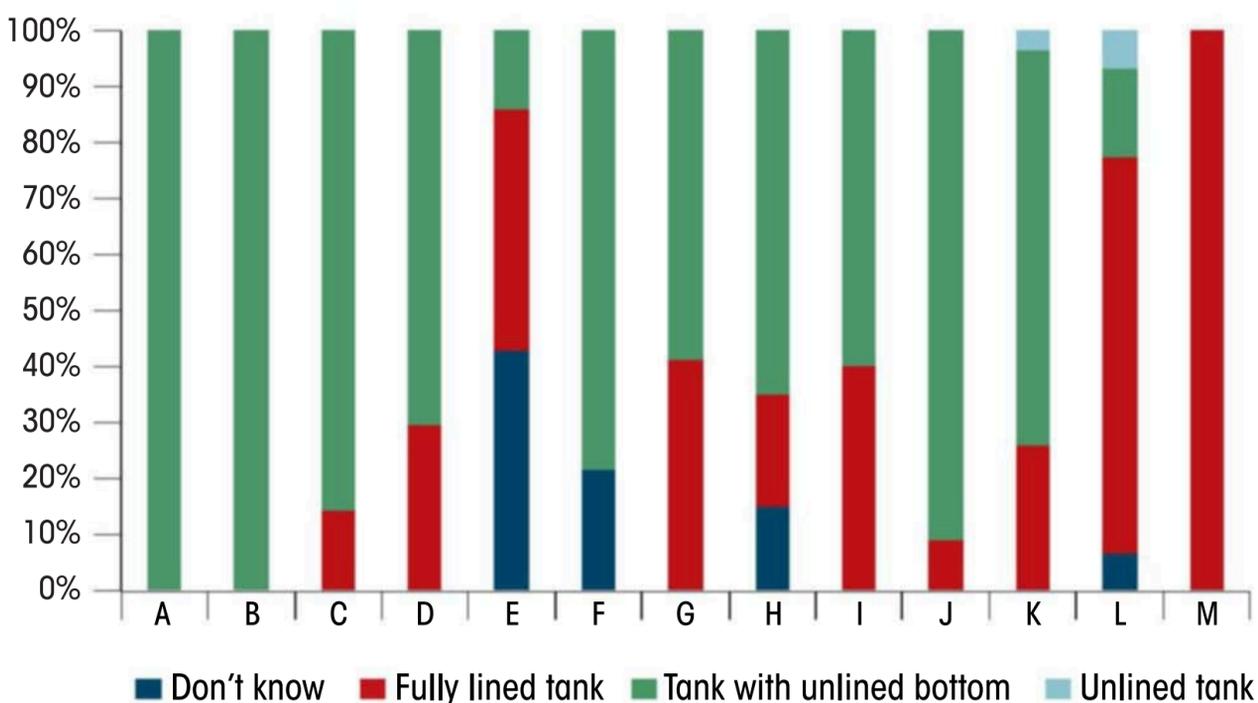
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Informal sanitation systems

Most Sangam Vihar households have non-sewered sanitation systems, but some blocks have been connected to sewer lines since 2022



Households' non-sewered sanitation systems comprise underground septic tanks. Not all of these are lined, risking seepage into the ground



Source: "Water and Wastewater Visioning for Large, Dense Unplanned Urban Settlements in an Era of Climate Risk", Centre for Science and Environment, May 2024

NON-SEWERED SANITATION

The total estimated wastewater generated in Sangam Vihar, based on 45 LPCD of water supply per household, is about 36 MLD. Some 75 per cent of this is greywater (discharged from domestic activities) and 25 per cent is blackwater

(which includes faecal matter, urine and other waste from bathrooms and toilets). The majority of the settlement has one or two toilets per property (which may house more than one family). There is no community toilet in the entire study area, observed the researchers. All

faecal waste, even in properties with multiple floors, is collected in an underground sealed septic tank.

In the absence of a planned sewerage line, residents set up this non-sewered, septic tank system to ensure that effluent discharge does not spread into open drains outside the houses. The CSE survey found that more than 70 per cent of the septic tanks in the study area are unlined, while only 27 per cent are fully lined. This may pose threats of faecal matter leaching underground through the tanks (see 'Informal sanitation systems').

The sanitation system is undergoing a change, with a centralised sewer system under construction from 2022. The system would channel faecal matter from the area to the Okhla sewage treatment plant (STP) some 10 km away, through retrofitted connectivity with the main trunk sewer line on Mehrauli-Badarpur Road. But due to the high and variable population density in Sangam Vihar, the waste generated would not be as per the usual quantities in other urban settlements. This may pose problems in retrofitting a conventional sewerage system and the authorities may need to ensure that larger pipes are laid to avoid choking and overflow.

Another problem would be altering the interior plumbing, which was designed for the toilets to be connected to the underground septic tank, to now connect to the sewage collecting chamber outside the house. It appears, retrofitting all the sanitation infrastructure in Sangam Vihar may not be feasible.

Meanwhile, to discharge greywater, almost all households rely on drains that move domestic wastewater along with stormwater collected during the rainfall months.

STORMWATER FLOODING

A large part of Sangam Vihar slopes towards Mehrauli-Badarpur Road. This means that during periods of rainfall, blocks nearer to the main road see greater accumulation of stormwater (see ‘Stagnant stormwater’). CSE’s analysis shows that the total catchment of the stormwater shed is approximately 5 sq km. The runoff can range from 52 million litres after 15 minutes of normal rainfall to 117 million litres after 15 minutes of heavy downpour. Currently, there is no infrastructure or plan to channel and store this runoff for groundwater recharge. Combined with greywater from households, it flows directly onto the Mehrauli-Badarpur Road through drains.

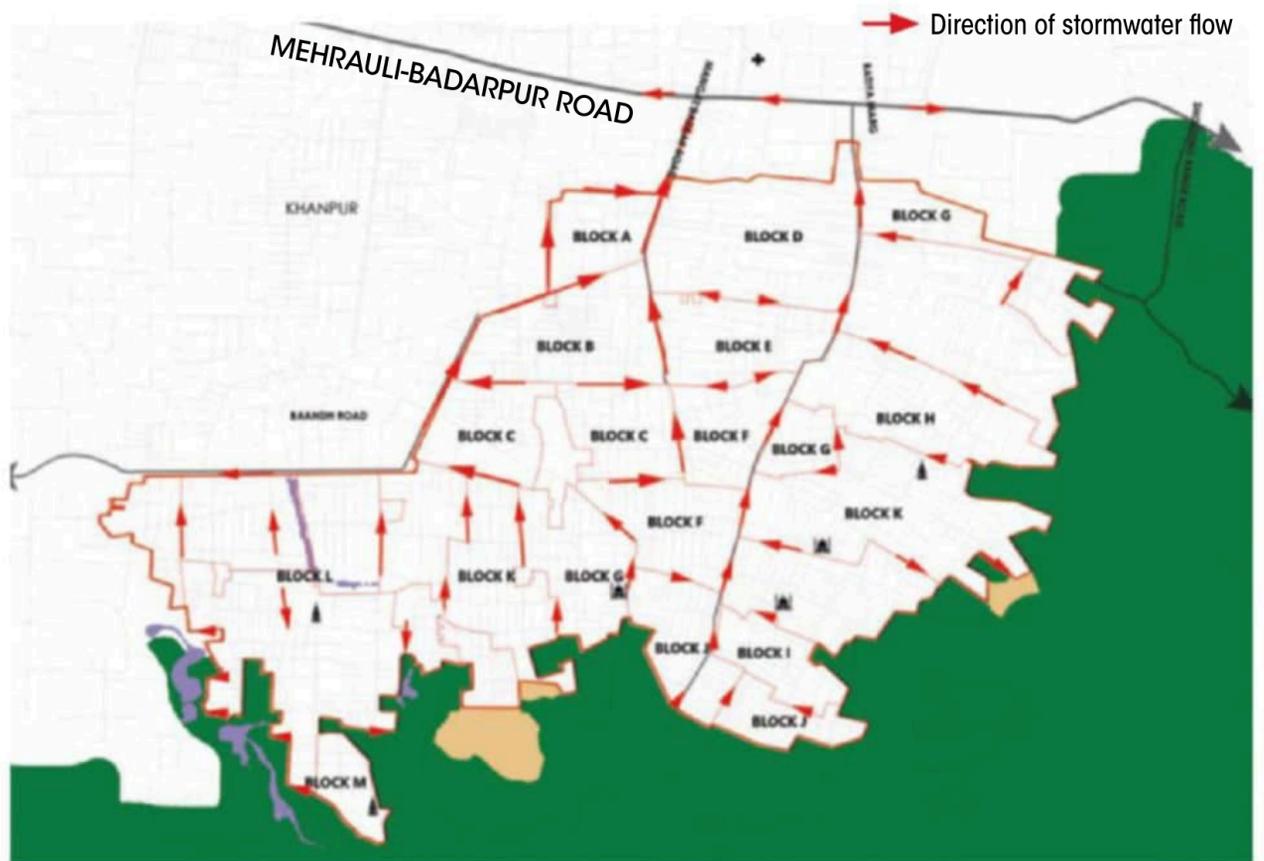
In more than 80 per cent of Sangam Vihar, it takes 30 minutes to three hours for the stagnant water to be drained away from the streets after a heavy rainfall event. However, at times it takes around six hours or more, residents say in CSE’s surveys.

About 92 per cent of the drains found are open and uncovered, with only a few closed drains in blocks F and K. Some affluent households (like those in block D) have, however, illegally covered drains outside their residences to park vehicles and allow for other activities, finds CSE’s analysis.

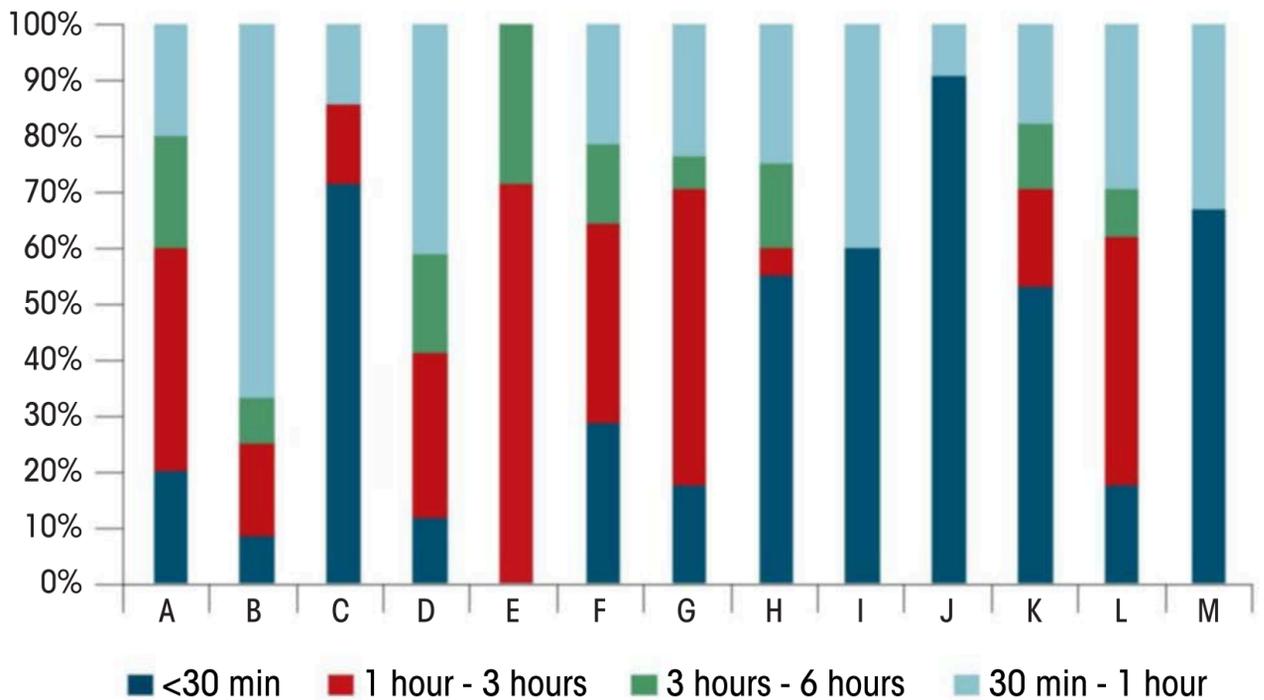
The Municipal Corporation of Delhi is responsible for periodic cleaning of the drains every day, but given that the colonies are unauthorised, and some streets may be too narrow for the authorities to reach, residents also hire private players. Many residents said that cleaning is done on an extremely irregular basis, ranging from once a week to once a month. This

Stagnant stormwater

Sangam Vihar largely slopes towards Mehrauli-Badarpur Road. Stormwater accumulates in open drains in blocks near this main road



Stormwater collected in drains after rainfall can take 30 minutes to six hours to move, posing public health and safety risks



Source: “Water and Wastewater Visioning for Large, Dense Unplanned Urban Settlements in an Era of Climate Risk”, Centre for Science and Environment, May 2024

means stormwater runoff and greywater stagnates for significant periods on the streets, potentially causing public health and safety hazards.

In the CSE survey, about 80 per cent of the residents say that such waterlogging and flooding can be resolved if new sewer lines are in-

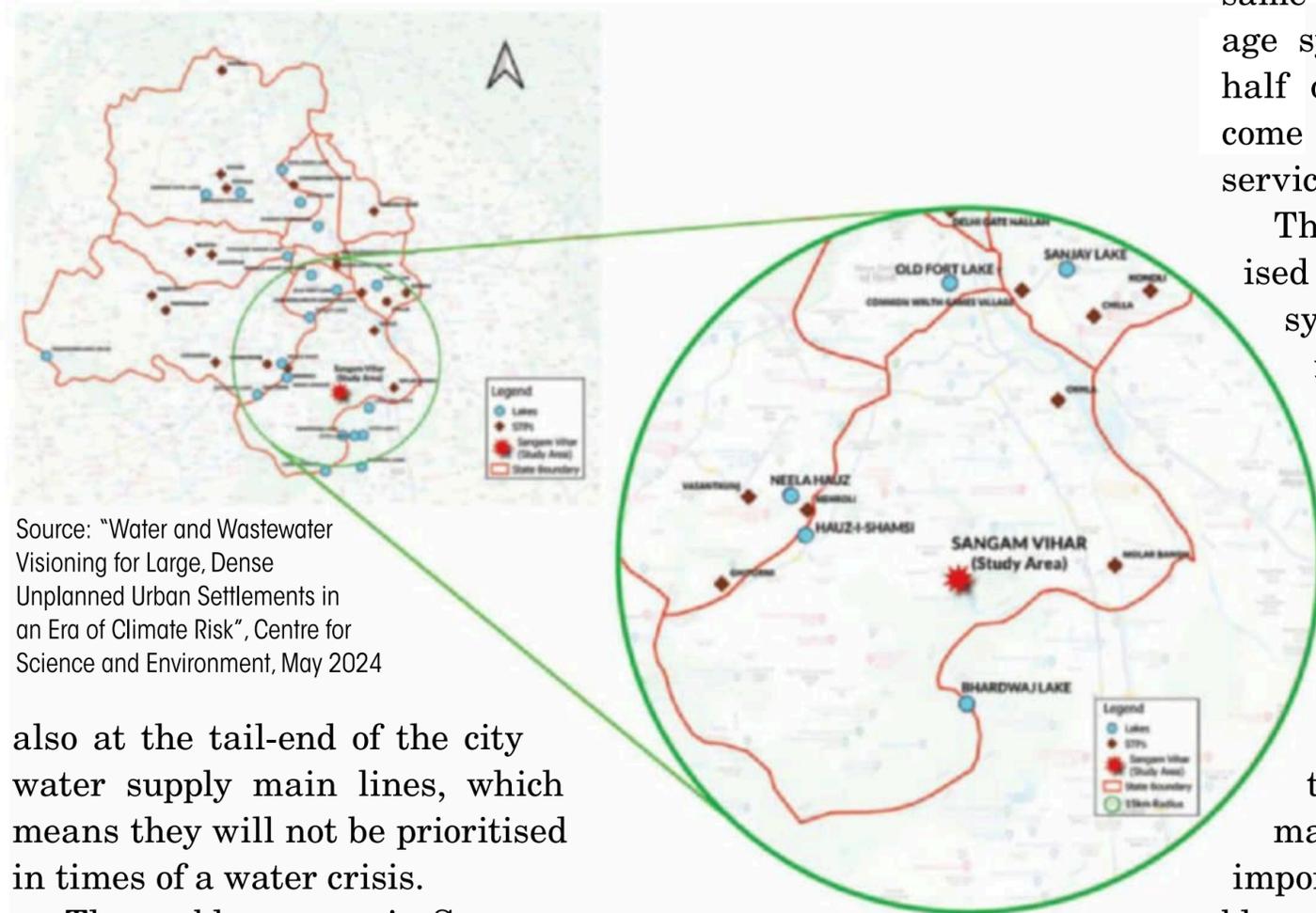
troduced to drain and channel excess wastewater from the roads.

REIMAGINE SOLUTIONS

The entire rim of southern Delhi has several large dense unplanned settlements like Sangam Vihar, which will bear the brunt of water problems. These settlements are

Opportunity to augment

Decentralised sewage treatment plants near Sangam Vihar can help treat wastewater to flow into nearby lakes to recharge groundwater



Source: "Water and Wastewater Visioning for Large, Dense Unplanned Urban Settlements in an Era of Climate Risk", Centre for Science and Environment, May 2024

also at the tail-end of the city water supply main lines, which means they will not be prioritised in times of a water crisis.

The problems seen in Sangam Vihar cannot be resolved without proactive measures. However, bringing more water from rivers and reservoirs outside Delhi may not improve the water supply. Retrofitting infrastructure may also not be feasible. We need to reimagine and reconfigure our internal water supply, and how we deal with treated wastewater. CSE proposes some solutions:

Decentralise the water supply: The current 45 LPCD supplied to the 13 blocks of Sangam Vihar needs to be at least doubled. This is also necessary to plan for sewerage systems. The highly concretised and built-up area does not allow for much in situ groundwater conservation and recharge. However, if decentralised STPs are built in the periphery forests and open areas, wastewater and stormwater from the drains can be collected, treated and flowed into the small waterbodies at

these sites to recharge groundwater, ensuring non-potable resources (see 'Opportunity to augment').

On a larger scale, Delhi must adopt strategies for city-wide decentralised water supply using treated wastewater for recharge of a few big lakes, which can then supply to nearby vicinities.

Combine sanitation systems: By the end of 2023, a little less than half of the 13 blocks of Sangam Vihar had gotten sewer lines connected to the main sewer trunk line on Mehrauli-Badarpur Road. However, connecting all the households in the settlement to this line may not be possible. Instead, CSE recommends that decentralised STPs on the periphery of Sangam Vihar could be designed to take all the greywater and blackwater. Three to five decentralised STPs in the forest areas of the southern periphery,

for instance, could handle over 25 MLD of sewage water (estimated for the 45 LPCD supply). At the same time, the retrofitted sewerage system already in place for half of the households will not come under stress and provide service to half the residents.

This combination of centralised and decentralised sanitation systems can also be planned for similar large unplanned settlements.

Plan for stormwater management:

Currently, there is no plan to augment infrastructure to manage stormwater runoff in Sangam Vihar.

From the perspective of water sensitivity, stormwater management is considered an important component of a city's blue-green infrastructure. But the current administrative arrangement is geared towards the principle that "those who own the road, manage the stormwater drains". The Delhi Metro Rail Corporation (DMRC) has been handed this responsibility for Mehrauli-Badarpur Road, where the stormwater of Sangam Vihar flows to, given that a new metro rail line is under construction here. DMRC is not a suitable agency to plan for stormwater management, but it is capable of constructing larger drains and diverting the stormwater to an area in the forest for groundwater recharge—which also prevents flooding. It can also divert stormwater to the Yamuna.

In all metro cities, there is an urgency to initiate stormwater management as a nature-based solution to address stormwater runoff and use it for groundwater recharge. **DTE**

@down2earthindia

RESIDENTIAL TRAINING ON WATER EFFICIENCY AND CONSERVATION (WEC) IN URBAN INDIA



Date
**21-23 AUGUST,
 2024**



Last date to apply
**30 JULY,
 2024***



Venue
**ANIL AGARWAL
 ENVIRONMENT TRAINING
 INSTITUTE, NIMLI, RAJASTHAN**

Water efficiency and conservation (WEC) are crucial for sustainable urban water management in India, where increasing population and changing land-use patterns challenge freshwater resources. The complex urban water cycle, influenced by surface runoff and piped-water systems, underscores the need to prioritize conservation of local sources like groundwater and waterbodies, often overexploited and neglected. WEC strategies involve optimizing resources, minimizing waste, and promoting sustainable practices, aligning with SDGs. In 2019, the Centre for Science and Environment (CSE) released a policy paper and guide on WEC for the Ministry of Housing and Urban Affairs. Building on this, CSE is organizing a three-day residential training program on Water Efficiency and Conservation in Urban India, aimed at equipping participants with the knowledge to engage effectively with WEC projects for resilient water supplies in cities.

AIM

This comprehensive training program aims to educate participants on advanced aspects of Water Efficiency and Conservation planning and implementation, equipping them with the knowledge and skills essential for excelling in water resource management.

OBJECTIVES

- To sensitize practitioners to the crucial need for Water Efficiency and Conservation (WEC) and to impart a deep understanding of its concepts.
- To provide participants with a structured approach to WEC planning at various scales.
- To equip participants with an in-depth understanding of tools and methodologies used for assessing and measuring WEC.
- To facilitate learning on existing policies, guidelines, and best management practices related to water efficiency and conservation.

COURSE FEES
FOR INDIAN PARTICIPANTS
 ₹ 28,000 for single occupancy
 & ₹ 25,600 for double
 occupancy room.

FOR INTERNATIONAL PARTICIPANTS
 US \$760 for single occupancy
 & US \$590 for double
 occupancy room.

SPECIAL OFFERS
50% off for college students
 and registered NGOs
25% off for industry consultants, and
 professionals
*Note: No training fee will be charged
 for nominated government officials.
 They only need to make their
 transportation arrangement to and
 from the CSE Head Office, New Delhi.*



TARGET AUDIENCE

City officials from urban local bodies (ULBs) and development authorities such as urban planners, town planning officers, engineers, those involved in preparing and enforcing WEC plans at the city/ zonal level and developing and implementing local WEC strategies.

TRAINING METHODOLOGY

The training methodology will follow a mixed approach involving lectures, group exercises, interactive discussions, video documentaries etc.

*(nomination will be accepted on first come first serve basis due to limited seats)

FOR MORE INFORMATION, KINDLY CONTACT:

TRAINING COORDINATOR

ANURAG VIJAY NAIDU

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Water Programme, CSE

Email: anurag.n@cseindia.org

Mobile: +91 7276 4979 68

Pathogen benefit-sharing pact thwarted again

Deep political rifts at WHO leave a critical pandemic treaty hanging in limbo as rich nations balk at equitable vaccine sharing

WHEN YOU watch international organisations thrash out a major new agreement, it's a lesson in how geopolitics and rich-country heft plays out, even when it relates to something as fundamental as public health. Inevitably, developed countries manage to get their way and seal the highly unequal and iniquitous terms reached by "consensus" in multilateral fora into binding agreements. We have seen this time and again at the World Trade Organization (WTO). If, however, the developing world digs its heel in, the negotiations are given a fresh lease of life, quite often for an undetermined number of years till a "consensus" more favourable to the developed world is eventually reached. This time, it was the World Health Assembly (WHA) that saw another round of protracted negotiations without concluding a treaty on an improved global strategy to fight future pandemics.

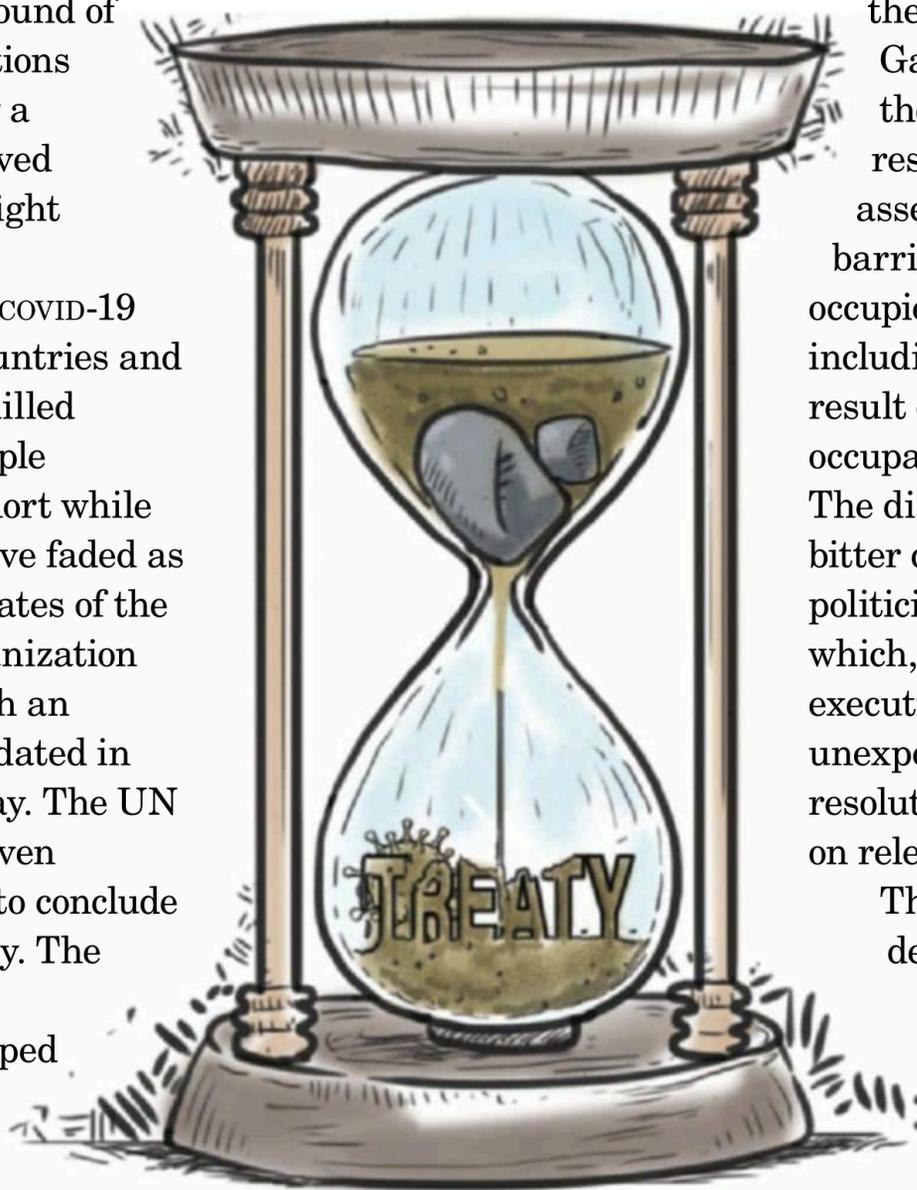
The memory of COVID-19 that devastated countries and communities and killed several million people worldwide just a short while ago appeared to have faded as the 194 member-states of the World Health Organization (WHO) failed to reach an agreement as mandated in the last week of May. The UN agency has been given another two years to conclude the pandemic treaty. The deep differences between the developed nations and poor

countries on critical measures like pathogen- and vaccine-sharing, which have marked negotiations in the UN agency for two years, were on full display once again. For one, it was a world more polarised than ever before that was meeting in Geneva in May, sharply divided over the savage war unleashed by Israel in Gaza. This ongoing war, which has resulted in the biggest humanitarian crisis in modern times, has also blurred the lines between rich and poor nations and seen dramatic changes in strategic alliances over the genocidal Israeli assault on the Palestinian people.

The war on Palestine overshadowed the 77th WHA negotiations, with several rounds of voting on a resolution moved by a large group of countries (32) trying to focus more attention on

the catastrophic conditions in Gaza. India was not among the sponsors of this resolution that sought WHO's assessment of "the impact of barriers to health access in the occupied Palestinian territory including East Jerusalem, as a result of the longstanding occupation and the ongoing war". The discussions were marked by bitter debates and accusations of politicisation of the issue by Israel which, just elected to the executive board, managed an unexpected amendment to the resolution by adding a paragraph on release of hostages by Hamas.

This resulted in a denunciation of the politicised nature of the Israeli amendment, which seeks to "justify



targeting health facilities and putting the lives of citizens in danger”. As a riposte, three additional amendments were suggested by sponsors of the original resolution condemning the “indiscriminate attacks on medical and humanitarian facilities used exclusively for humanitarian purposes”, and referred to two provisional measures ordered by the International Court of Justice, according to a report by the independent news website Geneva Health Files.

A report by Health Policy Watch, which tracks major global health policy challenges, says delegates spent over 10 hours in diplomatic manoeuvres and debates before finally approving the resolution. In contrast, a resolution on humanitarian assistance to Ukraine took just two hours to be passed.

Since last year, WHO, as per its mandate, has been calling for “the unimpeded passage of humanitarian relief, including the access of medical personnel, the entry of humanitarian equipment, transport and supplies in the occupied Palestinian territory, in particular the Gaza Strip”. It had expressed grave concern over the "catastrophic humanitarian situation" and the magnitude of the intense damage to the public health sector, the hospitals bombed, the health personnel killed and the death of thousands of civilians, the majority of them children, women and elderly. The report, prepared by WHO Director-General Tedros Adhanom Ghebreyesus, and its recommendations were also approved. Among other immediate measures, it calls upon the international community to secure enough funds to rebuild the Palestinian health system (wrecked by the Israeli bombings) in full cooperation with WHO and relevant UN agencies.

If this was the big drama, what exactly did WHA achieve? As usual, at the end of such concaves, organisations lay claim "historical" achievements or developments. WHO settled for the latter, a claim based on the agreement reached on a package of amendments to the 2005 International Health Regulations (IHR), and to the fact that commitments have been made to

complete negotiations on a global pandemic treaty within a year.

The historic achievements, according to a WHO statement celebrating the conclusion of WHA, singled out first the introduction of a definition of a pandemic emergency to trigger more effective international collaboration, and second a commitment to solidarity and equity on strengthening access to medical products and financing. But of the critical pathogen access and benefit sharing (PABS) issue, there was no mention at all. This is one of the biggest sticking points in the proposed pandemic treaty, requiring member-countries to quickly share genetic sequences and samples of emerging pathogens. This information is vital for the rapid development of diagnostic tests, therapies and vaccines to fight new pathogen. Rich countries, however, are reluctant to agree to such data sharing because they are expected to provide in

Discussions at the 77th World Health Assembly were marked by Israel-Palestine war, while sticking points of the proposed pandemic treaty took a backseat

return for the genetic sequences vaccines and other products developed from such sequences to poor countries at low cost (see 'Grab the pathogens but don't share the drugs', *Down To Earth*, 16-31 March, 2024).

Among the proposals on the table is the setting up of a WHO-coordinated laboratory network, PABS database and legal devices like Standard Material Transfer Agreements. African members are determined for a multilateral PABS with clearly defined rules on governance and accountability. Another proposal, already dropped because rich countries and the drug giants have rejected it as unworkable, is for manufacturers to set aside 10 per cent of vaccines for donation and another 10 per cent to be provided at cost to WHO for distribution to low-income nations.

The experience of the SARS-COV-2 pandemic has deepened mistrust. At the end of 2021, more than 90 per cent of the people in richer countries had received two doses of the COVID vaccines, whereas less than 2 per cent of the population in poor countries had got it. It's telling that while WHO is hopeful of concluding a pandemic treaty by 2025, it has been more flexible with the date for finalising a PABS agreement. The target date is May 2026. [DTE](#) [@ljishnu](#)

RESIDENTIAL TRAINING

COMPRESSED BIOGAS (CBG) POTENTIAL, TECHNOLOGY, POLICY, OPERATIONS AND ECONOMICS

Date
**28TH-30TH AUGUST,
2024**

Last date to apply
**31ST JULY,
2024**

Venue
**ANIL AGARWAL ENVIRONMENT
TRAINING INSTITUTE (AAETI),
NIMLI, RAJASTHAN**

The Indian government has set a target to raise the share of gas in the energy mix: 15 per cent by 2030 from the current 6.5 per cent. This move aims to transform India into a gas-oriented economy. Presently, India produces 34,000 million standard cubic meter of gas (MMSCM) but consumes 64,000 MMSCM, resulting in a substantial shortfall of 30,000 MMSCM. This deficit accounts for 47 per cent of the total consumption, which is fulfilled through imports. Compressed Biogas (CBG) as a domestic energy source can play a key role in addressing this gap and helping the nation achieve its clean energy goals.

The CBG production potential in India is estimated at around 62 million metric tonne, as per the Union Ministry of New and Renewable Energy (MNRE). The Sustainable Alternative Towards Affordable Transportation (SATAT) scheme aims to tap 15 million metric tonne of this. In the 2023-24 Union Budget, finance minister Nirmala Sitharaman has earmarked Rs 10,000 crore for the establishment of 200 CBG plants and 300 community and cluster-based plants. In addition to this budgetary allocation, the government has introduced several policies and initiatives to accelerate the implementation of CBG projects in India. These measures include MNRE's Waste to Energy programme, the Swachh Bharat Mission (SBM), and the Galvanizing Organic Bio-Agro Resources (GOBAR)-DHAN scheme. However, despite these policy efforts, the number of CBG plants currently installed on the ground is only 46. This slow progress can be attributed to the limited dissemination of CBG-related information among potential investors.

Centre for Science and Environment (CSE) is offering a tailor-made three-day residential training programme on 'CBG: Potential, Technology, Policy, Operation and Economics'. The high-impact training has been conceived to provide an end-to-end solution to design and install a CBG plant that aligns with the principles of circular economy, energy transition, and sustainable development.

FOR FURTHER DETAILS, PLEASE CONTACT THE COURSE COORDINATOR

RAHUL JAIN,
Deputy Programme Manager, School for Sustainable Energy, AAETI,
Renewable Energy Unit, CSE
Mobile: +91 8901448131 Email: rahul.jain@cseindia.org

HIGHLIGHTS

THE PROGRAMME IS OPEN TO

Government officials, regulators, renewable energy nodal agencies, urban development authorities, civil society organizations, start-ups, professors, researchers, private sector consultants, individual practitioners, and international participants.

COURSE FEE

- » **Government Officials:**
Registration fee is waived for Central and State Government officials*
- » **Indian Participants:** ₹21,000
- » **Foreign Participants:** US \$300

**Cost of travel to Delhi and back for the nominated officials to be borne by the nominating government authority*

The course fee is inclusive of travel from Delhi to the training institute, accommodation, food, resource person, and training kit.

Palette

WHAT'S INSIDE

How reptiles can help in natural crop pest control **P54**

Wasteland decodes the dirty business of waste management **P56**

Rising mistrust in chosen governments **P58**

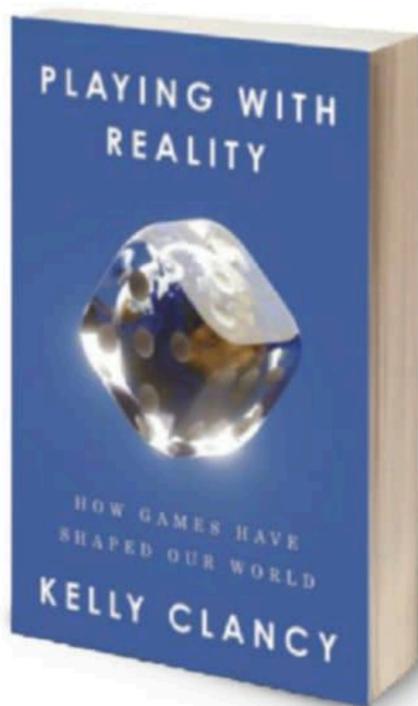
RECOMMENDATIONS

EXHIBITION

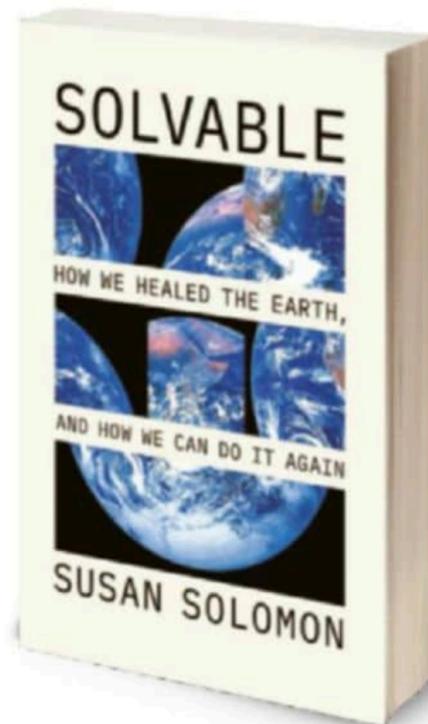


Explore the science and engineering behind the Wimbledon Championship; the truth of how processed food and packaged labels are made; and how artificial intelligence can improve urban transportation during The Royal Society's Summer Science Exhibition 2024. As part of the annual exhibition, The Royal Society, which is the UK's national academy of sciences, will host a series of talks by experts in the fields of sports science, biology, and technology from July 2 to July 7. These talks will be free to watch on The Royal Society's YouTube channel during the week. For the event schedule and more details, visit www.royalsociety.org.

BOOKS



Humans have invented and played games throughout history. In fact, games created over the centuries provide significant clues on the politics, philosophy, economics and technology of their respective societies. In cases such as wars, however, gamification has overridden human decision-making, says neuroscientist and physicist Kelly Clancy. In *Playing with Reality: How Games Have Shaped Our World*, she decodes humankind's fascination with games and the ways it affects our nature and behaviour.



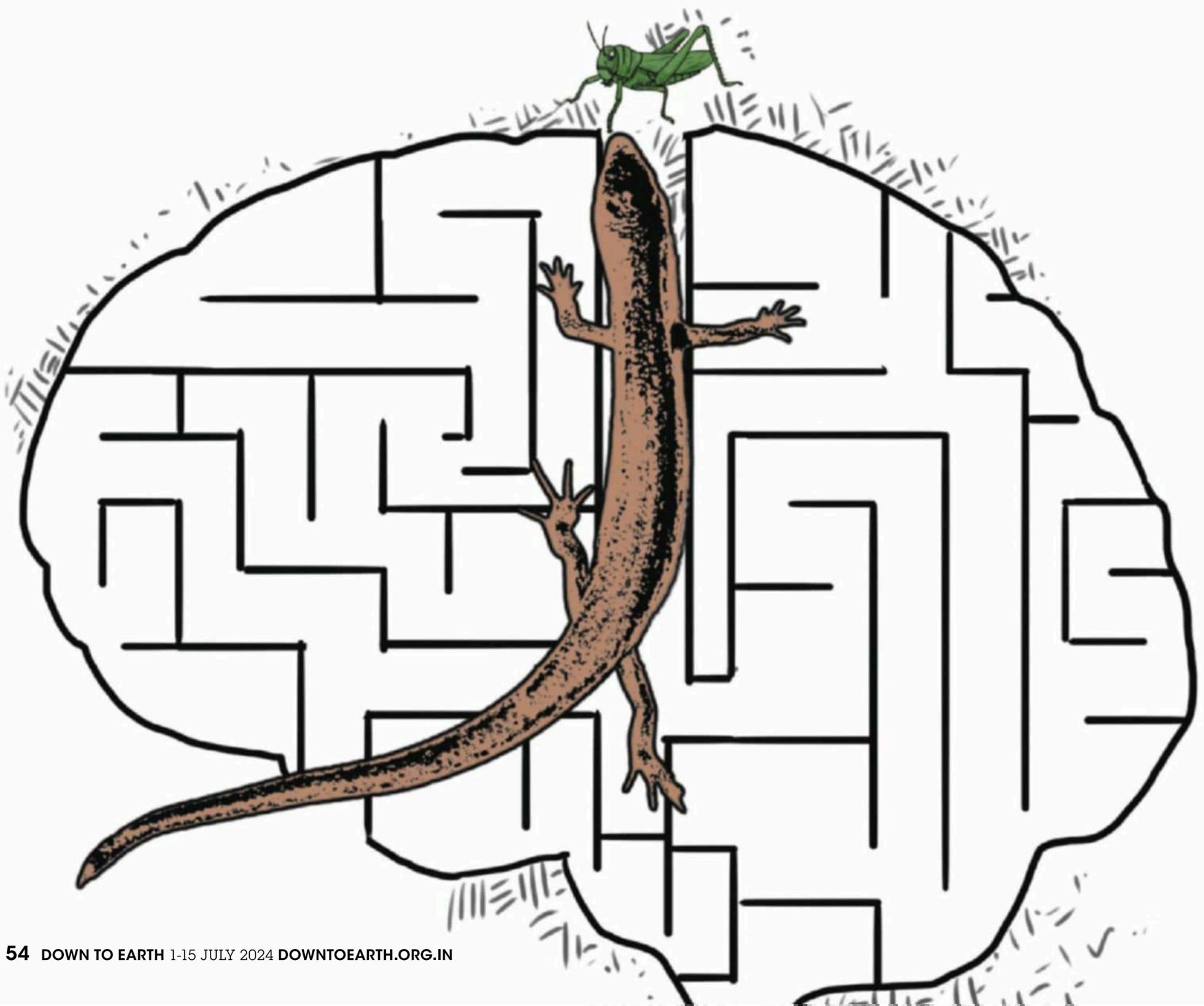
Humankind today faces a host of problems threatening survival, such as greenhouse gas emissions and pollution. But this is not the first time such problems have arisen. People have battled, and overcome, challenges such as ozone depletion over the Antarctic. The key to finding solutions to such problems lies in making them practical and personal, says Susan Solomon, an atmospheric chemist known for her work on the ozone layer over Antarctica, in *Solvable: How We Healed the Earth, and How We Can Do It Again*.

NATURE'S MAPPERS

Reptiles show an ability to understand and remember spaces, which makes them a natural insect pest controller

DEYATIMA GHOSH

CAN YOU see it?" I asked my fellow researcher one evening in the summer of 2022. "Not yet," the researcher replied, "but I am sure it is hiding somewhere inside. There is no way for it to escape." The two of us, along with three other researchers, were looking for Dritto, a male garden lizard (*Calotes versicolor*) that had escaped from our experimental plot at the campus of the Gandhi Krishi Vigyana Kendra in Bengaluru. I was certain that the lizard had escaped from the fenced plot. For the last five days, the lizard had been frequenting one area of the plot. We suspected that it had found a way out through here. Dritto eventually returned to the plot, but five days later, it escaped again. This time, we confirmed its escape route. This indicated that in the three months since it was under observation, the lizard had gained a spatial understanding of the plot.



Business of dirt

The waste management ecosystem is rooted in poverty, politics, colonialism, corporate greed and environmental injustice, with serious consequences to human health

ROHINI KRISHNAMURTHY

OLIVER FRANKLIN-WALLIS, features editor at *British GQ* magazine, felt sick walking through a waste dump in Kanpur, a major industrial cluster of leather factories in Uttar Pradesh. The dump was carpeted with leather scraps. Goats and chickens were seen picking through the waste for food. Calling it a desolate site, Franklin-Wallis went on to ask a poignant question: “How little we truly see of the way things are made, and how little we understand of the true cost?” The statement sums up his book *Wasteland: The Dirty Truth About What We Throw Away, Where it Goes and Why it Matters*.

The book is as much about waste as it is about people involved in the dirt business. The whole ecosystem built around waste management is rooted in poverty, politics, colonialism, corporate greed and environmental injustice, which comes with some serious consequences to human health.

The author follows the complex journey of different variety of wastes—solid, industrial, paper, plastic, food, fashion, nuclear and electronic—in the Global North, largely the UK. Barring field visits

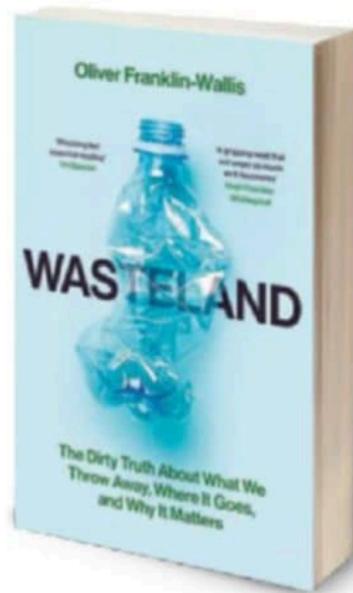


to India and Ghana, the developing world—which faces a higher burden, given its growing population and poor infrastructure—finds little space in the book. However, issues concerning the Global South are briefly covered at various points in the book.

Perhaps the most powerful part of the book is the comparison of landfill facilities in Ghazipur in Delhi and the Ellington Sanitary landfill in rural UK. The former is infamous for its immense size, environmental impact and improper working conditions for the waste workers, who mostly belong to marginalised groups like Dalits and Muslims, while the latter runs on cutting-edge technology. The reason the two sites look poles apart is, as one would expect, money. The author rightly points out that waste disposal is a basic human right in the Global North, but a luxury in the Global South, whose citizens struggle to meet their basic needs of food, water and education.

Though wealthy nations have better resources at their disposal, they resort to outsourcing their wastes (plastics, clothes, and electronic waste) to the Global South, without providing it enough resources to deal with the toxic consequences. They find it cheaper to ship waste abroad than to recycle it within their borders, the author explains in his book.

Take fashion, for instance. Globally, the number of garments purchased per capita increased by about 60 per cent from 2000 to 2014, according to the multinational consultancy McKinsey, partly due to the rise of fast fashion. The discarded materials find their way to Pakistan, east Europe or west Africa for reuse. But here is the catch: Even as the import of



Wasteland

Oliver Franklin-Wallis

Publisher: Simon & Schuster

MRP: ₹ 799 | Pages: 400

discarded clothes increases job opportunities and tax revenues in the Global South, there are glaring problems. For example, 40 per cent of the clothing that arrives in Kantamanto in Ghana every week (an estimated 6 million garments) is not fit for use and becomes waste, the author points out. This waste, then, accumulates in the gutters or dump sites. The leachate (contaminated liquid generated from water percolating through a solid waste disposal site, accumulating contaminants and moving into subsurface areas) ends up polluting surface rivers and groundwater or reaches the beach before washing out to the sea.

Like fashion, gadgets are not being built to last. This invariably means more e-waste. Ghana has become a popular destination of e-waste in recent years. The imports have polluted the soil, groundwater and even food in Agbogbloshie, an e-waste recycling site in the capital. The author writes that informal recyclers were found to have unsafe levels of lead and cadmium in their blood and urine. A similar story emerged with used plastics, which are exported for recycling to the

developing world.

In the Global South, there is a larger problem of industrial pollution and the ensuing blame game between the different stakeholders. The author highlights this during his visit to Kanpur, where a leather tannery owner blamed electroplating and metalwork industries for polluting the Ganga river. The situation was the same in Ludhiana, an industrial hub in Punjab, when *Down To Earth* visited the city in 2023. The dyeing and electroplating industries were pointing fingers at each other when 11 unsuspecting residents were killed in the city after inhaling a toxic gas on April 30, 2023, probably due to the dumping of acidic effluent wastes into the sewers.

As the world moves towards a low-carbon economy, newer challenges will emerge. The author stresses that the planet is not prepared for the decaying fossil fuel infrastructure like oil rigs, pipelines and power plants, nor is it prepared to deal with the renewed interest in the nuclear sector, which faced a setback following the Chernobyl and Fukushima disasters. In December 2023, as many as 198 signatory countries to the UN Framework Convention on Climate Change called for accelerating the deployment of low-emission technologies, including nuclear energy, to help achieve deep and rapid decarbonisation. Countries, barring Finland, do not have a plan to deal with the toxic nuclear wastes, which will remain radioactive for tens of millennia. Until then, the author writes, “traces of nuclear wastes will be evident in the geological record billions of years from now, as perhaps the most enduring marker of the Anthropocene.” **DTE**

⊗ @down2earthindia

The mistrust factor

IN A year when every second citizen of the world will vote to elect a government, there is a debate brewing: do we trust our chosen governments?

All political parties make promises to the electorate. In India, for instance, some parties even issued guarantee papers to the voters during the just-concluded general elections (besides running a toxic, divisive poll campaign). Such political parties are increasingly being elected by people across continents, especially in Europe, America and Asia. Most of the populist governments elected recently have aggressively pursued polarising agenda: on communal and community lines as well as on the economic front. And people have voted on the agenda. So one would tend to assume that the winning political party has a popular mandate to pursue the agenda. Elected governments use this mandate to legitimise their actions.

This might not be the case, as a recent survey shows. Earth4All, a collective of economic thinkers, scientists and advocates, released the findings of a survey conducted in the G20 countries (including India) on trust in their governments. It also covered aspects such as whether the wealthy be taxed more and if people trust that their government is doing enough to save the planet from an environmental meltdown. The survey sought opinions from 22,000 people from the countries that account for 85 per cent of the world GDP.

The Earth4All survey found that just 39 per cent of the people believe that their “government can be trusted to make decisions for the benefit of the majority of people.” The question on their trust in the government to take such beneficial decisions in long run (20-30 years) saw only 37 per cent replying in the affirmative.

This lack of trust in the government reflects people’s desire for reform of both national and global political systems. Nearly two-thirds of the people surveyed wanted changes in the political system of their country. Close to 30 per

cent people felt a need for a “complete” reform of their political system.

In India, the survey offers interesting insights on the people’s trust in the political system. On trusting the government for making decisions for the majority, 74 per cent Indians surveyed showed strong confidence. Nearly the same level of trust was recorded for the government making suitable decisions in the long run. A question on which political system will be suitable to run the country, saw 87 per cent vote for “having experts make decisions according to what they think is best for the country”. However, 86 per cent people voted for a “democratic political system”. Among the low-income households surveyed, 83 per cent showed trust on a system run by experts while 79 per cent on the democratic system, which is significantly lower than the overall figure (of 86 per cent) recorded in the survey.

Sandrine Dixson-Declève, executive chair of Earth4All, says the mistrust on government is notable in Europe. He sees the mistrust in context of another significant finding: over two-thirds of the

Lack of trust in governments reflects people’s desire for reform of both national and global political systems

respondents felt that the G20 countries’ economic priority should be health, general wellbeing and nature instead of just creating profit and wealth. “With the recent European elections moving towards the radical right, we need to hold governments accountable to introduce an economy that services people and the planet at the same time,” he says. Owen Gaffney, co-lead of the Earth4All initiative, sums up the findings, saying, “The vast majority of people we surveyed in the world’s largest economies believe major immediate action is needed this decade to tackle climate change and protect nature. At the same time many feel the economy is not working for them and want political and economic reform. It’s possible this may well help explain the rise in populist leaders.” [DTE](#) [@richiemaha](#)



ADVANCE ONSITE TRAINING PROGRAMME ON

CONTINUOUS EMISSION AND EFFLUENT MONITORING SYSTEM

DATES: AUGUST 6 TO 9, 2024 | LAST DATE TO APPLY: 24 JULY, 2024

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

CEMS is a regulatory requirement for industries to monitor the emission and effluent quality data online and report it to the regulators. In 2014, the Ministry of Environment, Forest and Climate Change (MOEF&CC) and the Central Pollution Control Board (CPCB) mandated the installation of Continuous Emission Monitoring System (CEMS) and Continuous Effluent Quality Monitoring System (CEQMS) in 17 categories of highly polluting industries and common pollution treatment facilities.

The proper implementation of CEMS in India requires a thorough understanding of CEMS technology, appropriate selection as per the requirement and guidelines, correct installation, operation and maintenance, calibration, data handling and data interpretation with clear understanding on CEMS regulatory guidelines. A lack of adequate knowledge in these areas has led to numerous challenges resulting in poor data quality and various non-compliances in the industries. Therefore, it is imperative to build thorough knowledge and skill regarding CEMS regime among the regulators, industries and other relevant stakeholders for better implementation of CEMS in India. This programme will also lay focus on audit methodology, which ensures correct implementation of CEMS by ensuring certification, suitable technology selection, correct installation, calibration and other quality assurance practices, transparency in sharing credible data with regulators etc.

CEMS is soon to become a legal requirement for compliance assurance, it is therefore essential for different stakeholders including the industries, regulators and consultants to be adequately trained in all aspects. Keeping this in mind, Centre for Science and Environment is organising a 3-days certificate course on "Advance Training Programme on Continuous Emission and Effluent Monitoring System" from 6 to 9 August, 2024.

PARTICIPANTS WILL BE AWARDED WITH A "CERTIFICATE OF COMPLETION" ON SUCCESSFUL COMPLETION OF THE PROGRAMME

For any other query, please contact:

Shreya Verma

Programme Manager, Industrial Pollution Unit

Email at shreya@cseindia.org | Phone: + 91 8882084294

COURSE HIGHLIGHTS

- PM, Gaseous CEMS and CEQMS Technology: suitable technology selection and correct installation
- Operation & maintenance and calibration procedures of PM, Gaseous CEMS and CEQMS.
- CEMS guideline and best practices.
- Data acquisition, handling and analysis
- Audit Methodology and self-assessment.
- Hands on experience on manual stack monitoring

COURSE FEE

₹28,000 for single occupancy and ₹25,600 for double occupancy. Course fee entails lodging, boarding and training kit costs. It does not cover travel costs from your respective location to Delhi and back.

WHO SHOULD ATTEND?

Environment professionals from industries, regulators, consultants, environmental laboratories, and others interested participants.

ANNIVERSARY

16-31 MAY, 2024

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