

16-31 JANUARY, 2024

Down To Earth

FORTNIGHTLY ON POLITICS OF DEVELOPMENT, ENVIRONMENT AND HEALTH

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STUDY

RICE AND WHEAT HAVE LOST NUTRIENTS

India's key staple grains have lost up to 45% of food value

By 2040, grains will be impoverished and worsen India's disease burden

The grains are also high in toxic elements now



LONELINESS P16

World unprepared for this health threat

BIODIVERSITY P38

Narkya tree case highlights lax laws



SCHOOL OF WATER AND WASTE

AAETI



TRAINING PROGRAMME

RAINWATER HARVESTING AND STORMWATER MANAGEMENT FOR CLIMATE-RESILIENT RIVER CITIES

ONLINE AND ONSITE

A two-part training programme that teaches you to reinvent water management in cities

Centre for Science and Environment (CSE) invites nominations/applications for a **two-part training programme**, which is a part of the three-year CSE sub-programme supported by the National Mission for Clean Ganga (NMCG), aimed at building capacity of cities in the Ganga basin and making them water-sensitive. It is a part of the ongoing efforts by NMCG for ensuring convergence of Namami Gange with other national missions such as AMRUT 2.0, Smart Cities and SBM 2.0.



PART A (ONLINE)

January 29-February 14, 2024

Open to Indian and foreign participants

Part A of this training programme – which will be delivered online – will familiarise the participants with the fundamental concepts and learnings. It will focus on:

- Overview of changing rainfall patterns in today's climate-risked world
- Introduction to urban flooding: Why urban India floods
- Basics of designing stormwater drains in cities
- Ways to collect, divert and recharge groundwater through rainwater harvesting structures



PART B (ONSITE)

February 21-23, 2024

Open only to Indian participants

Part B of the training programme will be held at the Anil Agarwal Environment Training Institute (AAETI) in Nimli. It will offer the participants advanced concepts and learnings, and will focus on:

- Challenges of managing stormwater in cities: Anthropogenic and natural factors, urban planning and drainage disruption, density of built-up area and run-off, and rainfall intensity and climate change
- Engineering (stormwater drainage systems) and spatial planning challenges
- Planning and designing of rainwater harvesting systems using stormwater drains: Maintenance and monitoring the system for improved groundwater recharge

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

WHO WILL BENEFIT FROM THE TRAINING

Central/ state/ municipal functionaries (decision makers/ managers and regulators); any other functionaries dealing with AMRUT, Smart Cities Mission, Jal Jeevan Mission (Urban), Swachh Bharat Mission (U), Atal Bhujal Mission and Namami Gange; officials with water utilities; engineers/ architects/planners/researchers/academicians

TRAINING FEES

No training fee will be charged from nominated government employees from India.

For the rest:

Part A

Rs 3,500 (for Indian participants);
US \$75 (for foreign participants)

Part B

Rs 28,000 (single occupancy accommodation);
Rs 25,600 (double occupancy accommodation)

Early bird entries (till January 20, 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.

Please get in touch with the training coordinator before fixing your travel itineraries.

TRAINING COORDINATOR

Pradeep Kumar Mishra, Programme Officer, Water Programme, CSE
+91-8085443793 /+91-7903143870 | pradeep.mishra@cseindia.org

A new world order taking shape

IN 2024, we must rework trade rules for a different kind of globalisation. This is important both for the economies in the Global South and the fight against climate change.

Many yesterday's ago, when the world was discussing the possibility of a climate crisis, it was also negotiating a new trade agreement. In early 1990, when the UN Framework Convention on Climate Change was agreed at the Rio Summit, the World Trade Organization (WTO) was also set up and global rules to facilitate free trade between nations was signed on. The deal was simple: the cost of manufacturing would come down when goods were produced in countries with lower labour costs and environmental standards. The export-economies would drive prosperity in the still-developing world, but most importantly in the rich world where consumers would benefit from cheaper goods and the boom in services. The tectonic shift came in 2001, with the acceptance of China into WTO. China had massive workforce; no trade unions; little environmental safeguards; and an authoritarian government. After joining WTO, China's share of global CO₂ emissions rose from 5 per cent in 1990 to 21 per cent in 2019. Trade boomed but the age of global prosperity did not come, and an increased trade meant that CO₂ emission increased.

In 20 years, this idea of globalisation has soured—the proponents of the grand scheme are turning their backs to the idea of unfettered global trade, which was designed to be without distortions of subsidy and support by national governments. The question is how will these new globalisation rules take shape in a climate-risked and war-torn world?

Today the most hyped issue is US' position against China. This is being talked about as the fight against autocratic and undemocratic regimes (*which is true*). But the real reason is to gain control over resources and technologies needed for the future, including the green economy that the world so desperately needs. China today dominates the supply chains for batteries; it processes over half of the world's lithium, cobalt and graphite; and it is an established leader in solar energy. To fight this "enemy", the US has decided to give up all its ideological qualms about subsidies; the Inflation Reduction Act (IRA) is providing finance to companies to manufacture low-carbon products in the US.

The issue is if the western world's mission to break this stranglehold will lead to higher costs of the green transition and even delay it? Or will it be successful in doing the impossible—securing access to rare minerals

and rebuilding its manufacturing industry, despite the higher costs of labour and environmental standards. This could lead to de-globalisation or localisation as more countries decide to maximise their advantage as holders of natural resources, and technology and the knowledge that goes with it. It is also a possibility that there are new breakthroughs in technology, which would make the China-dominated supply chain redundant. For instance, there is talk about sodium-ion batteries that could take down the need for lithium batteries.

De-globalisation could equally mean that the pace of green transition is disrupted. For instance, the US, through IRA, is providing support to local manufacturing of electric vehicles. It has notified that electric vehicles that include Chinese-made battery components will not be eligible for full subsidies. It goes on to say that these vehicles will not qualify for IRA if they have "significant" ties to the Chinese government or are produced with a licensing agreement with a China-based or -controlled operator. Given the near-complete control of China in the raw mineral and battery manufacturing segment, this disengagement may delay the electric vehicle transition or make it more expensive. The Chinese electric car manufacturer, BYD, has already overtaken Elon Musk's Tesla.

According to the *Financial Times*, in the fourth quarter of 2023, BYD sold a record 526,000 battery-only electric vehicles, as compared to Tesla's 484,000. Therefore, managing the twin objectives of localisation and a speedy green transition in today's China-dominated world could be a challenge.

It is the same in India. We have decided—and rightly so—to invest in local capacity for solar industry. The Indian government has announced fiscal incentives for solar cell and module manufacture and imposed higher import duties on Chinese products. It is difficult to say, as yet, if this will impede India's ambitious renewable programme, as domestic production may not be able to keep pace or be cost-competitive. On the other hand, there is an obvious advantage in building our industry. The gradual closing of the free-trade world will also have implications for Indian industry's exports. All in all, there is a new game in town and we need to see if this time around the rules of trade will work for or against the people and the Planet. [DTE](https://www.downtoearth.org.in) [@sunitanar](https://twitter.com/sunitanar)

As the world enters an era of deglobalisation, we need to see if the new rules of trade will work for or against people and the Planet

DownToEarth

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PRODUCTION Rakesh Shrivastava, Gundhar Das

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MULTIMEDIA Joel Michael, Sunny Gautam, Midhun Vijayan, Shreya KA

INFORMATION AND RESEARCH SUPPORT Kiran Pandey, Susan Chacko, Madhumita Paul, Sheeja Nair, Lalit Maurya, Dayanidhi Mishra

CONSULTING EDITORS Anumita Roychowdhury, Vibha Varshney

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Editorial, subscriptions and advertisements:
Society for Environmental Communications,
41, Tughlakabad Institutional Area, New Delhi 110062.

Phone: 91-11-40616000, 29955124,
29956110, 29956394, 29956399 | Fax: 91-11-29955879.
Email: editor@downtoearth.org.in

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FOR ADVERTISEMENTS Jyoti Ghosh
jghosh@cseindia.org

FOR SUBSCRIPTIONS
K C R Raja, raja@cseindia.org



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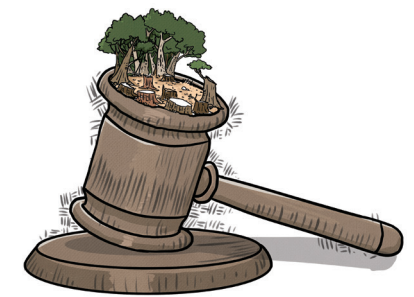
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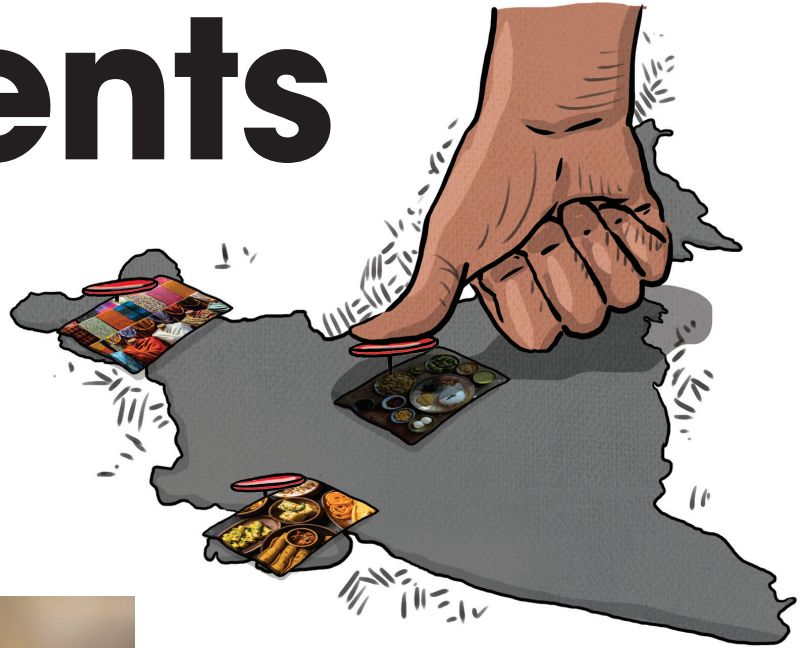
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SCHOOL OF SUSTAINABLE INDUSTRIALIZATION

AAETI



INTEGRATED ONLINE AND ONSITE TRAINING PROGRAMME ON

WATER AUDIT AND WASTEWATER MANAGEMENT IN INDUSTRIES

Last date to apply: 2nd February, 2024

Centre for Science and Environment (CSE) is launching an integrated training programme on Water Audit. 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 water audit process which includes theoretical knowledge via lectures from sector experts, first-hand experience through group exercises, discussions, exposure visit to industries.

PART (A)

BASIC LEARNING (ONLINE)

February 6-19, 2024

- Introduction to water audit
- Instruments used for water auditing
- Basics of water circuit diagram
- Fundamentals of Cooling towers, and Boilers
- Concept of water costing
- Highlights of CGWA notification
- Industrial wastewater management
- Case studies and assignments

Note: The training will be conducted on Moodle Platform where participants will be provided with the reading /audio-visual training material.

The course material be for the duration of 2 hrs per day and live sessions will be on weekends for discussions.

PART (B)

ADVANCE LEARNING (ONSITE)

May 7-10, 2024

- Advance concepts of water accounting
- Monitoring and Metering in industries
- Preparation of Water Audit Questionnaire
- Concept of water positivity, neutrality in industries
- Increasing COC of cooling towers
- Concepts to enhance boiler, pumps efficiencies
- Achieving ZLD in Industries
- Sector specific Case Studies

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

The 4 day's training will have sessions from sector experts, followed by class exercises and industry exposure visit.

Course fee

Part A: ₹ 3,500/-
(Indian participants)
USD100/- *(Non-Indian participants)*

Part A+B: ₹ 28,000/-
(Indian participants)
Full waiver on online fees for participants applying for onsite programme

AWARD OF CERTIFICATES

Certificate of completion will be awarded for both the programme.

WHO CAN APPLY

Industry professionals, EHS officials, Environmental Consultants, Engineers, Regulators, Environmental laboratories, Academic institutions, Students, Research scholars, and others aspiring to work in the field of water.

For any query, contact: **Shobhit Srivastava**, Deputy Programme Manager
Centre for Science and Environment, 41, Tughlakabad Institutional Area, New Delhi-110062 | Ext: 383; Mobile- +91-9711049558 | Fax: 011-29955879

Engage



Railways' persisting waste problem

Recently, while travelling from Kerala (Ernakulam Junction) to Maharashtra (Lokmanya Tilak Terminus) by the Duronto Express, I noticed that the waste disposal bins at both ends of the train compartments were overflowing after a few hours into the journey. The cleaning and pantry staff on the train were clearing the bins by throwing the waste out of the moving carriage. Such a sight is common all across the country. All the train tracks are littered with solid waste.

Indian Railways has the technology and equipment needed to dispose of sewage through biodigestive systems, but it has not yet found way to clear solid waste that is continuously generated by passengers. In fact, there are many videos on social media that show how the staff throws rubbish from moving trains, in a mockery of the Union government's Swachh Bharat objectives. But one cannot even blame these workers, as this is a problem that needs to be tackled at the management level.

The real issue lies in the organisation and logistics required for disposal of solid waste on trains. Duronto Express, for instance, has seven stops and the train halts only for a short while each time. In Panvel, Maharashtra, it only halts for two minutes—how can one empty all the bins from 20 compartments in such a short time? Even if the waste is packed, there are neither enough cleaning staff to clear the bags nor any wastepickers at the stations to collect them. Apart from this, the cleaning staff must jostle with desperate passengers trying to board or leave the train.

It is also worth noting that waste disposal bins are only placed in the compartments on trains like Duronto and the Rajdhani Express. In other express and passenger trains, people directly throw the waste out of the compartment windows or doors. The perishable food leftovers are consumed by animals, birds and worms. Plastic items, especially water bottles, are collected by ragpickers. These are small consolations. But what is needed is a comprehensive strategy to tackle this national problem.

Indian Railways has issued many circulars and letters to address this matter. But any measures introduced or proposed are rarely put into practice. Some experts are of the opinion that the Research Design Standards Organization under the Union Ministry of Railways should take up this matter and develop technologies and machines that will crush the solid waste and pack it in bags that can be deposited on stations. These can then be picked up by wastepickers for final disposal.

BIJU CHERIAN
DIWANMAN, VASAI ROAD, MAHARASHTRA

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Schools as well as NGOs and Individuals concerned about climate action and Nature education for children are welcome to join this nationwide alliance of schools.

This alliance is being supported by Bhoomi Network which is also launching the **Teach for Nature Fellowship** for those interested in helping children in schools learn about climate action and Nature.

Contact: connect@allschoolscan.org

Education in Tune with Nature

On Schooling and the Future of Our Children

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Digest

WHAT'S INSIDE

A couple in Karnataka works to conserve paddy varieties **P10**

First tropical cyclone of 2024 hits Madagascar **P11**

New antibiotic shows promise against drug-resistant bacteria **P12**

1,000 WORDS VIKAS CHOUDHARY



Wood being burned for fuel in earthen kilns set up near Abohar town of Punjab. The production of wood charcoal, an important source of domestic energy in low- and middle-income countries, is on the rise, says a 2022 report by the UN Environment Programme. However, this method can have disastrous environmental effects such as excessive deforestation and loss of biodiversity. The agency urges that to reduce further degradation and forest loss, there should be more research on making charcoal from organic waste materials.

FOR MORE PHOTOS, SCAN



Paddy warriors

"CONSERVATION OF indigenous crop varieties does not mean just collecting and storing seeds in a container. We need to cultivate and harvest the crop every year to ensure its conservation," says Asma Aboobakar, a teacher from Murathangadi town in Karnataka.

For the past 13 years, Asma and her husband Aboobakar, a hotelier, have been working to conserve indigenous paddy varieties. The couple has so far documented 840 native varieties, including *nagasampige*, *karingajavili*, *raktasali*, *jugul* and *rajamudi*. Of these, almost 85 per cent have been successfully germinated. "We aim to collect 1,000 varieties or more in the coming years, with 100 per cent germination," says Aboobakar. One variety, *nagasampige*, has also been revived for commercial use.

The couple's mission began with a desire to have their own paddy field. In 2010, they attempted to cultivate the crop on their 0.4-hectare (ha) land in Murathangadi, located on the border of Dakshina Kannada and Udupi districts. However, they found that several farmers were, in fact, turning away from the crop due to its labour and resource requirements. Moreover, traditional paddy varieties had nearly disappeared with the focus on high-yielding crops. "I believe there will be a time when we will realise the importance of indigenous crop varieties. We want to save as many of these crops as we can for future use," says Aboobakar. The couple began finding indigenous paddy varieties by visiting places with a history of the crop's cultivation in Karnataka and some parts of Kerala. They cultivate the collected seeds on

A couple in Karnataka is preserving rare native paddy varieties through cultivation

M RAGHURAM

their land as well as on three other plots taken on lease from acquaintances. "We first sun-dry the seeds and plant them on natural soil, without spraying pesticides or fertilisers. After harvest, we mulch the fields to preserve the soil nutrition levels," Aboobakar says. While the seeds are collected and stored, the paddy is sold to farmers as livestock fodder. As both Asma and Aboobakar have their own careers, they use the earnings from selling the paddy to fund their preservation efforts.

Over the years, they have obtained seeds from, and exchanged them with, various collectors. "Along with seeds, we share 'advisories' with the collectors and cultivators on how to get a potent seed that can be cultivated for conservation," says Aboobakar. They are now attempting to initiate a regular exchange programme with paddy conservationists and cultivators in Chhattisgarh, Andhra Pradesh, Telangana, Maharashtra, Tamil Nadu, Punjab, Madhya Pradesh and Uttar Pradesh.

The couple's efforts are now being appreciated by scientists and experts, who travel to Murathangadi to see their paddy seed collection. "Conservation is a highly intensive and micro-level activity which only a few visionaries can take up, and Aboobakar and Asma are on the top rung of this group. Their collection is of a national scale, and has inspired many of our scientists and students," says Dhananjaya B, head and senior scientist, Krishi Vigyan Kendra, Zonal Agricultural and Horticultural Research Station in Brahmavar, Udupi district.



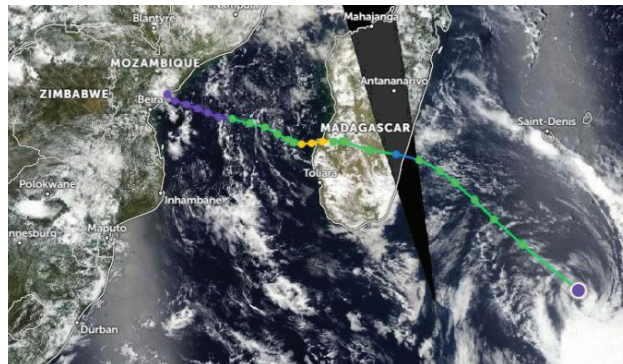
Asma and Aboobakar of Murathangadi, Karnataka

EXTREME WEATHER

Madagascar faces year's first cyclone

THE FIRST cyclone of 2024 made landfall near Morombe in Madagascar on January 1, affecting around 16,100 people. At least five people have been killed and 8,400 people displaced by the disaster, as on January 5. This means Alvaro has affected close to half of the total number of people affected by cyclone Freddy in February 2023.

Alvaro formed in the Mozambique Channel on December 30-31, 2023, and moved east. The Channel sees formation



of three to 12 tropical cyclones in a year, but their intensification to severe storms is rare. The cyclone intensified from a depression to a moderate storm and then a severe

cyclone (with windspeeds up to 110 km per hour) right before making landfall. It then crossed over Madagascar to the western Indian Ocean.

In the aftermath of

the disaster, experts highlighted the need for early warning systems for Madagascar, which would have improved disaster response. The existing early warning systems in the Southern Africa region, including Madagascar, are inadequate to prevent loss of life and economic hardship. This underlines the growing importance of early warning for all, the World Meteorological Organization said in a post on X (formerly Twitter) on January 3.

DISEASE

First polar bear death from avian influenza

THE FIRST death of a polar bear due to the Highly Pathogenic Avian Influenza (HPAI) has been reported from the Arctic region, Alaskan officials announced in December. The bear was found in Utqiagvik, an area that has been hit hard by the current global outbreak. While the virus was first detected in the Arctic region in the second week of April 2023 among birds and a fox, the bear was found dead in October, according to the Alaska Department of Environmental Conservation. It is suspected to have contracted the disease after feeding on the carcass of an infected bird. Viruses tend to live longer on dead animals due to cold conditions, scientists said. Polar bears are listed as “vulnerable” in the International Union for Conservation of Nature (IUCN) Red List of Endangered Species due to the increasing loss of habitat (sea ice). The news of this death also came weeks after scientists confirmed the presence of HPAI or bird flu in the Antarctic region for the first time. Currently, several countries are seeing the spread of HPAI clade 2.3.4.4b, killing millions of birds and mammals.

AGRICULTURE

Field experiment finds problems with nano urea

A TWO-YEAR field experiment on the efficacy of nano urea by scientists from Punjab Agricultural University has found a substantial decrease in rice and wheat yields when compared to conventional nitrogen fertiliser application. The experiment also found a decline in grain nitrogen content, which is essential for protein production. Nano liquid urea was launched as a foliar spray (to spray on plants once leaves are formed) in June 2021 by the Indian Farmers and Fertiliser Cooperative (IFFCO). The body claimed a 500 ml spray bottle of nano urea can substitute a 45 kg bag of conventional fertiliser. However, the 2020-22 experiment found that there was a 21.6 per cent decrease in wheat yield and a 13 per cent decrease in rice yields with the use of nano urea. The decrease in grain nitrogen is also worrisome, as this would deplete the nutrition uptake from the consumption of wheat and rice, which are staple crops in India. Earlier, farmers had said that nano urea increases input costs due to high prices but does not lead to any noticeable results (see ‘Small wonder?’, *Down To Earth* 1-15 June, 2023)

QUERY

Zosurabalpin offers hope

1 What is zosurabalpin?

This is a new antibiotic that can kill bacteria which are resistant to most drugs. Researchers at Swiss pharmaceutical group Roche have found that Zosurabalpin is highly effective against carbapenem-resistant *Acinetobacter baumannii* (CRAB), classified as a “priority 1” pathogen by the World Health Organization.

2 What is CRAB and how does zosurabalpin fight it?

CRAB is a gram-negative bacterium associated with healthcare-related infections. It causes

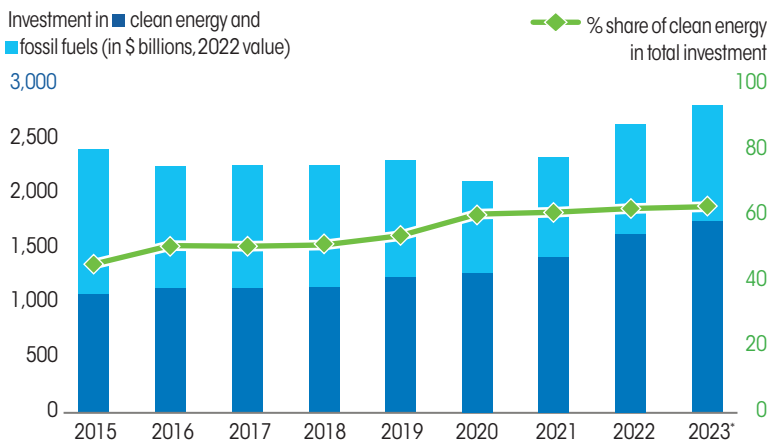
infections of the urinary tract, respiratory tract and blood stream in hospitalised patients, potentially leading to sepsis, and can kill up to 60 per cent of people who contract it. The researchers tested zosurabalpin against more than 100 CRAB samples from patients and found that it was able to kill all of these bacterial strains, by blocking a toxin that the bacterium releases. It could also kill the bacteria in the bloodstream of CRAB-infected mice.

3 How will zosurabalpin be further developed?

Roche is conducting phase-1 trials with zosurabalpin for use in patients infected with CRAB. This will help the work out any side effects and check that the drug works well in humans.

TRACKER

In 2023, global energy investment is estimated to have increased by **7% to a record level of US \$2.8 trillion**. Investment in clean energy exceeded **\$1.7 trillion**, but its share in total energy investment rose marginally. Investment in fossil fuels, on the other hand, surpassed pre-pandemic levels in 2022 and 2023.



Note: 2023 figures are estimates; Source: "World Economic Situation and Prospects 2024", UN Department of Economic and Social Affairs (UN DESA)

BITS GLOBAL

Japan on January 1 was hit by a massive earthquake of 7.6 magnitude in its western region. As of January 6, the death toll due to the quake was 110, with 22,000 homes in the Hokuriku region left without electricity. According to some estimates, more than 30,000 people who evacuated their homes awaited aid, but were left stranded due to rainfall. Some 5,000 officials were deployed to manage rescue efforts.



At least three new cases challenging inaction on climate change were filed every week in 2023, according to a year-end assessment by the Sabin Center for Climate Change Law, a US-based research centre. As of December 15, 2023, the Center's Climate Litigation database had recorded 2,540 cases. Since 2017, the US has consistently maintained the highest share of cases filed in courts, accounting for 114 of the 183 cases filed in 2023.

On January 1, the Saskatchewan province in Canada stopped collecting federal carbon tax applied to homes heated by natural gas and electricity, weeks after Prime Minister Justin Trudeau announced exemptions for home heating oil. The tax has faced criticism from politicians due to its potential impact on inflation, and opposition parties in Canada's Parliament have been calling for a complete rollback since December.

Temperatures in Sweden fell below -40°C on January 3-4, breaking a 25-year-old record for the coldest January night. A cold snap gripped the Nordic countries of Sweden, Finland, Norway and Denmark since the last week of December, resulting in widespread power outages. In countries like France, Germany and the Netherlands, cold weather was accompanied by persistent flooding.

BITS INDIA

Acreage under rabi crops this season is around 1.6 million hectares (ha) less than usual as on January 4, according to data from the Union Ministry of Agriculture and Farmers' Welfare. Until the last week of December 2023, rabi crops were sown on a total of 62.96 million ha, as against 64.61 million ha until the last week of December 2022. Pulses have seen the most reduction in acreage (1.07 million ha), while wheat and paddy sowing has also dropped, says the data.

A cholera outbreak in Rourkela, Odisha has infected some 1,400 people and led to 15 deaths by the beginning of January. The outbreak reportedly began in early December and in January, a team of public health officials from the Union government visited Rourkela to assess the situation. Cholera outbreaks in Odisha are largely restricted to the southern and western districts, but the latest spread in the northwestern city of Rourkela suggests lapses in the water distribution and sanitation systems.



Namibian cheetah Aasha has given birth to three cubs at Kuno National Park in Madhya Pradesh, Union Minister of Forest, Environment and Climate Change Bhupender Yadav announced on January 3. This is the second litter born in India, after the birth of four cubs in March 2023 (of which only one remains). The current count of cheetahs at Kuno is 18—with seven adult males and females each, and four cubs.

A pond in Darbhanga, Bihar was reportedly "stolen" on December 29. The public pond was reportedly filled with sand, and a hut, with boundary walls, was erected over it. The pond was previously used by local fishers for fishing and growing water chestnuts and fox nuts, but it was unused for a few years and no tender was issued by the government for its commercial use, claimed residents. Authorities said they have registered a case.

POLICY FRAMEWORKS

- The Union Ministry of Mines has proposed changes to the **Mineral (Auction) Rules, 2015**, to cap the performance security and upfront payments payable after winning rights to extract minerals. The move addresses concerns on financial barriers that might impede bidder participation in auctions of critical minerals.
- The Union Ministry of Environment, Forest and Climate Change has introduced the **Environment (Protection) Sixth Amendment Rules, 2023**, to bring forth key amendments to the regulation of brick kilns. The amendments include mandating the conversion of existing brick kilns to zig-zag technology, vertical shaft or the use of piped natural gas as fuel in brick-making.
- The Centre and the Bureau of Energy Efficiency have introduced amendments to the **Carbon Credit Trading Scheme, 2023**. The key changes focus on an offset mechanism to allow non-obligated entities to register projects for tracking and certifying reductions or avoidance of greenhouse gas emissions.

IN COURT

NATIONAL GREEN TRIBUNAL

■ The National Green Tribunal (NGT) has sought a detailed report from the Tamil Nadu Pollution Control Board on an ammonia gas leak from fertiliser manufacturing firm Coromandel International Limited in Ennore. The leak occurred on December 26, from pipelines used to transfer ammonia from ships to the storage tanks of the company's unit. NGT also inquired about fish mortality in the sea near the unit due to the leak.

■ In a case regarding dumping of hazardous waste and polluting of groundwater in Aloarakh village of Punjab, NGT has ordered the state pollution control board to file a fresh report on remedial action by the end of February. Earlier, the board filed two reports saying a layer of soil from the contaminated site was being removed, but it could not provide the reasoning behind this move.

■ NGT directed the Chief Secretary, Himachal Pradesh to file an affidavit by February indicating the timeline for implementation of an action plan to clean the nine rivers of Himachal Pradesh. The tribunal had taken up the matter *suo motu* after a newspaper article highlighted the high levels of pollution in Ashwani Khand and other rivers in the state.

SUPREME COURT

■ The Supreme Court stayed two Union government orders of 2021-22 for ex-post facto clearance for mining projects without prior environmental clearance mandated under the Environment Impact Assessment (EIA) notification of 2006. The case was based on a petition by a non-profit which said that the EIA notification mandates prior environmental clearance without exception. The matter will be taken up again in February.

So far...

Number of cases on environment and development tracked from January 1 to January 4, 2024

NATIONAL
GREEN
TRIBUNAL

5

SUPREME
COURT

1

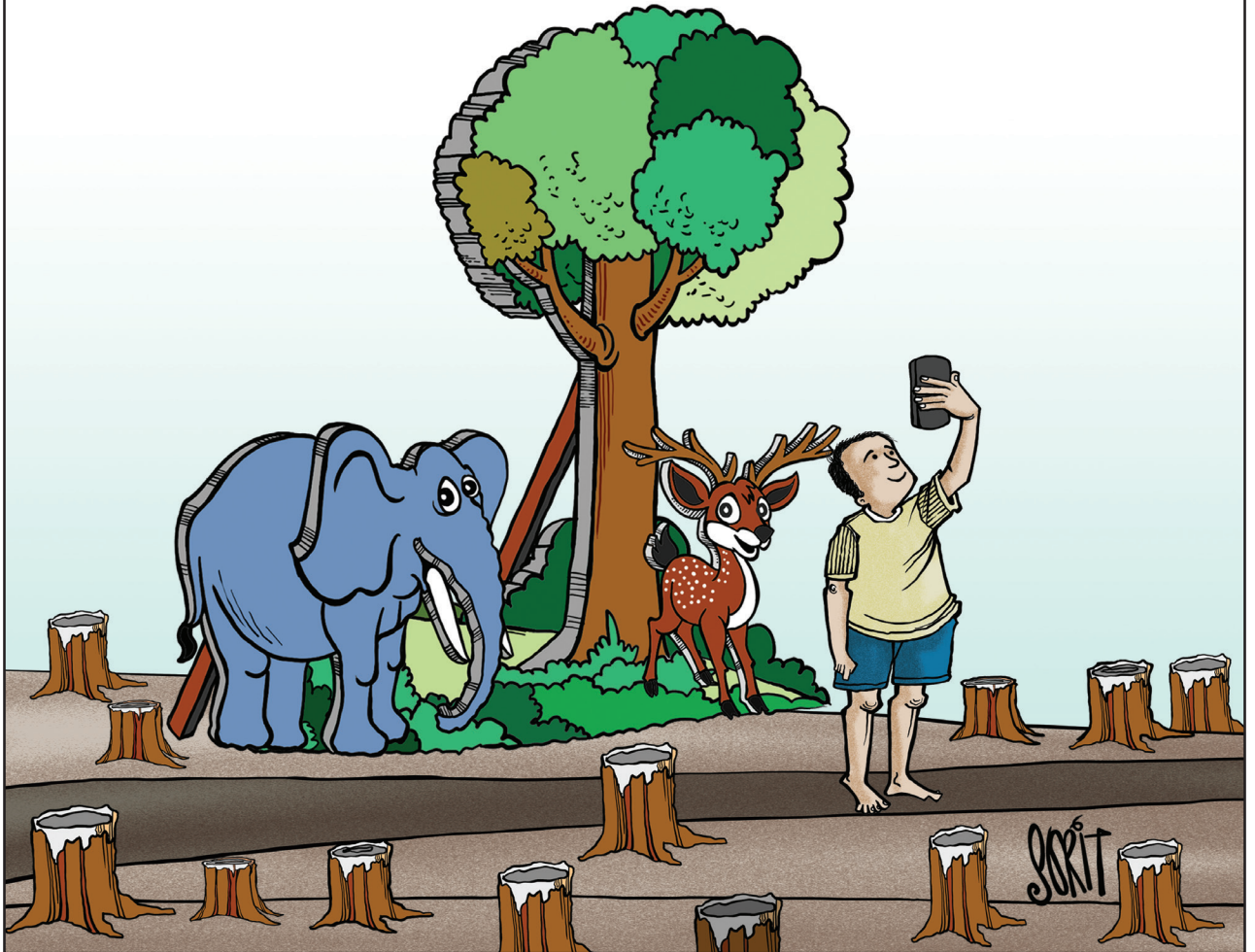
HIGH
COURTS

2

FOR DETAILED VERDICTS, SCAN



Hasdeo forest selfie point



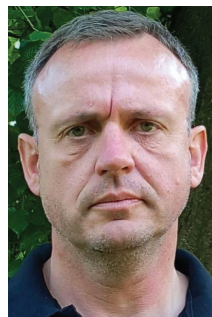
BIG NUMBER

1.2 million

new cases and **929,600** deaths due to cancer were reported in India in 2019, the second highest in Asia. India also accounted for **32.9%** of global deaths and **28.1%** of new lip and oral cavity cancer cases in 2019.

Source: "Temporal patterns of cancer burden in Asia, 1990–2019: a systematic examination for the Global Burden of Disease 2019 study", *The Lancet Regional Health Southeast Asia*

VERBATIM



"WHEN IT COMES TO THE CLIMATE CRISIS, THERE IS A GLOBAL POSTCODE LOTTERY THAT IS STACKED AGAINST THE POOR"

PATRICK WATT

Chief executive officer of Christian Aid, a UK-based non-profit. In 2023, floods and storms accounted for 85 per cent of the top 20 most expensive disasters linked to climate change, says a new report by the non-profit. The time taken and costs incurred to recover from such disasters is highly unequal, flags the report, with people in richer countries able to recover much faster.

By Snigdha Das, Shagun, Kiran Pandey, Himanshu N, Seema Prasad, KM Sheeja, Susan Chacko and Dakshiani Palicha

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THAT LONELY FEELING

WHO has recognised loneliness as a public health crisis and is trying to devise a way to measure the condition that affects a quarter of the world population

ROHINI KRISHNAMURTHY

ARIJEET MANDAL'S struggle with loneliness began at the age of 10. He would often wonder why he felt sad when everyone around him was happy. "Back then, I did not know how to describe how I was feeling," he says. Mandal lost his sibling at age 13 and his mother the following year. "I did not see efforts from my family to process the grief. Three months after my mother's death, people were too busy trying to get my father remarried. My faith in the institution of family and marriage collapsed," he says. Though Mandal moved to Kolkata in 2007 and has since become an assistant professor of film studies at the Jadavpur University, he continues to feel lonely. "I am a Dalit man. Most of my friends and colleagues are from upper caste and upper-middle-class. I feel that I am all alone," he says.

Though seldom talked about in the society, the feeling of loneliness that Mandal has lived with most of his life is experienced by almost a quarter of the world's population, suggests "The Global State of Social Connections", the largest worldwide study on loneliness conducted in 2023 by US-based technology firm Meta, and analytics and advisory company Gallup. In India,



the study found that as high as 30 per cent of the respondents reported to feeling lonely.

In psychology, loneliness is defined as a subjective feeling of lacking social connections. It is, however, not the same as being alone. “Loneliness is subjective because the experience can vary from one person to another,” says Aparna Shankar, professor of psychology at FLAME University, Pune. This feeling can be triggered by social isolation, which is defined as a lack of social contact. But it can also occur when people are surrounded by friends. For instance, Sheela (*name changed*) felt the sting of loneliness in her early 20s after she had just moved to Delhi to work at a publishing house. This was in 2013. Hailing from a small town, she describes moving to a big city as a huge cultural shift. “I tried to fit in. I attended parties. But I was feeling empty because there was no emotional connection. In retrospect, it was a very long period of feeling lonely,” she says. Shankar explains that this is because loneliness can occur when one is dissatisfied with the quality of a relationship. Sheela is currently in therapy for depression and anxiety.

The prevalence of loneliness is so high that the World Health Organization (WHO) last November described it as a priority public health problem and announced a new Commission on Social Connection to address it. The commission, comprising 11 psychologists and mental health experts, is tasked with defining a global agenda on social connection, raising awareness and building collaborations for evidence-based solutions.



Loneliness is subjective because this experience can vary from one person to another. It cannot be quantified

Aparna Shankar,
professor of psychology,
FLAME University, Pune



The reason WHO has recognised loneliness as a public health concern is that it has several important medical and psychological implications

Debanjan Banerjee, consultant
neuropsychiatrist, Apollo
Multispecialty Hospital, Kolkata

While a welcome step, experts that *Down To Earth* (DTE) spoke to warn that the commission will need to address several key knowledge gaps to be able to prescribe effective solutions. For starters, there are inconsistencies in how loneliness is measured. “Given that loneliness is based on a subjective emotional experience, self-reported measures (such as questionnaires) are the most suitable to evaluate it and, given its significance for health, it is pivotal to have validated tools to measure it,” says a July 2021 research paper published in *Current Psychology*.

DTE analysed two surveys in India—by WHO in 2007-08 and by the Union Ministry of Health and Family Welfare in 2017-18—and found that the participants were asked: “Did you feel lonely for much of the day yesterday?” and “How often did you feel alone in the past week?” Such questions do not help in adequately measuring loneliness. “An individual living in a society that stigmatises loneliness is less likely to be forthcoming,” says Melody Ding, associate professor at the University of Sydney in Australia. But if people are asked if they are happy with their social connections, they are more likely to open up.

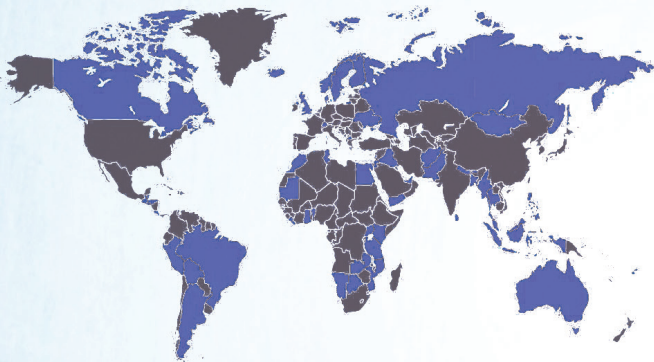
Ding also calls for more research to calibrate how loneliness is perceived in different cultures and languages. For example, there is no translation for loneliness in many languages in India, says a 2022 report, “Loneliness in India” by Delhi-based non-profit Ananta Centre, information-focused agency Aspen Digital and Meta. “It could prevent an accurate articulation of the emotion, thus limiting the development of appropriate interventions,” says the report.

Elderly focused

India currently possesses national-level loneliness prevalence data exclusively for older adults, leaving a significant gap in understanding the extent of loneliness among adolescents, adults

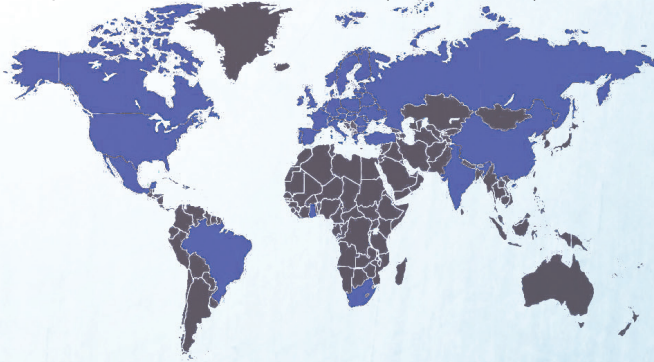
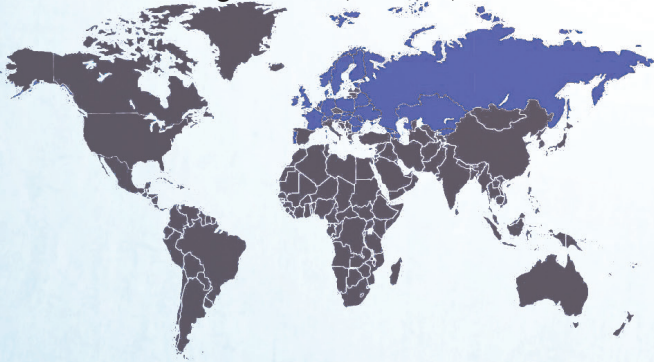
77 countries or territories have national loneliness prevalence data for **adolescents** (12-17 years)

30 countries or territories have national loneliness prevalence data for **young adults** (18-29 years)



32 countries or territories have national loneliness prevalence data for **middle-age adults** (30-59 years)

40 countries or territories have national loneliness prevalence data for **older adults** (60 years or more)



Countries or territories where
■ National loneliness prevalence data is available
■ National loneliness prevalence data is not available

Source: "The prevalence of loneliness across 13 countries: systematic review and meta-analysis", published in the *British Medical Journal* on February 9, 2022

Without factoring in language and culture, people might respond differently to the same set of questions. "This is something that still needs a lot of work from the scientific community in terms of the best way of measuring it," says Ding. In a 2023 paper published in *Public Health Research and Practice*, Ding and her colleagues urged WHO to develop population-level surveys that use comparable measures of loneliness and social

isolation across the globe to understand the prevalence of loneliness.

The UCLA Loneliness Scale, one of the most widely used tools to measure loneliness in the world, also suffers from many limitations. It cannot, for instance, distinguish between short-term and long-term loneliness. It also does not factor in the cultural realities of the respondents, making it unsuitable for most countries.

Loneliness often pushes people

towards several ailments. It increases the risk of cardiovascular diseases by up to 30 per cent and of type-2 diabetes by 98 per cent. A person facing loneliness is also 14 times more likely to be depressed and is highly prone to suicidal thoughts. Loneliness also triggers behavioural changes such as smoking and alcohol abuse (see "Behavioural change" on p20).

Shankar says the general perception is that loneliness

affects only the old population, but people from all age groups and backgrounds suffer from it. There is also a lot of societal stigma associated with loneliness, and, as a result, people suffering from it often experience extreme shame or fear that they will be further alienated if they talk to others.

DATA DISPARITY

A 2022 study published in the *British Medical Journal* looked at 113 countries or territories and found that most low- and middle-income countries do not report any nationally representative information on loneliness. Most data, the paper finds, are from Europe. “The substantial difference in data coverage between high-income countries (particularly Europe) and low- and middle-income countries raised an important equity issue,” the study highlights (see “Elderly focused”).

Low- and middle-income countries like India face different socio-economic challenges that can trigger loneliness compared to the wealthy world, notes a 2022 paper published in the *International Journal of Food and Nutritional Sciences*. These include high poverty, income inequality, low education, high dependency ratio, lack of transportation, unplanned urbanisation, rapid industrialisation and a deterioration in social capital.

The paucity of research and data can be seen even in India. The 2022 *British Medical Journal* paper shows that national prevalence data in the country is only available for older adults, who make up around 10 per cent of the population. There is little information on how widespread it is among adolescents, young and middle-aged adults.

One of the India-specific studies, published in 2020 in *Ageing*



An individual living in a society that stigmatises loneliness is less likely to admit that they are lonely. But if people are asked if they are happy with social connections, they might be more likely to open up

Melody Ding,
associate professor,
University of Sydney, Australia



Increased urbanisation means there is more privacy and seclusion. This has led to many physical and psychological problems

Vidya Yadav, assistant professor,
Patliputra University, Patna

International, shows that nearly 18 per cent of old adults reported feeling lonely. The study by researchers from the International Institute for Population Sciences and Sree Chitra Tirunal Institute for Medical Sciences and Technology interviewed 6,532 adults aged 50 in six states: Assam, Uttar Pradesh, West Bengal, Karnataka, Maharashtra and Rajasthan. The participants were asked if they felt lonely for much of the previous day.

Another study, published in *The International Journal of Geriatric Psychiatry* in 2021, included a much larger sample size of 72,262 middle-aged and older adults. The paper looked at data from a national community-dwelling survey in India conducted in 2017-18. The participants were asked how often they felt alone in the previous week. Their analysis revealed that the prevalence of moderate loneliness (1-2 days a week) was 20.5 per cent and severe loneliness (3-7 days a week) was 13.3 per cent.

Some studies have examined factors driving loneliness. Shankar and her colleagues assessed the role of work-related factors and food security on older adults' levels of loneliness by combing the 2017-18 national community-dwelling survey data and filtering out participants below the age of 60 years. She found 31,477 old respondents and of them, 9,309 were employed.

Her theory was that adverse working conditions such as exposure to noxious substances or odours were associated with higher levels of loneliness. A lack of food choice and availability are associated with greater feelings of loneliness among those who work. Her report showed that over 11 per cent

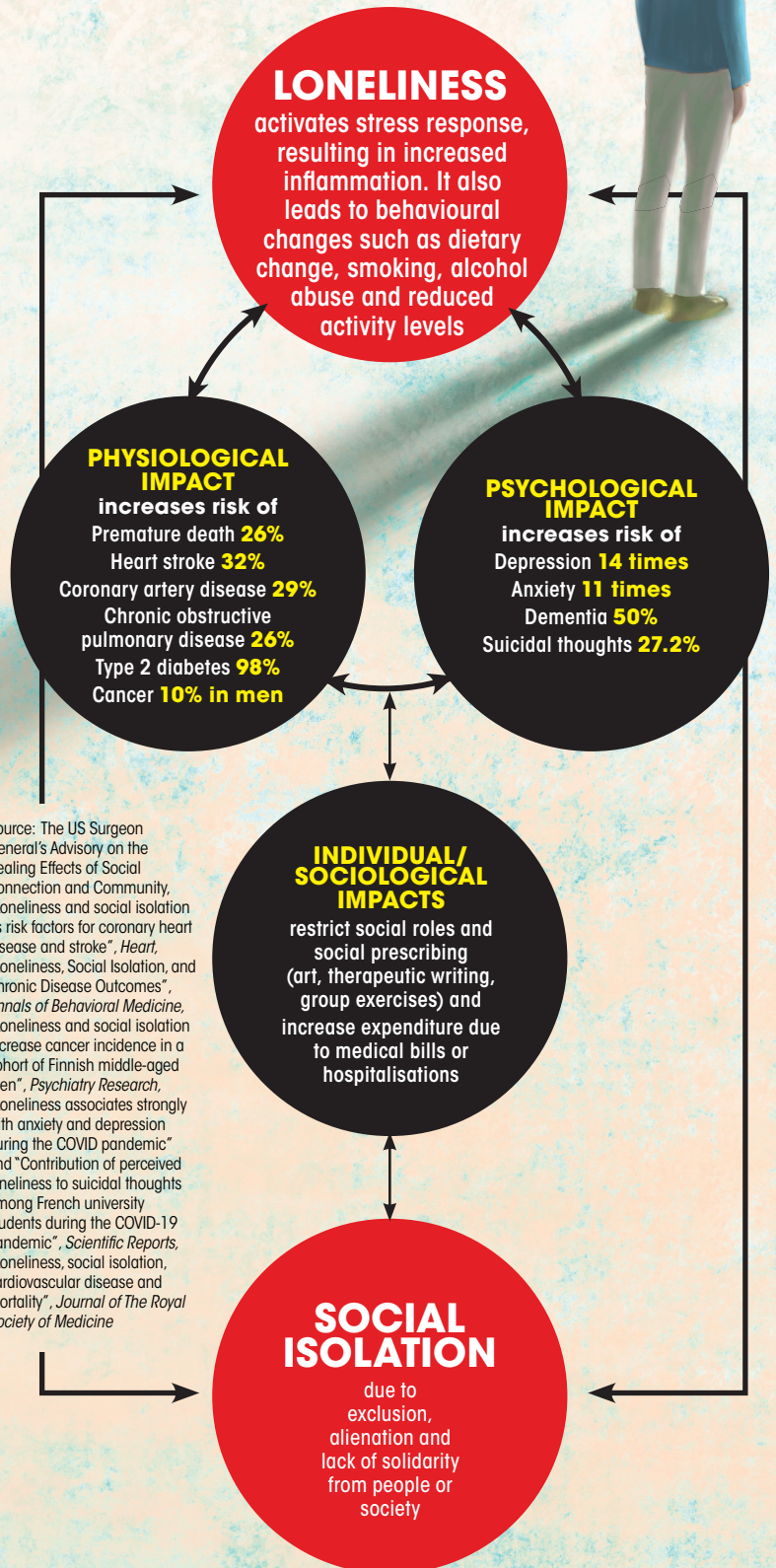
of participants reported being lonely most or all of the time and over 20 per cent experienced this feeling some of the time. The study also found that people in unpleasant working conditions had higher odds of loneliness compared to those in jobs requiring more mental effort. Participants facing higher levels of food insecurity had over twofold higher odds of reporting loneliness. The findings were published in a 2023 paper in the *Society of Gynecologic Surgeons*.

Research has also pointed to links between a rise in loneliness and urbanisation. “Increased urbanisation means there is more privacy and seclusion. And this has led to many physical and psychological problems,” says Vidya Yadav, assistant professor at Patliputra University, Patna. As a research scholar with the International Institute for Population Sciences in Mumbai in 2016, Yadav had surveyed 450 households in three suburbs of Mumbai: Dadar, Bandra and Chembur, between January and June 2016 and found that around 7 per cent of respondents often felt lonely, and 21 per cent sometimes felt lonely.

Yadav’s paper also found some issues with a government housing scheme. In 1995, the Maharashtra government launched a rehabilitation scheme to provide free housing for slum dwellers. “I found high levels of loneliness among those residing in slum rehabilitation buildings. They have shifted from that horizontal slum area to the vertical apartments. This shift may have affected sensory connectedness and the traditional flows as the buildings and the flats were allocated randomly to the households, which may have hampered their collective identity

BEHAVIOURAL CHANGE

Loneliness increases the risk of physiological and psychological ailments and can also lead to social isolation



and their social support network,” she says.

Evidence is also emerging that the current cost-of-living pressure is likely to exacerbate loneliness, suggests a policy paper, “Tackling Loneliness”, published in March 2023 by the UK government.

The COVID-19 pandemic has worsened the problem because it has altered the typical patterns of social connection for many people, says “The Global State of Social Connections” report. This is consistent with several studies that have shown social distancing and lockdowns during the pandemic have led to increased rates of loneliness.

COUNTRIES WITH A PLAN

The fallout of the world’s limited understanding about loneliness is that there are limited policy mechanisms or long-term interventions to fight loneliness, says Debanjan Banerjee, consultant neuropsychiatrist at Apollo Multi-specialty Hospitals, Kolkata. Identifying lasting interventions for loneliness is one of the intended outcomes of the WHO commission. Ding’s 2023 research paper notes that there has been an uptick in intervention studies addressing loneliness in the last five years. “We now need an overall synthesis of the findings from intervention studies to be undertaken with an implementation lens to derive clear recommendations of which interventions work, for whom, and pin what contexts,” states the paper.

Currently, only two countries—the UK and Japan—have a dedicated ministry to fight loneliness. The UK in 2018 became the first country to set up a Union Ministry of Loneliness. In 2021, after the

pandemic, Japan followed suit.

The UK ministry has three guiding objectives: reduce stigma around loneliness, introduce initiatives that bring about a lasting change and improve the evidence base on loneliness.

The country, in the past five years, has innovated several schemes such as conducting loneliness training for receptionists at government hospitals to identify and interact with patients who are lonely to running a “Happy Cab” service in Leeds county. The Happy Cab offers a door-to-door service to get people where they need to go and have a conversation on the way. All drivers have received happiness training to help them create a positive and welcoming environment. Journey-sharing is encouraged, so that passengers can meet new people from their area and socialise. According to the Royal College of General Practitioners, “Three out of four general physicians (in the UK) say they see between 1 and 5 people a day who have come in mainly because they are lonely.”

Japan, in May 2023, enacted a legislation to arrest loneliness among its people. A 2022 study published in *Psychiatry Research* suggests that 41.1 per cent of Japanese are lonely. The legislation calls for the creation of a Headquarters for Promotion of Measures for Loneliness and Isolation to formulate a priority policy that will serve as guidelines for measures to curb loneliness. The country has also mandated local governments to set up councils made up of groups that offer help to people suffering from social isolation.

The governments of Denmark and the US have also established

national programmes of work to address loneliness, social isolation and social connection. A May 2023 report released by the US government says that even before the pandemic, about half of the country’s adults were experiencing measurable levels of loneliness.

In India, like in most countries across the world, there are no policies targeting loneliness. The issue does not find mention in the “National Mental Health Survey of India, 2015-16” released by the Union Ministry of Health and Family Welfare. The country has two existing national policies dealing with older adults. The National Policy on Older Persons, 1999, talks about loneliness once in the entire policy document. But that is in context of volunteers being encouraged to assist older adults who are confined to their homes, explains Shankar in her 2023 paper. Similarly, the National Policy for Senior Citizens, 2011, mentions loneliness just once, noting that it is higher among older women than men.

The 2022 *International Journal of Food and Nutritional Sciences* paper notes that India needs to conduct longitudinal studies, where participants are tracked for risk factors or health outcomes over time, which can also last decades. Such research can then be used to develop or implement effective interventions.

It remains to be seen if WHO’s Commission on Social Connection, which is expected to release its first report by mid-2025, will highlight these issues. “The report will form a common reference guide for every stakeholder, including physicians, organisations, social workers and policymakers,” says Banerjee. **DE**

📧@down2earthindia

Fight for land

From stricter land laws to revising domicile rules, Uttarakhand residents demand government action to stop the sale of agricultural land to outsiders

VARSHA SINGH
DEHRADUN

ON DECEMBER 24, 2023, thousands of people gathered in Uttarakhand's winter capital, Dehradun, to pressurise the government to enact strict land laws, aiming to halt the large-scale sale of agricultural land to individuals from other states. The protestors, organised under the banner Mool Niwas Bhu Kanon Samanway Sangharsh Committee, assert that since the state's formation in 2000, governments have relaxed rules to attract outside investment. According to them, this approach has deprived Uttarakhand residents of their land, culture and identity.

In the days following the pro-

tests, Uttarakhand chief minister Pushkar Singh Dhama imposed an interim ban on the purchase of new agricultural land by outsiders and is now awaiting the report of an ongoing Law Land Committee to determine further steps.

Chandrashekhar Kargeti, a lawyer with the Uttarakhand High Court in Nainital, points out that Uttarakhand is the only Himalayan state that allows the sale of agricultural land to outsiders. This poses a significant problem, given that only 14 per cent of the state's geographical area is designated as agricultural land, Kargeti says. "The land records for the region were last updated in the 1960s.

PHOTOGRAPH: RAJESH DOBRIVAL



Since then, extensive agricultural land has been repurposed for non-agricultural activities such as road construction and industries. The state government does not even have the details on the extent of agricultural land lost over the past 60 years,” says Dehradun-based historian Shekhar Pathak.

In 2003, the state’s first government attempted to address the issue by amending Section 154 of the Uttaranchal (The Uttar Pradesh Zamindari Abolition and Land Reforms Act, 1950) Act. This allowed outsiders to buy agricultural land of up to 500 sq m only for farming purposes. In 2008, the cap was reduced to 250 sq m.

In 2018, the state government lifted the cap entirely, enabling large-scale purchase of agricultural land, along with easing the process

to change land use. “The then chief minister, Trivendra Rawat, justified the move by saying that it will bring about industrial development. While small industrial areas have been created in every district, till date no industries have been established in them. Instead, a large land bank has been created by purchasing agricultural land in Haridwar, Udham Singh Nagar and Yamkeshwar of Pauri. In Garhwal, all the commercially important land beyond Srinagar towards Alaknanda and Mandakini valley, Badrinath, Kedarnath has been sold, mostly for resorts,” says Manoj Rawat, a former Member of Legislative Assembly from Uttarakhand, who had opposed the 2018 relaxations.

Although the 2018 amendment included a provision that the state government could take over land if

benefits in government jobs and land purchases to the original settlers of the region, particularly those settled until 1950, when the country issued a Presidential order that set the basis for the concept of domicile residents in states.

Anoop Nautiyal of Dehradun-based non-profit Social Development for Community Foundation notes that Uttarakhand’s population has increased from around 8.5 million in 2001 to 13 million now. “The state was formed to preserve the rights of the mountain people. Instead, it paved the way for outsiders to settle down here. Almost 4 million people have migrated to the state since 2000 and they are now being given domicile status as the current rules require an Indian national to stay in a state for 15 years to apply for the same,” says Kargeti.

He highlights that when the state was formed, the cut-off date for domicile was revised to 1985, even though other states were still following 1950 as the cut-off year.

In 2012, while hearing a case related to domicile status, the high court ruled that any person who has been living inside the border of Uttarakhand since November 9, 2000, when the state was formed, is a domicile resident of the state. The state government did not challenge the verdict in the Supreme Court even though it was not in the interest of the people. “Our land serves as the foundation of our identity. Our songs, cultural traditions and folk deities are all intricately linked to our land. If we lose it, we risk becoming a displaced person, disconnected from the roots that define us,” says Pathak. **DTE**

⊗@down2earthindia

IN GARHWAL, ALL COMMERCIALLY IMPORTANT LAND BEYOND SRINAGAR TOWARDS ALAKNANDA AND MANDAKINI VALLEY, BADRINATH AND KEDARNATH HAS BEEN SOLD, MOSTLY FOR HOTELS AND RESORTS

it was not used for the prescribed purpose or was sold to someone else, this clause was lifted in 2022, giving a free hand to outsiders to hold on to land or use it for any purposes they deem fit, says Rawat.

He alleges that the state government has also broadened the definition of “industrial purpose” to include educational institutions, hospitals and even gardens.

Apart from the diversion of agricultural land for non-agricultural purposes, the state has experienced a population surge since 2000, exacerbating the problem. Protestors are demanding a revisit of domicile requirements to limit



Uttarakhand residents held a protest in Dehradun on December 24, 2023, urging for stringent laws to regulate the sale of land to non-residents



SILENT FAMINE

For the past 50 years, the country has introduced high-yielding rice and wheat varieties at breakneck speed to achieve food security. A study led by scientists with the Indian Council of Agricultural Research (ICAR) has for the first time looked at the food value of these modern-bred grains, and delivers some dire warnings: the food grains that we eat have lost food value; instead they are accumulating toxins. Worse, by 2040, the grains will become so “impoverished” that they would worsen the country’s growing burden of non-communicable diseases.

A report by **SHAGUN**





YOU ARE what you eat, or, rather, what you grow to eat. Imagine an entire population eating something that has little food value—something that is devoid of nutrients such as a host of vitamins which are essential for growth, disease prevention and maintaining overall health and well-being. “This is the future we are hurtling towards,” says Sovan Debnath, a soil scientist at the Indian Council of Agricultural Research (ICAR) under the Union Ministry of Agriculture and Farmers Welfare.

In November 2023, Debnath and 11 other scientists from ICAR, Bidhan Chandra Krishi Viswavidyalaya—another premier agricultural research institute in West Bengal—and the National Institute of Nutrition in Telangana published a seminal study that says the Green Revolution has helped India achieve food security, but by compromising its nutritional security. In a first, the study reports that breeding programmes focused on developing high-yielding varieties have altered the nutrient profiles of rice and wheat, two major staple food grains of India, to the extent that their dietary significance to the population has diminished. While chasing yield, the plant genetics have been tinkered with so much that they no longer do the fundamental job of delivering nutrition from the soil to the grains.

Between 2018 and 2020, the scientists grew “landmark” high-yielding cultivars of rice and wheat released in succeeding decades since the Green Revolution was introduced in 1967. Cultivars are plants developed to have particular features. As many as 16 cultivars were chosen for rice and 18 for wheat. “Around 1,500 different cultivars of rice and wheat have been released since the 1960s. The landmark ones were selected after discussions with breeders of different institutes in the country. These had been popular and thus

were adopted widely across the country in a particular decade. We stopped at the 2000s for rice and at the 2010s for wheat as after those decades we did not find cultivars that could be called landmark,” says Debnath. Seeds for the cultivars were procured from gene banks.

Evaluation of the nutrient profiles of the harvested grains showed that rice and wheat, which meet over 50 per cent of the



daily energy requirements of people in India, have lost up to 45 per cent of their food value in the past 50 years or so. At this rate, the grains will become impoverished for human consumption by 2040, they estimate.

What's more worrying is that along with diminishing nutrient levels, the concentration of toxic elements have increased in the grains. For instance, in the past 50 years, the concentration of essential nutrients like zinc and iron has decreased by 33 per cent and 27 per cent in rice, and by 30 per cent and 19 per cent in wheat, respectively. In contrast, the concentration of arsenic, a toxic element, in rice has increased by 1,493 per cent. In other words, our staple food grains are not only less nutritious, but also harmful to health.

The scientists have also assessed the health impact of this “historical shift” in the nutrient profiles of rice and wheat, and warn that the impoverished staple grains could worsen the country's growing burden of non-communicable diseases (NCDs).

It is well known that essential and beneficial nutrients such as phosphorus (P), calcium (Ca), silicon (Si) and vanadium (V) play an important role in bone formation; zinc (Zn) is crucial for immunity, reproductive and neurological development; and iron (Fe) is key for haemoglobin formation. The depleted concentration of these essential nutrients in the staple grains could result in

higher prevalence of diseases related to the neurological, reproductive and musculoskeletal systems, the scientists write in *Scientific Reports*, published as part of multi-disciplinary science journal *Nature*. There is also strong evidence that oral ingestion of metal toxicants, such as arsenic, chromium, barium and strontium has toxic effects like lung cancers or chronic respiratory diseases, cardiovascular diseases, hyperkeratosis, renal toxicity and impaired bone calcification. They further note that over the years, the consumption of nutrient-rich cereals (sorghum and other millets) has reduced. Together, these put the Indian population at a higher risk of nutritional insecurity.

The study's findings corroborate a report by the Indian Council of Medical Research (ICMR) that indicates a 25 per cent rise in NCDs among the Indian population from 1990 to 2016. Estimates show that India is home to one-third of the 2 billion global population suffering from micronutrient deficiency. Though the National Family Health Survey reports show a decline in child stunting—an indicator of micronutrient deficiency—between 2015-16 and 2019-21, the rate is still significantly high at 35 per cent among children under five years of age. In 161 districts, more than 40 per cent children under five years of age suffer from stunting. While there could be several reasons for such high prevalence of micronutrient deficiency in India, the scientists assert that the diminishing food value in the staple food grains could be a significant contributor to the problem.

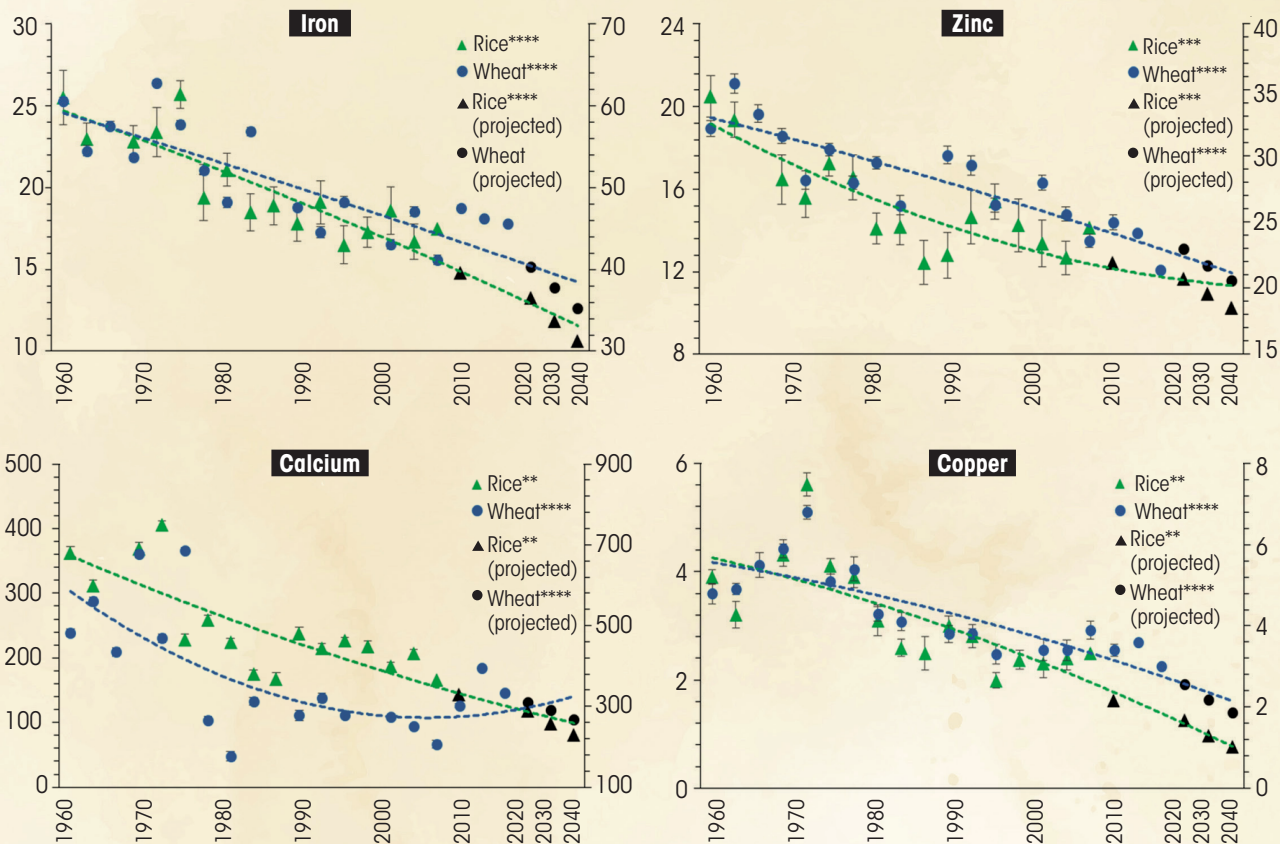
SYSTEMATIC ELIMINATION

Agricultural practices that the Green Revolution shaped have often been criticised for their impact on the environment and food systems. But discussions have rarely moved beyond the impact on soil degradation, surface water pollution, groundwater depletion and monocropping. The *Scientific Reports* study has for the first time put the spotlight on the impact of Green Revolution on the nutritional security of India.

Debnath says the 2023 study is an extension of another study he and a few other scientists from ICAR and Bidhan Chandra Krishi Viswavidyalaya conducted in 2021, to explore the reasons for zinc- and iron deficiency in populations dependent on a cereal diet. They conducted experiments with high-yielding cultivars of rice and wheat released in succeeding decades since the Green Revolution and observed a downward trend in grain density of zinc and iron in those cereals. There can be two reasons for this depletion: poor availability of nutrients in the soil and inefficient cultivars that fail to deliver the nutrients to grains. While enough studies have been reported across the globe to show a

Decline in essential minerals

High-yielding rice and wheat varieties released over last 50 years show drastic decline in concentration of key essential micronutrients in food grains. The decline is more severe in rice than wheat



Note: The left vertical axis represents mineral concentration in wheat and the right vertical axis represents mineral concentration in rice. All units are in mg per kg. Asterisks indicate significant differences between the observed means of the decades for the cultivars of rice and wheat released up to the 2000s and the 2010s, respectively (*P < 0.05; **P < 0.01; ***P < 0.001; ****P < 0.0001)

Source: "Historical shifting in grain mineral density of landmark rice and wheat cultivars released over the past 50 years in India", *Scientific Reports*, November 2023

significant depletion in grain densities of zinc and iron in the modern, high-yielding cereal cultivars, not much evidence is available to establish that poor soil mineral availability leads to poor mineral concentration in food grains, they write in the study published in *Environmental and Experimental Botany*. Rather, the experiment showed that the decrease in grain mineral densities coincided with the introduction of semi-dwarf, high-yielding cultivars. "These findings led us to infer that the modern-bred cultivars of rice and wheat are less efficient in sequestering Zn

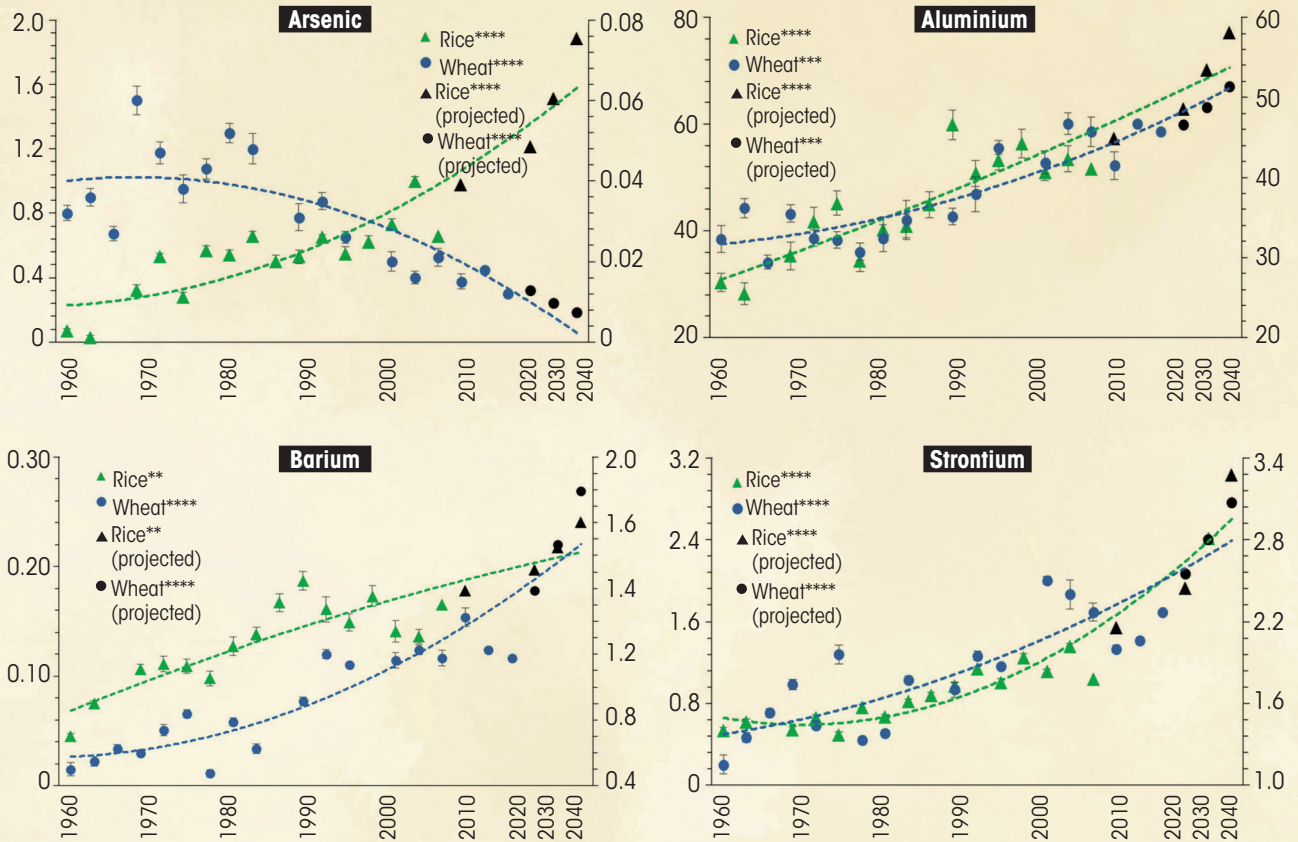
and Fe, despite their abundance in soils," the team states.

The 2021 study hinted at a disruption in the crop plants' inherent intricate regulatory mechanisms for balanced uptake and distribution of mineral nutrients, inadvertently created in the course of the past breeding programmes. The team's latest study was to unearth the existence and extent of the problem.

To rule out any relation between grain mineral density and the deficiency of nutrients in soil, the crops were grown on the experimental soil that contained

Alarming rise in toxic elements

High-yielding rice and wheat varieties released over last 50 years show higher accumulation of toxic elements in food grains. Toxin accumulation is particularly severe in rice



Note: The left vertical axis represents mineral concentration in wheat and the right vertical axis represents mineral concentration in rice. All units are in mg per kg. Asterisks indicate significant differences between the observed means of the decades for the cultivars of rice and wheat released up to 2000s and 2010s, respectively, respectively (* $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$; **** $P < 0.0001$)

Source: "Historical shifting in grain mineral density of landmark rice and wheat cultivars released over the past 50 years in India", *Scientific Reports*, November 2023

adequate amount of nutrients. When the scientists analysed the varieties, they found that as breeding progressed, the newer released cultivars had less concentration of four essential elements—Ca, Zn, Fe, Cu—compared to the traditional ones. For example, Ca, Zn, and Fe concentrations in grains of rice cultivars released in the 1960s were 337 mg per kg, 19.9 mg per kg and 33.6 mg per kg, respectively. It dropped to 186.3 mg per kg (45 per cent drop), 13.4 mg per kg (33 per cent drop), and 23.5 mg per kg (30 per cent drop), respectively, in cultivars of the 2000s and the 2010s. Grains of wheat

cultivars released in the 1960s had 492.3 mg per kg, 24.3 mg per kg and 57.6 mg per kg concentration of Ca, Zn and Fe, respectively. In the cultivars of the 2000s and 2010s, this was reduced to 344.2 mg per kg (30 per cent drop), 17.6 mg per kg (27 per cent drop), and 46.4 mg per kg (19 per cent drop), respectively. With time, barring the lithium (Li) and vanadium (V) concentrations in rice, the concentration of all the other beneficial elements—silicon (Si), nickel (Ni) silver (Ag) and gallium (Ga)—depleted in newer released cultivars over their older counterparts in grains of rice and wheat.



“Our experiments show that the modern-bred cultivars of rice and wheat are less efficient in sequestering nutrients like zinc and iron, despite their availability in soil”

Sovan Debnath, scientist, Central Agroforestry Research Institute, Jhansi



“Rice is an intelligent plant. It can screen out the harmful elements and prevent them from reaching the grains. This inherent mechanism has now deteriorated”

Rubina Khanam, scientist, National Rice Research Institute, Cuttack

This simply means that plants have lost their capacity to take up nutrients from the soil. Biswapati Mandal, soil scientist at the Bidhan Chandra Krishi Viswavidyalay and co-author of the study, explains: “As the country started breeding for high-yield characteristics, it led to genetic exclusion of traits related to enhancing grain mineral loading. The high yields, took away focus from food value, particularly total mineral elements content, known as ionome.”

DILEMMA AMID HUNGER

When the Green Revolution began in India, the aim was to feed the rapidly growing population—which had jumped by 21 per cent in just 10 years to reach 439 million in 1961—and to become self-sufficient in food production. The country by then had suffered frequent famines and food shortages; hunger was widespread. So main motive of agricultural scientists was to improve yield. “We were never in a position to think about

malnutrition,” says Debnath, adding that the country released its first official reports on malnutrition only after the 1980s.

The traditional rice and wheat varieties or landraces grown in the country before the Green Revolution had several crucial traits. Developed over time largely through selection by farmers, these landraces were not only highly suited for the local agroecology, but also had rich nutritional content. During the Green Revolution, these landraces were utilised in breeding programmes and crossed to make the new varieties. Dwarf genes isolated from high-yielding varieties were inserted to ensure a higher distribution of photosynthates (products of photosynthesis that are usually simple sugar) into the grains, thereby increasing the grain size and improving yield. “While photosynthates reached the grain in sufficient quantity, it was not necessary that nutrient and minerals also reached in the same and equal proportion. So slowly, the trait of taking more nutrient by the grain got lost,” says Rubina Khanam, a scientist with National Rice Research Institute (NRI), Cuttack, Odisha, and co-author of the study. With the cross-breeding of landraces picking up pace, the original parent varieties started getting excluded from the breeding process. The native, useful genes also started to slowly decrease as the country focused on more high-yielding varieties.

“After the 1980s, the focus of breeders shifted to developing varieties that are resistant to pests, diseases and tolerant to several stresses like salinity, moisture and drought,” says Mandal. “They did not have the luxury of thinking whether the plants were taking nutrients or not,” he adds.

“We gained quantity but lost quality,” says Khanam, who works with different rice varieties. She highlights another fallout of Green Revolution. Amid continuous genetic tampering under the modern breeding programme, the plants have also lost their natural evolutionary defence mechanisms against toxicants. “In a plant, both the good and bad mineral elements are absorbed

through the same channel. So it is normal for the toxic elements to reach till the stalk. But rice is an intelligent plant. So it uses its genetic potentiality to screen out the elements that are either not good for itself or for humans and does not allow the elements to reach the grain. For example, arsenic is not very harmful to the plant but very harmful to humans. So, whenever high amount of arsenic is present in the soil, the rice plant would automatically switch off the transporter's ability to take up that element. Or it would deploy another mechanism to deposit the toxic metal in some unused part of the plant, like in the vacuole. This inherent mechanism of the plant has now deteriorated," Khanam says.

Now, to increase grain yield, plants are taking particular nutrients in high amounts. Through the same channel, the negative elements also reach the stalk in high amounts. The great quality of screening present in good rice varieties is now lost, she adds.

This is also the reason that the accumulation of toxic elements was higher in rice than in wheat. For instance, concentration significantly decreased from 0.032 mg per kg in wheat cultivars released in the 1960s to 0.015 mg per kg (53 per cent-drop) in cultivars of the 2010s. There was also a downward trend in the concentration of lead and chromium for wheat.

Scientists point towards the difference in the growing conditions of the two crops as one of the possible reasons for more increase of toxins in rice compared to wheat. Rice is grown in submerged conditions. When soil is flooded, an anaerobic condition is developed, which means that air does not reach the soil. Under this condition, heavy metals undergo chemical transformation and take a form which is more soluble, thus coming in more "plant available" form. And the roots cannot be distinguished.

WORLD WIDE DESPERATION

The pattern is not unique to India. Scientists from several other countries have also reported similar depletion in nutrition levels



"As the country started breeding for high-yield characteristics, it led to the genetic exclusion of traits related to enhancing grain mineral loading"

Biswapati Mandal, former professor, Directorate of Research, Bidhan Chandra Krishi Viswavidyalaya, Kalyani



"To improve nutritional content in food grains, we are identifying donors rich in nutrients, such as zinc or iron. We are also creating nutrient profiles of landraces"

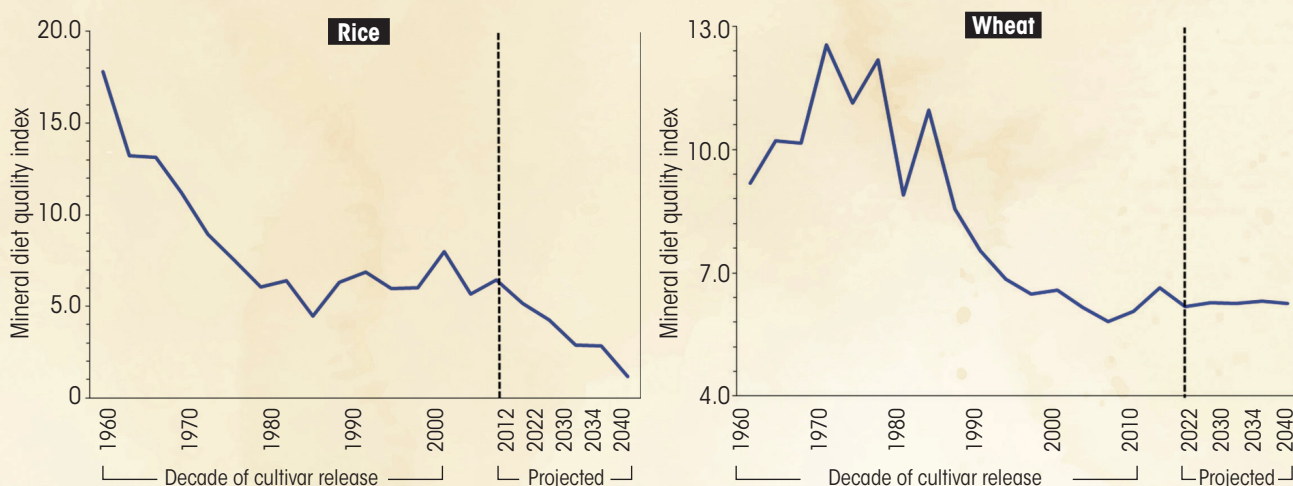
Sanghamitra Samantaray, head of Crop Improvement Division, National Rice Research Institute, Cuttack

in food grains since the introduction of high-yielding varieties.

One such study was led by Ming-Sheng Fan from the Rothamsted Research, UK, which evaluated mineral concentration of archived wheat grain and soil samples from the Broadbalk Wheat Experiment, one of the oldest continuous agronomic experiments in the world that started in 1843. The researchers chose samples from eight plots; and in all them, the study found significant decreasing trends in the concentrations of zinc, copper, iron and magnesium in wheat grain since the 1960s. "The concentrations of zinc, iron, copper and magnesium remained stable between 1845 and the mid 1960s, but since then have decreased significantly—20-30 per cent—which coincided with the introduction of semi-dwarf, high-yielding cultivars. In comparison, the concentrations in soil have either increased or remained stable," the scientists wrote in the *Journal of Trace*

Depletion in mineral diet quality

Nutritional quality of rice and wheat cultivars continue to deteriorate with each passing decade



Note: Mineral diet quality index was computed based on the concentrations of essential beneficial and toxic mineral elements in the grains of rice and wheat cultivars. P < 0.0001

Source: "Historical shifting in grain mineral density of landmark rice and wheat cultivars released over the past 50 years in India", *Scientific Reports*, November 2023

Elements in Medicine and Biology in 2008.

The Green Revolution has unintentionally contributed to decreased mineral density in wheat grain, the study found.

The 2021 study led by Debnath also showed that the large increase in the proportion of the global population suffering from zinc and iron deficiency over the last four decades coincided with the global expansion of high-yielding, input-responsive cereal cultivars released in the post-Green Revolution era.

In 2006, scientists from the US showed that zinc and iron concentrations in food grains decreased significantly with the release of 14 wheat cultivars from production eras spanning more than a century. The study was published in the *Journal of the Science of Food and Agriculture* in 2006.

In 2015, researchers in Iran found that during the 70 years of introduction of high-yielding varieties, yield has shown a small improvement, while the concentrations of protein, iron and zinc have shown a drastic decline. "These showed breeders' attention

was often paid to enhancing grain production and they mostly neglected the quality of wheat production specially protein, iron and zinc," said their study published in *European Journal of Agroecology*. "These relationships might be attributed to a dilution effect of the minerals due to the increased grain yield of most recent genotypes which is impacted by both environmental and genetic factors," it said.

UNDOING BLUNDERS

Irrespective of the reason, a significant effort is being made in India to improve the nutritional profile of food grains. This time, agricultural scientists have turned to landraces and wild species of cultivated varieties for answers. In the past 10 years, scientists at ICAR and agriculture universities have undertaken germplasm exploration across the country to find donor varieties that are high in nutritional content under a special project on biofortification, launched by the Union government.

"We are trying to identify donors that are

rich in at least one nutrient, for instance zinc or iron,” says Sanghamitra Samantaray, who heads the crop improvement division at ICAR’s National Rice Research Institute, Cuttack, Odisha. “Since strong donor varieties are not easy to find, we are also creating nutrient profiles of landraces conserved by farmers and of wild varieties that are not cultivated but are naturally growing,” she says.

G Padmavathi, principal scientist, Indian Institute of Rice Research (IIRR), Hyderabad, explains the institute’s plan of using the donor varieties in biofortification. Most donor varieties are usually poor yielders, photosensitive, suffer from lodging, and have other negative traits. They need to be crossed with either already released high yielding varieties or unreleased promising lines, so that there is no compromise on yield, Padmavathi says.

Since 2016, three national plant breeding institutes under ICAR—the National Rice Research Institute (NRRI), Cuttack; the Indian Institute of Rice Research (IIRR), Hyderabad, and the Indira Gandhi Krishi Vishwavidyalaya, Raipur under the All India Coordinated Research Project on Rice—have released 10 such zinc- and protein-rich rice varieties. Other institutes under ICAR have developed 43 wheat varieties that are rich in protein, iron and zinc. “There are many malnourished children in India who do not get enough protein-rich food. But they are habituated in taking rice and wheat. So, these varieties can provide them that required nutrition,” says Samantaray.

So far, institutes under ICAR have developed 142 biofortified varieties. The list includes 124 field crops (10 rice varieties, 43 wheat, 20 maize, 11 pearl millet, 13 small millets, one linseed, two lentil, two chickpea, one mungbean, one field pea, one *urd* bean, eight mustard, seven soybean, one sesame, three groundnut varieties) and 18 horticultural crops (five sweet potato varieties, three amaranthus, two greater yam, two potato and one each of cauliflower, okra, grapes, banana, guava and pomegranate varieties).



“Under biofortification, donor varieties are crossed with already released high-yielding varieties or unreleased promising lines so that yield is not compromised”

G Padmavathi, principal scientist, Indian Institute of Rice Research, Hyderabad



“There should be an integrated process where breeders can use multiple parents to pool genes and traits into one variety of different packages”

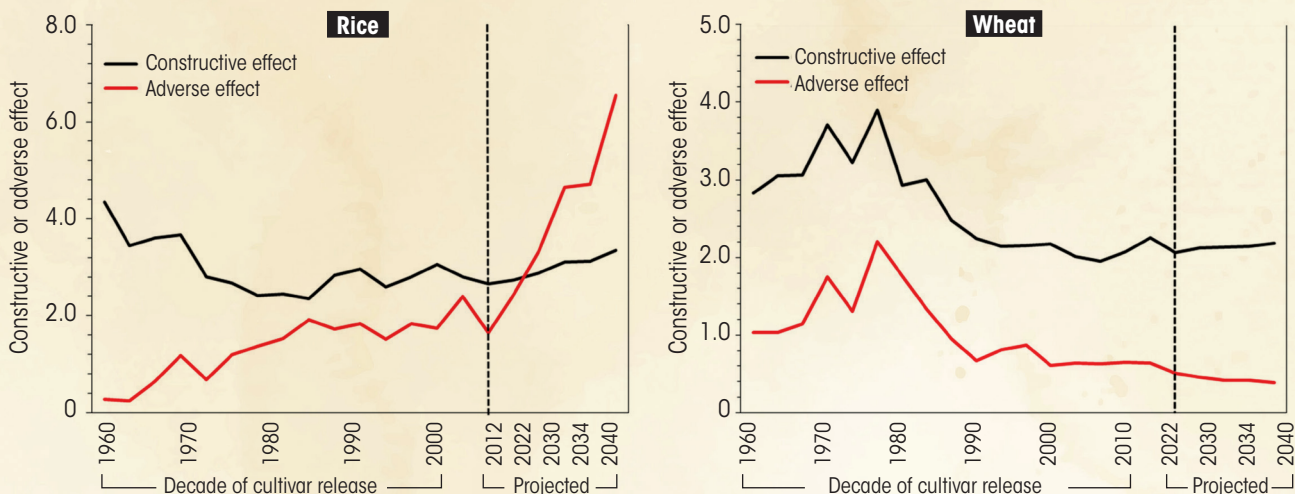
Abhinandan Patil, scientist, Agharkar Research Institute, Pune

However, these varieties are far from being popularised and adopted by farmers on a large scale. “This is because the task of convincing farmers to switch to a new cultivar is huge. Then, there are problems like availability of seeds,” says Debnath.

During the past six years, about 10 million hectares (ha), or 6 per cent of the country’s total area under farming, has been brought under biofortified varieties, including that of wheat, rice, pearl millet, mustard and lentil, as per a reply by the Union government in Lok Sabha on December 8, 2023. The statement does not give any bifurcation of area under rice and wheat, but according to an ICAR document on biofortified varieties published in 2022, only 25,565 kg and 1,043,014 kg of breeder seeds of rice and wheat, respectively, have been produced. To put this in context, in the kharif season of 2023, rice was sown on 41 million ha. The optimum seed rate is 40 kg per ha on average, with the transplanting method commonly used in the country. The

Food not for health

Adverse health effects of mineral diet quality has steadily increased in high-yielding rice varieties, exceeding constructive effects in 2022. For wheat, adverse and constructive effects continue to deteriorate



Note: The constructive and adverse effect on the Y axis represents the average diet quality indexing scores of elements having beneficial and harmful effects on human health, respectively. This mineral diet quality index was computed based on the concentrations of essential beneficial and toxic mineral elements in the grains of rice and wheat cultivars. $P < 0.0001$

Source: "Historical shifting in grain mineral density of landmark rice and wheat cultivars released over the past 50 years in India", *Scientific Reports*, November 2023

25,565 kg seed produced would cover just about 639 ha. Similarly, in the ongoing rabi season, about 30.73 million ha of wheat has been sown till December 15, 2023. And given that the seed rate of wheat is around 100 kg per ha, the 1,043,014 kg biofortified seeds will be sown in about just 10,430 ha.

Besides, the efforts on fortification as of now is focused on zinc, iron and protein. Scientists *Down To Earth* spoke to say other biofortification of other essential elements like manganese, copper and calcium will take some time as breeding and releasing any variety is a long and arduous task, and can take about eight years on average.

To fast-track the process, a few scientists are also experimenting with agronomic biofortification, which involves using micronutrients as fertiliser or spraying it directly on the leaves. However, the process is expensive. Environmental factors like rainfall soon after the spray can also nullify the effect, cautions Debnath.

Abhinandan Patil, scientist with

Agharkar Research Institute in Pune and a plant breeder, says research institutions developing varieties need to overhaul their breeding process. "There should be an integrated mainstreaming process where breeders can use multiple parents to bring out new varieties by pooling genes and traits into one variety of different packages. There is no need for so many different varieties. Those just confuse the farmers and consumers," Patil adds.

While yield continues to preoccupy the agenda of farmers as well as breeders in the face of food shortage because of extreme weather events and global conflicts like the Russian invasion of Ukraine, the government and its various research and extension institutes have their task cut out. If India has to have any chance in arresting malnutrition, micronutrient deficiency burden and other NCDs, nutrition has to be made a priority at par with yield if not more, and popularising these varieties among farmers has to be done on a mission mode. [DTE](#) [@down2earthindia](#)



SCHOOL OF WATER AND WASTEWATER

AAETI



World Health Organization



CSE-WHO TRAINING OF TRAINERS

CLIMATE-RESILIENT SANITATION SAFETY PLANNING

Dates: February 6-9, 2024 | **Language of instruction:** English

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

CSE's School of Water and Waste (AAETI) in collaboration with World Health Organization is organizing a four-day training on 'Climate-resilient Sanitation Safety Planning: Step-by-step risk management for safe sanitation systems'. It is based on the WHO's second edition of sanitation safety planning tool launched in 2022, aligned with WHO's 2018 guidelines on sanitation and health at the local authority level. The training emphasizes the importance of managing and investing in improved sanitation systems by understanding health risks. Sanitation Safety Planning (SSP) is a risk-based management tool that brings together stakeholders to identify and address health risks in sanitation systems through improvements and monitoring. It integrates the health sector in reusing wastewater, excreta, and greywater, providing a human health perspective to non-health sectors like sanitation engineering and agriculture.

WHAT DOES THE TRAINING PROGRAMME OFFER?

- Understanding SSP process and its importance for sanitation stakeholders.
- Learning risk assessment and management aligned with WHO guidelines for the sanitation chain.
- Acquiring knowledge on preparing SSP through step-by-step guidance.
- Establishing peer group relations and connecting with international SSP experts and peers from different regions.

TRAINING METHODOLOGY

The training style is based on the 'Harvard Case Method', which conveys teaching messages through interactive practical work done by trainees. The training will be focused on experiential learning – including individual/group interaction, practical group exercises, interactions with experts, discussions, and documentary films to highlight the best management practices implemented successfully.

The training programme will also incorporate a field visit to build practical knowledge about the SSP tool.

WHO CAN APPLY

- National and state-level training entities and PMUs supporting various initiatives.
- Public health personnel and sanitary inspectors from urban local bodies.
- Practitioners from consultancies, community-based organizations, social welfare organizations, and NGOs.
- Independent researchers, academia, and key stakeholders in the WASH sector.

COURSE FEES:

For Indian participants:

₹25,600 (double occupancy)

₹28,000 (single occupancy)

For international participants:

US \$590 (double occupancy)

US \$760 (single occupancy)

Limited full and partial fellowships available, covering travel and boarding expenses.

TRAINING INSTRUCTOR:



Leonelha Barreto Dillon

An experienced trainer and consultant specializing in SSP. Currently serves as a consultant for WHO

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Dr Sumita Singhal, Programme Manager, Water, CSE

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Pencil in this shortage

India's 'pencil village' faces uncertain future due to raw material crises

**TAUSEEF AHMAD
AND SAJID RAINA**
PULWAMA, JAMMU
AND KASHMIR

OUKHOO IS not a place that you may have heard of, but the last pencil you used is almost certain to have come from here. The non-descript village in Pulwama district of Jammu and Kashmir supplies slats—rectangular wood pieces—for most of India's pencils. However, there is an acute decline in the numbers of the poplar (*Popu-*

lus deltoids) tree that is used in making the slats, say manufacturing units.

Down To Earth visited all the 17 units operating in the village to find that from the earlier average of 100-150 workers employed per unit, the number has come down to 40-50. There is no official record of the slats supplied or people employed to assess the decline in

PHOTOGRAPHS: TAUSEEF AHMAD AND SAJID RAINA

production of slats. But unit-owners and workers say that employment opportunities are disappearing. “These factories not only produce pencils but also provide us employment. We are around 30 girls working in the factory, and most of us belong to poor families,” says Fatima Nabi, a local girl working in a factory.

Poplar’s shortage started in 2015, when the High Court of Jammu and Kashmir ordered felling of poplar trees to curb pollen-related chest infections. The intermittent political unrest in the state slowed down the process in

trees have already been felled while another 42,000 need to be felled. The order also bans planting of poplar trees. Following the order, deputy commissioners of all the districts of Jammu and Kashmir issued separate orders to cut poplar trees in their jurisdiction. There is no official data on the number of poplar trees felled so far, but residents say the numbers could be huge. “Hundreds of thousands of poplar trees have been cut. People have cut them along the banks of rivers and streams,” says Bilal Ahmad, a contractor from Bandipora district.

RECENT ASSOCIATION

Oukhoo’s association with pencil manufacture is quite recent. The first unit was set up only around 2013 by Manzoor Ahmad Ilhaie after he learnt this work in Jammu. “After buying wooden logs in bulk, we cut them into small blocks and then into slats, measuring 52x78x77 mm,” says Ilhaie, the owner of Jhelum Agro Industries. “The slats are then put in a machine to absorb moisture or sun-dried. Then they are packed in packs of 800 and sent for making finished products in Jammu, Chandigarh and other places,” he adds

Prior to Oukhoo becoming a pencil hub, India used to import pencil slats from countries like China. But now, 90 per cent of India’s pencils are made of wood processed in this village, say unit owners. The wood used in making pencils need to be soft and the Kashmir valley provides the ideal moisture and temperature to grow such wood.

Poplar was introduced to the valley in the 1980s under a World Bank-aided social forestry

initiative, and now dominates the region’s skyline. Estimates say that it accounts a third of the state’s tree population. This, combined with the local belief that the pollen from the tree causes infections, has led to its downfall. But the belief is without basis.

In 2015, the Department of Pulmonary Medicine at Chest Disease Hospital, Srinagar, compiled a list of common allergens based on prick tests (which involve injecting an allergen under skin and monitoring the reactions). In the tests, park grass triggered allergies in 73.5 per cent of the subjects, pine trees in 62.7 per cent, *chinar* (*Platanus orientalis*) in 59.3 per cent and poplar pollen in 18-20 per cent.

Factory workers fear that the crisis could result in the end of the units. “Poplar trees are mostly grown in the land which is not useful for any other purposes. Just like the government promoted high-density apple trees, if it can plan high-density poplar trees, which will be ready in five or six years, these industries could be kept alive,” says Farooq Ahmad Dar, a local resident who has worked at Jhelum Agro Industries since 2013.

Shabnam Akhtar, who also works at a slate factory, highlights the issue of inadequate afforestation, saying that for every ten trees cut, only one is replanted. She calls for a comprehensive mass plantation of trees during the spring season to safeguard the environment and mitigate shortage of raw material in the coming decades. “Can we not tolerate a 15-day pollen season of a tree that has given us so much?” she asks. **DTE**

⊗@down2earthindia



Oukhoo village, which supplies wood for pencils made in India, faces a severe shortage of raw material due to government order of felling poplar tree

2016 (see ‘Tilting at poplar trees’, *Down To Earth* 1-15 June, 2017), but the crisis became particularly severe during the pandemic, when the government decided to fell the tree for the same reason.

An April 2, 2020 order of the divisional commissioner of Kashmir mentions that there are some 1.8 to 2 million poplar trees in the division and that some 26,000

Narkya and the plunder of biodiversity

Dilution of biological conservation rules and lax enforcement of forest laws are giving free rein to the drug industry and trade

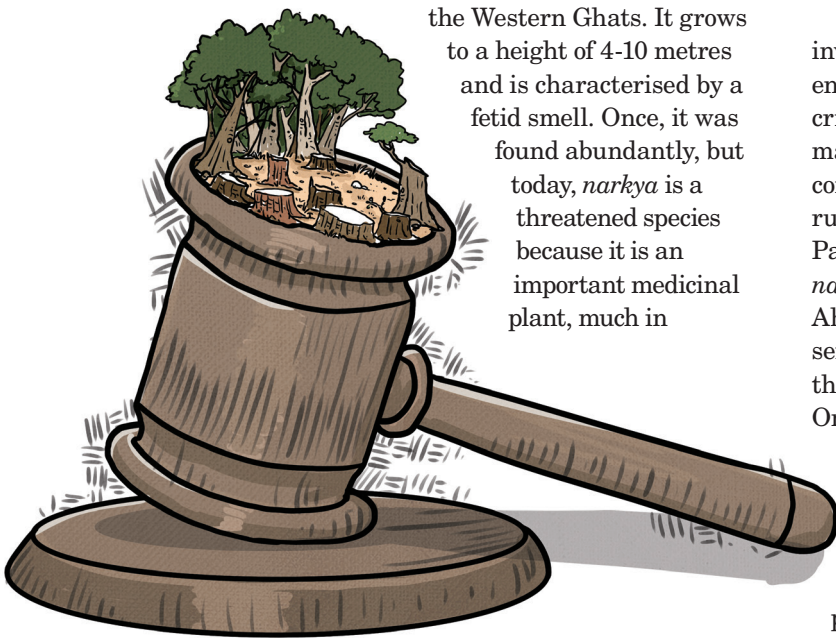
THE HEADLINES were arresting. “Improbable that company bought stolen forest item; cases quashed,” said a leading newspaper in Mumbai. “Cancer drug camptothecin not forest produce—Bombay High Court quashes cases against pharma company after 16 years,” proclaimed a well-known legal website in early January. Other publications had similar reports exonerating Fresenius Kabi Oncology, the Indian offshoot of German multinational Fresenius Kabi, of any wrongdoing in the purchase of camptothecin, which is used to make cancer drugs. The case is actually 18 years old—it was initiated in 2005—and illustrates why India’s rich biodiversity is depleting ever faster.

This story starts with a moderate-sized tree, *Mappia foetida*, known locally as *narkya* or *amruta*, which is found in the Western Ghats. It grows to a height of 4-10 metres and is characterised by a fetid smell. Once, it was found abundantly, but today, *narkya* is a threatened species because it is an important medicinal plant, much in

demand for its anti-cancer properties. The alkaloid camptothecin (CPT), extracted from the wood chips of the trees, is an essential component of chemotherapy and *narkya* is said to be the most promising source for large-scale production of CPT.

The illegal felling of *narkya* and the production of CPT form the substance of this case, which has proved a futile exercise by the forest department in nabbing the culprits. The 18-year-old case filed by the state of Maharashtra and conservator of forest, Kolhapur, involves the illegal felling of *narkya* trees in Chandoli National Park in Maharashtra. It was detected in April 2005 and cases were filed against 223 persons for offences punishable under the provisions of the Wildlife (Protection) Act, 1972, the Indian Forest Act, 1927, and the Bombay Forest Rules, 1942.

According to court documents, the investigation team successfully discovered the entire chain of accused persons involved in the crimes, right from cutting *narkya* trees to the manufacturing of CPT. A vast number of bags containing *narkya* wood chips worth lakhs of rupees were seized from Chandoli National Park and other places, along with 1,110 kg of *narkya* extract from Hyderabad and Ahmedabad. What is pivotal to the case is the seizure of 22 kg of CPT valued at ₹44 lakh from the manufacturing unit of Fresenius Kabi Oncology in Kalyani, West Bengal. The company was then known as Dabur Pharma, before the takeover by Fresenius Kabi was finalised. The company is among the world’s largest manufacturer of key anti-cancer APIs or active pharmaceutical ingredients which form the basis of a drug.



CPT was supplied by Coral Drugs, which is known as an integrated, research-based global pharma company that produces a wide range of APIs. The seized items comprised of *narkya* wood chips, crude jelly, crude camptothecin and the final product CPT. In short, all the above products were derived from the stolen *narkya* wood. A team from the wildlife department had visited the Kalyani plant and after exploring the nexus, seized the 22 kg of CPT. The material seized was the subject matter of the criminal proceedings in the Sangli and Kolhapur district courts. Other companies accused in the illegal *narkya*-felling case are Universal Chemical Industries, Hyderabad, Somaiya Farms and Organic Products, Gujarat and Naturite Agro Products, Hyderabad.

The case would wind its way through the various courts before dealing a thorough setback to the forest department in its efforts to stop the illicit trade in a scarce resource. In 2010, Fresenius Kabi Oncology and the factory manager of its Kalyani plant filed petitions in the High Court for quashing the criminal proceedings, contending that it had purchased CPT from another firm and had absolutely no knowledge that it was extracted from illegally removed *narkya* trees. It also claimed that CPT was not forest produce and, therefore, neither the company nor any of its representatives could be prosecuted for illegal removal of forest produce. This argument was based on an earlier Supreme Court decision showing that CPT was not forest produce.

The Bombay High Court found merit in this and stated that “it is highly improbable that the petitioner company would buy an illegal ‘forest produce’ for such a huge price, that too at the risk of its prosecution for serious offences.” Prosecution of the petitioners in the illegal *narkya* cases was thus unwarranted.

One of the problematic issues in the *narkya* case and to similar litigation is the Supreme Court’s 1996 interpretation of forest produce. It had declared that “if a product, commercially new and distinct, known to the business community as totally different is brought into

existence by human labour, such an article and product would cease to be a forest-produce.”

Narkya, meanwhile, is becoming ever more scarce. According to a paper published by a University of Pune researcher, the tree is being exploited clandestinely in the domestic market and is also shipped abroad. “The profit potential is enormous as the alkaloid extracted from the plant is an essential component of chemotherapy,” it says. Each dose is estimated to cost ₹1.5-2 lakh here.

For more than a decade, conservation experts have been warning that medicinal plants in the Western Ghats are facing the threat of extinction. A study done in 2012 in the Kalakkad Mundanthurai Tiger Reserve found that a primary reason was the excessive collection of these plants for use in traditional remedies. Yet, the government is whittling down laws to allow a free rein to the traditional

Experts warn medicinal plants in the Western Ghats face extinction. Yet, the government whittles down laws meant for conservation

medicine industry, some of whom are among India’s top corporate giants. Last year, it watered down the provisions of the Biological Diversity Act, 2002, to exempt the AYUSH industry (ayurveda, yoga and

naturopathy, unani, siddha and homeopathy companies) from sharing the benefits of using the country’s bioresources with the local communities that nurture these.

With the Narendra Modi government proving indifferent to the conservation and sustainable use of the country’s priceless biodiversity in order to promote “ease of doing business”, as it stated in Parliament, there is little to deter companies and the trade from marauding our biosphere hotspots.

It is curious that the many criminal charges listed in the *narkya* case do not cite the Biodiversity Act. But then, very few of the endangered species are covered by the Act or by the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) or even the Wildlife (Protection) Act.

Given the success rate of the forest department in proving biopiracy in the courts, it would seem that the saving of India’s biological diversity is a lost cause. 🇮🇳 📧 @jjishnu

A **DownToEarth** ANNUAL

STATE OF INDIA'S ENVIRONMENT

2024

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Palette

WHAT'S INSIDE

Flowers fast evolving to self-pollinate as insect numbers decline **P42**

India must simplify GI tags to protect producer communities **P46**

Fermentation can reduce food wastage at home **P56**

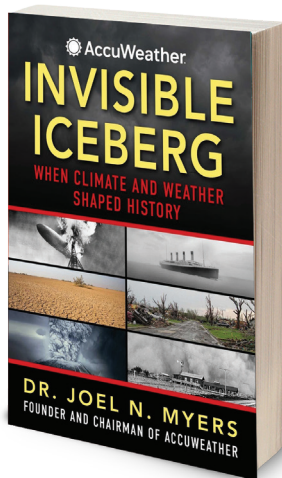
RECOMMENDATIONS

FILM FESTIVAL

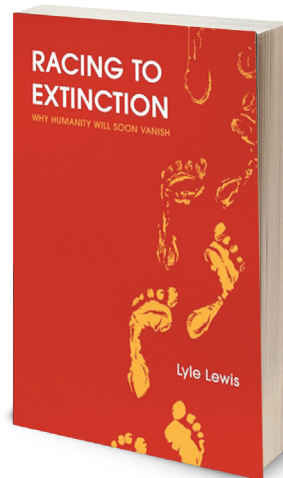


For the past decade, the Kolkata People's Film Festival has aimed to celebrate documentaries and films that portray hidden stories on identity, politics and the environment from India and South Asia. The 10th edition of the festival presented by the People's Film Collective, to be held on January 24-28, will strive to continue the legacy of sharing inspiring films and spurring dialogues relevant to communities today. *Seed Stories*, for instance, highlights large-scale paddy conservation efforts in Odisha, while *Miles Away* traces the lives of three women who have left home to work in brick kilns of Uttar Pradesh. To learn more about the films being presented, visit www.ourcinema.in/festival/.

BOOKS



Humankind may still be understanding climate change and its impacts, but this phenomenon is in fact as old as the planet. Science suggests that a large-scale climate disruption led to the extinction of dinosaurs millions of years ago, and that an eruption of Mount Okmok in Alaska in 44 BCE led to the rise of the Roman empire. Joel N Myers, founder and chief executive of US-based private weather forecast firm AccuWeather, explores such climate events and their implications in *Invisible Iceberg: When Climate and Weather Shaped History*.



The rise in global warming has several fallouts, not the least of which is the large-scale loss of biodiversity and disappearance of species. There is growing belief that the world is headed towards its Sixth Mass Extinction event, which is likely to hit humankind as well, says Lyle Lewis, former endangered species biologist with the US Department of Interior. In *Racing to Extinction: Why Humanity Will Soon Vanish*, Lewis reveals why and how *Homo sapiens* is vulnerable to disappearance in the near future.

Forced evolution

Plants shift towards self-pollination as they see disruption in interactions with insects due to changes in climate

HIMANSHU N NEW DELHI



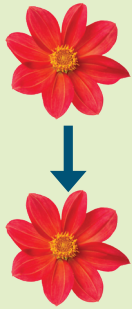
DISRUPTION IN interaction between plants and pollinator species is undoing millions of years of co-evolution. In a December 2023 study published in the journal *New Phytologist*, scientists from the University of Montpellier, France say field pansy (*Viola arvensis*) has shown rapid evolution towards “selfing syndrome”, in which the predominantly cross-pollinating plant begins to self-pollinate due to weakened interactions with pollinators. New generations of field pansy flowers were 10 per cent smaller, produced 20 per cent less nectar and were less visited by pollinators compared to their ancestors, say the scientists.

Field pansy is a low-growing plant with pale creamy-yellow flowers. The plant is considered a native of southeastern Europe and western and now grows in temperate zones. The scientists used a “resurrection ecology” approach, in which they grew dormant seeds collected from four populations of field pansy in 1990s-2000s, along with their descendants (collected in 2021). They also noted that pollinators have declined in their study region over the past few years.

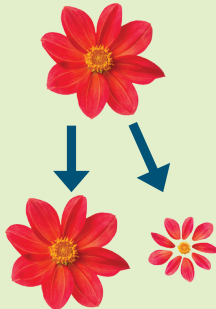
New generations of field pansy flowers are smaller, produce less nectar and are less visited by pollinators

Eventual deterioration

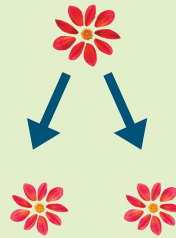
The move from cross-fertilisation to self-pollination may benefit plants in the short term, but it could lead species to an evolutionary dead end with increased chances of extinction



A predominantly cross-fertilising plant may self-pollinate in absence of or mismatch with pollinators



Increase in self-pollination may lead to selfing syndrome, raising the chances of inheritance of harmful genes



Selfing syndrome may cause inbreeding depression and loss of genetic diversity



Loss of genetic diversity and poor evolutionary potential may cause extinction of species

Source: Based on expert comments

The study compared various traits, including production of seeds in the presence and absence of pollinators. They also monitored how bumblebees interacted with the grown field pansy populations. The scientists note that in three of the four populations studied, the descendants showed an average increase of 27 per cent in selfing rate compared to ancestors. The plants also showed a marginal increase in the ability to set seeds over time.

Pierre-Olivier Cheptou, co-author and supervisor of the study, says that field pansy is reducing attractiveness and “giving up” on pollinators.

“We were surprised to find that these plants are evolving so quickly,” Samson Acoca-Pidolle, lead author of the study, says in a statement. “Our results show that the ancient interactions linking pansies to their pollinators are disappearing fast,” he says, adding that the effects of pollinator declines are not easily reversible.

A POTENTIAL TREND

Field pansy is not the only plant affected by pollinator decline. An October 2023 *Science Advances* study says that crops such as coffee, cocoa, watermelon and mango would be affected due to loss of pollinators caused by land-use changes and climate change.

Experts say that alterations in flowering and fruiting periods have thrown pollinators and plants out of sync. Soubadra Devy, senior fellow at Ashoka Trust for Research in Ecology and the Environment, Bengaluru, explains that such a phenomenon can also be observed in the Western Ghats and evergreen forests of India. “There are years when there is a boom of pollinators. But there are also years when there is a dearth of pollinators due to idiosyncratic cycles. But plants still flower and bear fruits,” she says. She explains that most plants generally accept external and self-pollen as a back-up strategy to manage the vagaries

common in tropical regions.

Gaurav Zinta, senior scientist at the Council of Scientific and Industrial Research-Institute of Himalayan Bioresource Technology, Palampur, Himachal Pradesh, says such shifting towards self-pollination is due to environmental pressure, and hence cannot be considered an organic evolution.

In fact, only 10-15 per cent of flowering species predominantly self-fertilise, says a 2013 review article published in *Proceedings of the Royal Society B: Biological Sciences*. The phenomenon can result in improved colonisation ability among plants. But benefits are only prevalent in the short term, and self-pollination could lead to an “evolutionary dead end”. Self-fertilised lineages suffer from increased rates of extinction, says the study.

Self-pollination increases the chances of plants becoming homozygous (possessing two identical forms of a particular gene), according to N G Prasad, an evolutionary biologist

DOUBLE JEOPARDY

Pollinator-plant mismatch spells disaster for both species

GAURAV ZINTA

CLIMATE CHANGE is leading to a significant mismatch in plant cycles and pollinator behaviour, which has multiple impacts on the phenology and other traits of plants. I have observed, for example, significant changes in apple-producing areas of the Himalayan region over the past 25 years. Apples are grown in low- as well as mid-altitude hills and the higher Himalayan ranges. However, with the increase in temperatures, fruit production has seen a

reduction. At the same time, warmer weather has resulted in early flowering that coincides with low pollinator availability.

A decrease in pollination hampers fruit production and yield quality, which has been evident in apples and almonds grown in the Himalayan region. Hence, commercial orchard owners now import honeybees and are diversifying pollinators to ensure pollination.

Cross-pollination allows plants to mix genes and add new traits, while self-pollination or selfing can induce inbreeding depression in species, make them more prone to diseases and reduce

diversity, which lowers their ability to fight climate change.

The disruption in plant-pollinator interaction also brings other changes in plant traits. A 2020 study in the journal *Current Biology* indicates that between 1941 and 2017, the species *Velleia paradoxa* changed the colour of its flowers by increasing an ultraviolet (UV)-absorbing pigment to adapt to the high exposure to UV radiation. But this has made the flowers less favourable to pollinators. The rise in atmospheric carbon dioxide can also increase insect herbivore incidence by altering nutritional quality and plant defence, says another 2020 study in the journal *Scientific Reports*. The increase in carbon dioxide enables plants to produce more carbohydrates and the high proportion of sugary food attracts herbivores such as fruit flies and grasshoppers, dissuading other pollinators. A long-term study, published in the journal *Cell Reports* in 2019, demonstrated that such a diet can also reshape the feeding behaviour of fruit flies.

The spread of invasive species also shifts pollinators away from traditional plant species. According to the International Union for Conservation of Nature (IUCN), climate change can increase cover of invasive species. Their presence introduces both risks and opportunities for pollinator nutrition, alters species interactions and influences native pollination dynamics and community stability. In the long term, such changes can result in a feedback loop amplification—a decline in pollinator populations may affect plant reproduction and potentially lead to further declines in both species.

(Gaurav Zinta is senior scientist, Council of Scientific and Industrial Research-Institute of Himalayan Bioresource Technology, Palampur, Himachal Pradesh)



at the Indian Institute of Science Education and Research, Mohali. “If the plant inherits two identical copies of recessive harmful genes, it may undergo inbreeding depression, exhibiting poor traits from stunted growth, lowered stress resistance and compromised reproduction,” he says. This will lead to the loss of heritable variation and evolutionary potential.

Reduction in variability or genetic diversity may, in turn, give rise to diseases that result in mass collapse of plant populations, says Manzoor Shah, professor in University of Kashmir’s botany department.

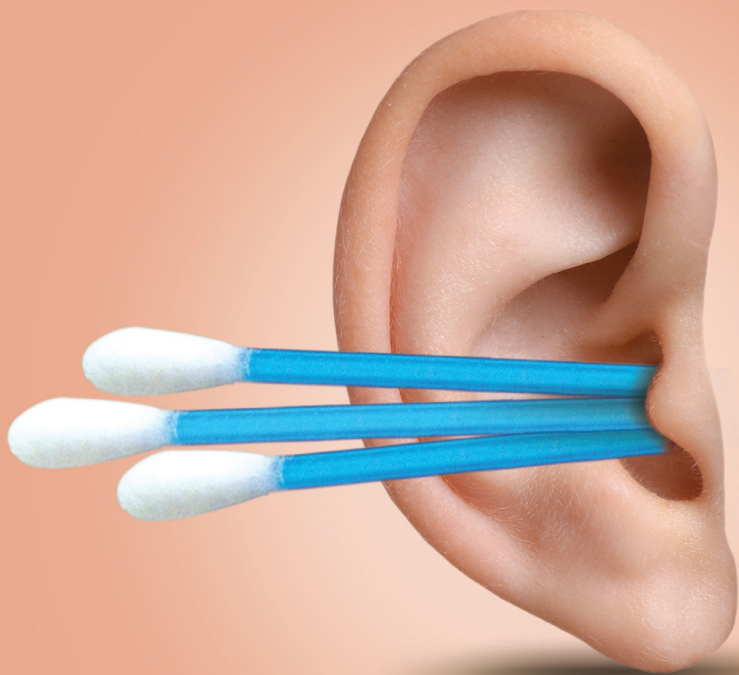
CO-EVOLUTION AT RISK

Self-pollination also threatens the pollinators that have co-evolved with plants right from the Cretaceous period (145-66 million years ago), says a 2021 *New Phytologist* study.

Over time, this intricate relationship has been refined to the point that a strict 1:1 co-evolution is found between some plants and insect partners, says a 2014 *Nature* study.

In comparison, says Prasad, the December 2023 *New Phytologist* study was able to document rapid evolution of floral characteristics over a relatively short period of 30 years, and relate it to pollinator decline. It would be crucial to check whether pollinators are undergoing evolutionary changes in response to plant characteristics and environmental shifts. Adds Shah, “Co-evolution has happened over centuries and if plant strategy changes suddenly, pollinators will take time to understand and it may be too late as generations of pollinators would be lost in the meantime.” Acoca-Pidolle urges, “Conservation measures are therefore urgently needed to halt and reverse pollinator declines.” **DTE**

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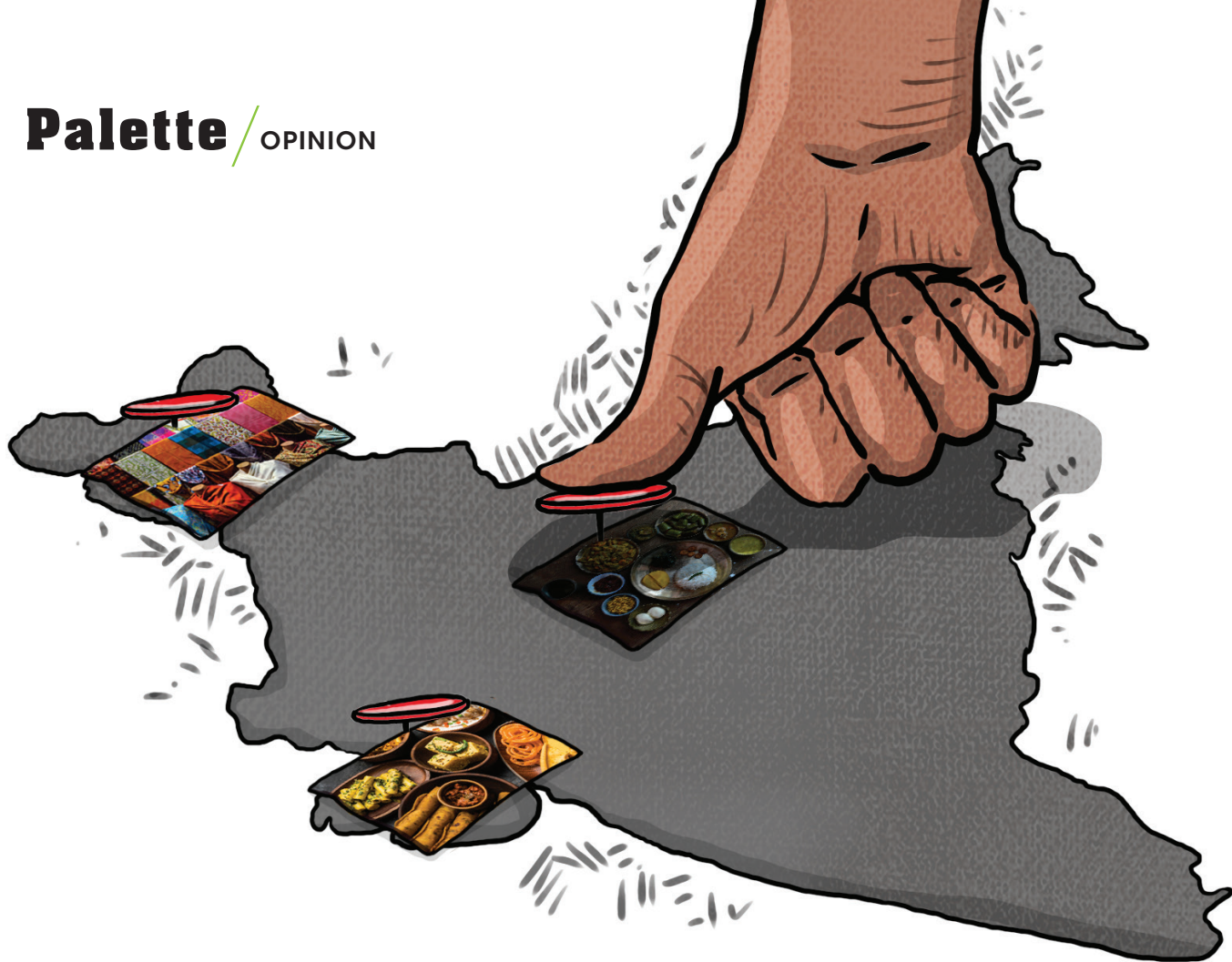
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UNTAPPED POTENTIAL

India's two-decade journey with Geographical Indication tags has shown limited outcome and there is an urgent need to simplify the registration processes to ensure that the protection mechanism helps producer communities

MOHIT SHARMA

GEOGRAPHICAL INDICATION (GI) is a form of certification that recognises unique products based on their origin, which is often attributed to agro-climatic variations and traditional cultivation practices. This certification is also extended to non-agricultural products, such as handicrafts, based on human skills, materials and resources available in certain areas that make the product unique. Consumers prefer genuine products, and GI provides the assurance of authenticity while also promoting community development.

Trade reforms, legal protection

and consumer acceptance are necessary to commercialise local products and gain premium prices in domestic and international markets. Empirical evidence from many developing and developed countries shows that GI helps economic enhancement at the producer's level. But this is not true to the same extent in India, perhaps due to flaws in the GI registration system and market inefficiencies. Therefore, India's journey of over two decades—the Geographical Indications of Goods (Registration and Protection) Rules was enacted in 1999—with GI has had limited outcomes and requires more popu-

larisation to achieve its full economic potential. This article seeks to provide a perspective on the efforts and attention towards GI from national and international lenses and draw policymakers' attention to this issue.

INDIA VIS A VIS WORLD

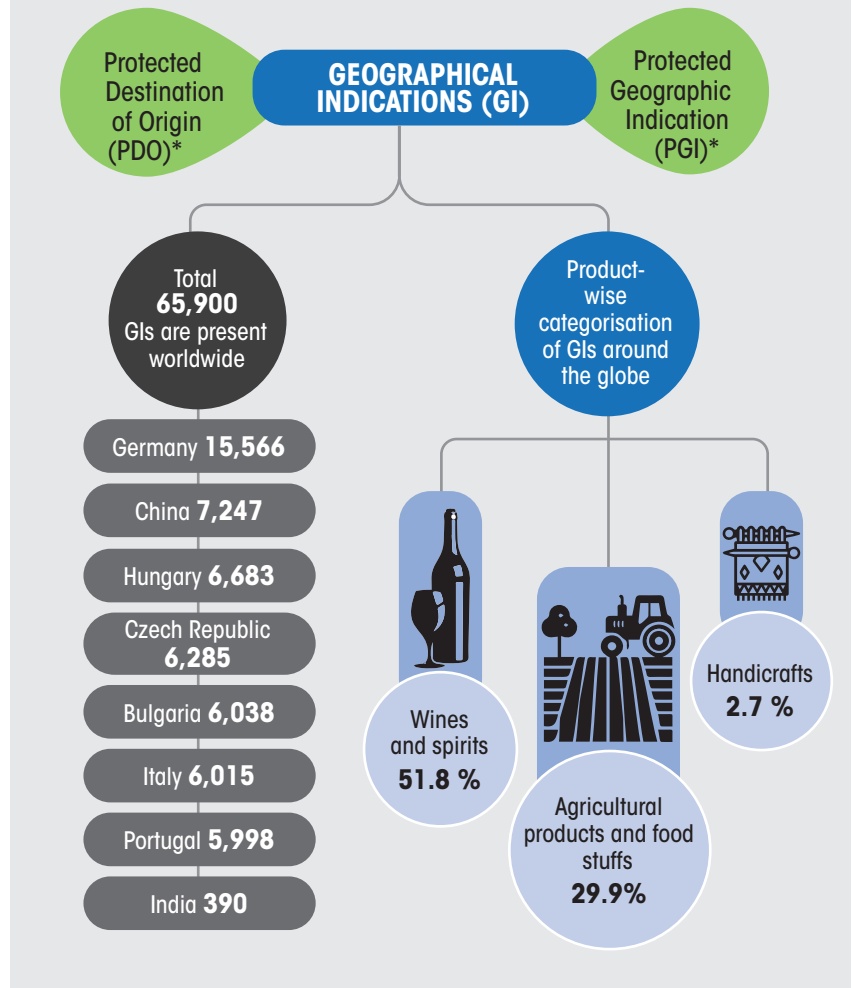
Compared to other nations, India lags in GI registration. Till December 2023, Intellectual Property India received just 1,167 applications, of which only 547 products have been registered, as per the GI Registry. This means the application acceptance ratio is only about 46 per cent, which indicates that regulations are quite strict. It took over a decade for the famous Alphonso mango to receive GI registration due to disputes over geography.

Germany leads in GI registrations, with 15,566 registered products, followed by China (7,247), as per 2020 data with the World Intellectual Property Organization (see 'Prime indicators'). Globally, wines and spirits comprise 51.8 per cent of registered GIs, followed by agricultural products and foodstuffs at 29.9 per cent. In India, handicraft (about 45 per cent) and agriculture (about 30 per cent) comprise the majority of the GI products.

At the level of the World Trade Organization (WTO), GI is governed under the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS). Article 22 (1) of TRIPS defines GIs as "indications which identify a good as originating in the territory of a member, or a region or locality in that territory, where a given quality, reputation or other characteristic of the good is essentially attributable to its geographic origin". In many EU nations, GI is classified in two basic categories—Protected GI (PGI) and Protected Destination of Origin (PDO).

Prime indicators

The number of Geographical Indication (GI) products registered in India is quite low



*These are the two broad categories of Geographical Indications, and the nomenclature is based on the raw material used and the dependence of the product-making process on the geography; Source: World Intellectual Property Organization data up to 2020

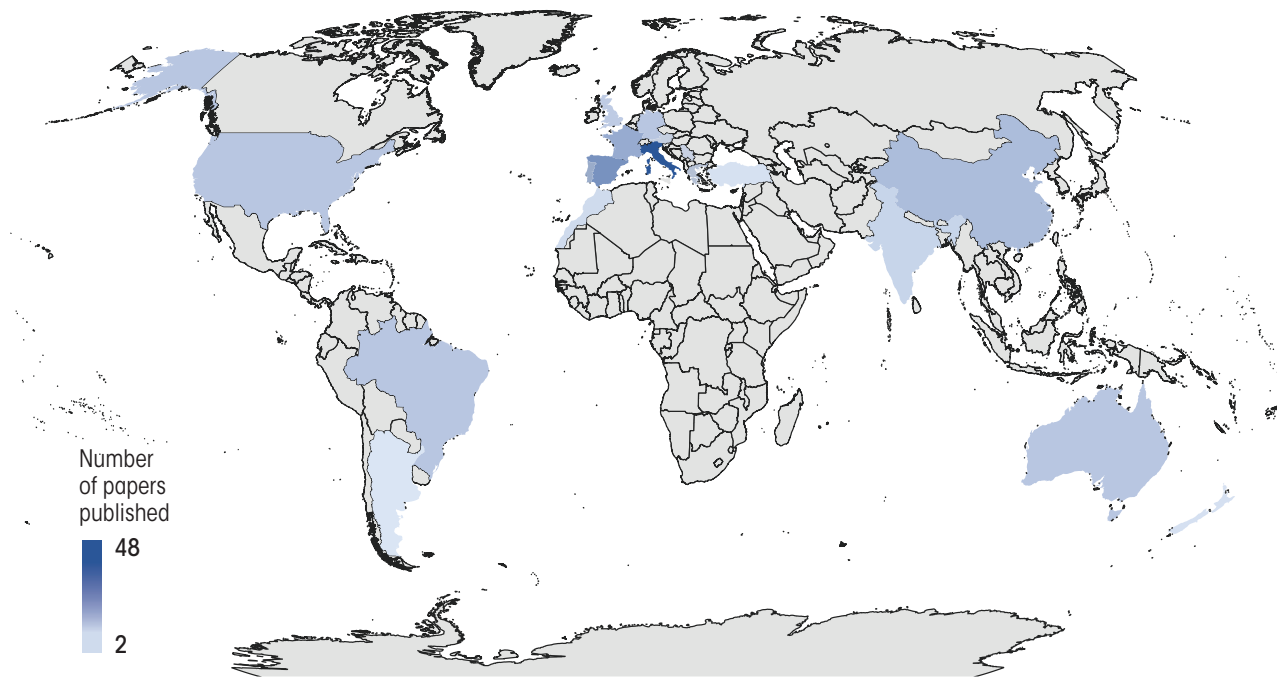
India only has the PGI category.

Since India's GI Act was framed more than two decades ago, it is time to amend it, along with the GI application forms and application processing time. This should be accompanied with suitable institutional development. There is also a need to help producers benefit after the registration process since they are often clueless on how to proceed after getting a GI tag.

The definition of "producers" also lacks clarity, which results in the involvement of intermediaries who share the benefits that should go only to the producers. Health, social wellbeing and welfare policies for artisans and labourers in the non-farm sector have also not received required attention from the policymakers. The government should bolster support to the GI workers in this regard.

Prominent proponents

Europe has dominated the academic research on Geographical Indicators in recent decades (2002-22)



Source: Author's analysis

A SECTOR IGNORED

Since its inception, there has been significant controversy among the WTO member countries on accepting GI as an intellectual property. There have been disputes on various GI products, such as Darjeeling tea and Basmati rice, which were claimed by one country as their property and legally challenged by another. The reason is that though WIPO promotes and develops intellectual property rights, GIs receive limited attention compared to patents, trademark and copyrights. An analysis of WTO's annual reports published over the past 22 years shows that the multilateral organisation's focus has been majorly on maintaining a national register for GIs, with little attention on promoting GIs or bilateral agreements. There is an urgent need to promote GIs among participating nations,

securing farmer and consumer interests, with discussions on subsidies and free trade agreements. Special trade agreements can facilitate GI trade between countries.

ACADEMIC ATTENTION

Though academic attention on GI has not been enough across nations, a recent push is evident. Bibliographic assessment through literature review of academic research, with results analysed through software, shows that a total of 138 articles could fall under GI research since 2017. These are related to producers (48.5 per cent), consumers (44.2 per cent), marketers (5 per cent) and entrepreneurs (2 per cent).

An analysis of publication trends over the past two decades reveals that the number of publications was below 15 from 2002 to

2016. However, there has been a recent increase, with 29 articles published in 2020. The highest number of articles published (35) was in 2021 (see 'Research focus').

Analysis of country-wise publication trend shows clear dominance by European countries like Italy (48), Spain (28) and France (20). India has had very limited publications, numbering about seven (see 'Prominent proponents').

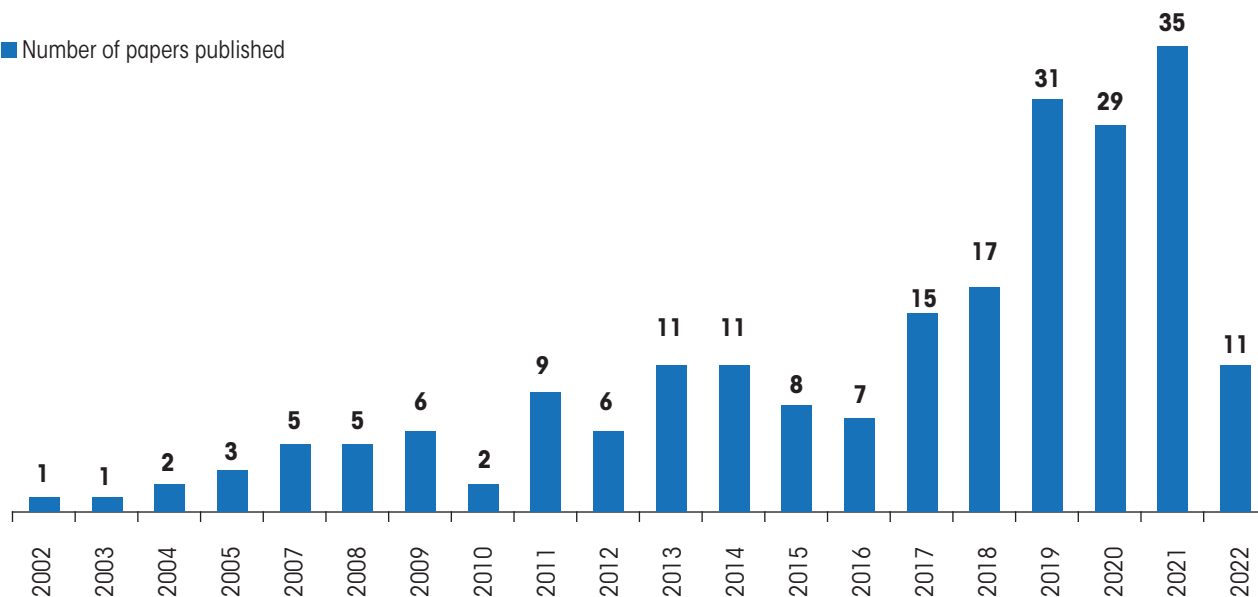
HOW TO POPULARISE GI

The government should incentivise GIs at the initial juncture—at the producers' level—to boost the numbers. Emphasis should also be on amendment of laws to clearly dictate exclusion of "non-producers" from benefiting from GIs, and ensure direct benefits to producers. It is also important to use technology, focus on skill-building and

Research focus

The number of academic articles on GI has been low in the past two decades but the trend is changing

■ Number of papers published



Source: Author's analysis

digital literacy among GI producers, manufacturers and labourers to ensure they can keep pace with modern trends and consumers' requirement.

The government's One District One Product scheme should be integrated with GIs through the involvement of food producer organisations. Promotion of GI-based products requires special emphasis on marketing and branding, which can be resolved to a certain extent by developing market outlet schemes. This can be integrated with the existing schemes to establish exclusive *gramin haats* (rural markets). These platforms would also be centres of tourist attraction and provide easy purchase option of GI products to visitors.

But the foremost thing is establishment of testing laboratories at such markets to ensure that consumers have faith in the quality of these products. The National Agriculture Market—eNAM—an online

trading platform for agricultural commodities in India, must carry a separate tab for GI-based products to provide an easy interface to all buyers and sellers.

There has been a rise in the number of startups in recent years, which should be aligned with the Sustainable Development Goals (SDGs). Connecting GIs with such startups and linking their performance with that of SDGs will ensure that they contribute to social development, while also provide attention to GI products.

Government agencies, trade and producer associations should integrate to organise more exhibitions for popularisation of GI-based products with the use of various types of media. India's embassies should also promote GI-based product to encourage growth in the foreign market. The government should make efforts to ensure that the international tariff regime for GI products is favourable to our

products. Developing nations can also make a case for special attention to GI products in the global market at WTO. The "vocal for local" initiative can also be enhanced by accelerating GI protection.

GI is a powerful tool for protecting traditional knowledge, culture and can boost socio-economic development. However, there is a need to increase income of producers by establishing pre- and post-registration GI-promotion mechanisms. More commodities should be brought under the GI umbrella. Subsidies for growers and promotion at national and international fairs are necessary. State-level attention from stakeholders is also crucial to protect producers' and consumers' interests. 🇮🇳 @down2earthindia

(Mohit Sharma is an assistant professor at the School of Agribusiness and Rural Management, Dr Rajendra Prasad Central Agricultural University, Pusa, Samastipur, Bihar)

Worthy alternative

A new field experiment shows that fertiliser derived from faecal sludge can improve crop yields

**ATUN ROY CHOUDHURY,
NEHA SINGH, NAMITA BANKA,
N CHANDANA AND JITESH LALWANI**

INDIA HAS constructed over 100 million household toilets under its Swachh Bharat Mission in recent years. While this has improved the country's overall sanitation levels, it has thrown open the challenge of handling vast amounts of faecal sludge, the mixture of human excreta and water. One of the solutions lies in separating the solid and liquid components and treating them separately. The liquid can be decontaminated and used for irrigation and toilet flushing. The solid can be composted and pasteurised to make biosolids and used as organic fertiliser.

To understand the potential of faecal sludge as a fertiliser, we recently conducted a field trial in Alair, Telangana. Our experiment, conducted on okra cultivation, shows that the use of biosolids sourced from faecal sludge as organic fertiliser positively influences germination rates and enhances the growth and yield of plants. Biosolid generally contains high concentrations of macro and micronutrients essential for plant growth.

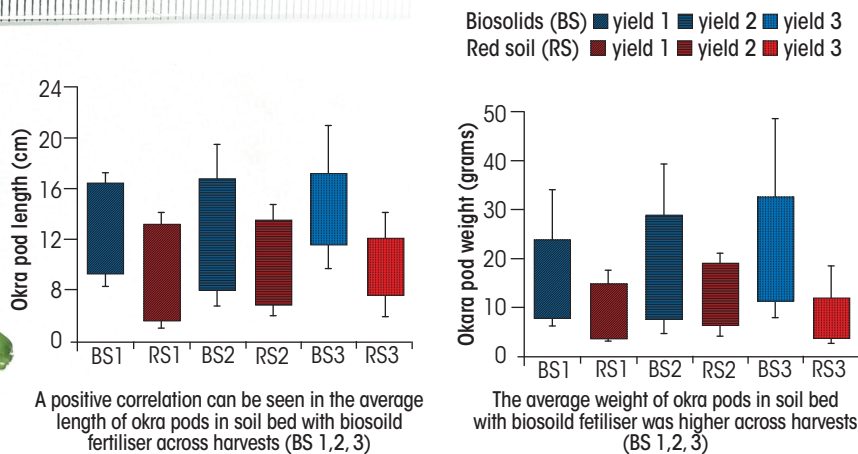
THE SETUP

The trial was conducted by growing okra on two soil beds, one with only red soil that is commonly used for farming in southern India (control bed) and the other with pre-



VISIBLE ADVANTAGE

The overall weight and length of okra pods produced using fertiliser derived from faecal sludge remained consistently higher than those grown without the fertiliser





The use of biosolids sourced from faecal sludge as organic fertiliser positively influences germination rates and significantly enhances the growth and yield of plants

mixed biosolids and red soil in a 1:1 ratio (experimental bed).

Both beds were initially flooded with 80 litres of water, carefully applied to ensure uniform distribution and to avoid water-logging. Next, 16 g or roughly 250 okra seeds were evenly distributed on each bed, ensuring optimal spacing for healthy plant development. The incorporation of biosolids into the experimental bed aimed to provide additional nutrients to the growing okra plants. The biosolids used had a high nutrient content, including a healthy carbon-to-nitrogen ratio of 9.57, a total nitrogen content of 0.93 per cent and a total phosphate content of 1.95 per cent.

To maintain the integrity of the experiment, regular monitoring and care were provided to both soil beds throughout the process. The experiment lasted for 75 days, allowing sufficient time for the okra plants to mature and produce yields. The first yield of okra pods was harvested on the 55th day, followed by two subsequent harvests after an interval of 10 days each. This frequency allowed for the assessment of multiple yields and the observation of any variations in yield over time.

BETTER YIELD, QUALITY

The impact of biosolids could be seen throughout the life cycle of the plant. Within just seven days of seeding, the control bed saw 92 saplings. In contrast, the experimental bed recorded as many as 98 saplings, indicating a positive influence of biosolids on the rate of germination. Over the course of the 55 days, okra plants in the experimental bed displayed a significant growth compared to those in the control bed.

The average height of the plants in the experimental bed ranged from 1 to 1.2 m, while those in the control bed ranged from 0.6 to 0.7 m, suggesting positive influence of biosolids on plant vigour and overall growth.

The total okra pod weight from the control bed for the first and second harvests was recorded at 0.519 kg and 0.830 kg, respectively. In contrast, the experimental bed produced substantially higher yields: 1.176 kg and 1.713 kg, respectively.

The application of biosolids also positively affected the quality of the okra pods. The average, maximum and minimum pod lengths were noticeably longer in the experimental

bed compared to the control bed.

While further research is required to ascertain the nutrition levels of crops grown with biosolids, the field trials offer an important first step to mainstream the conversion. Fertilisers derived from faecal sludge are not only healthier than their chemical counterparts, but they are also cheaper to produce. While the production cost of chemical fertilisers can be anywhere between ₹15 and ₹20 per kg, biosolids, when produced at a large scale, will cost only ₹5-8 per kg. Given the success of the Swachh Bharat Mission, particularly in rural India, the untapped potential remains immense. **DTE**

⊗@down2earthindia

(Atun Roy Choudhury is with the Cube Bio Energy Private Limited in Hyderabad, Telangana; Neha Singh and Namita Banka are with the Chadwick's FSM Laboratory in Secunderabad; N Chandana is with the Centre for Emerging Technologies for Sustainable Development, Indian Institute of Technology, Jodhpur, Rajasthan; and Jitesh Lalwani is with the Department of Civil Engineering, Vardhaman College of Engineering in Hyderabad)

Twist in the (fairy)tale



When Fairyland Lost Its Magic

by Bijal Vachharajani and Rajiv Eipe

Publisher: HarperCollins Publishers India

MRP: ₹499 | Pages: 120

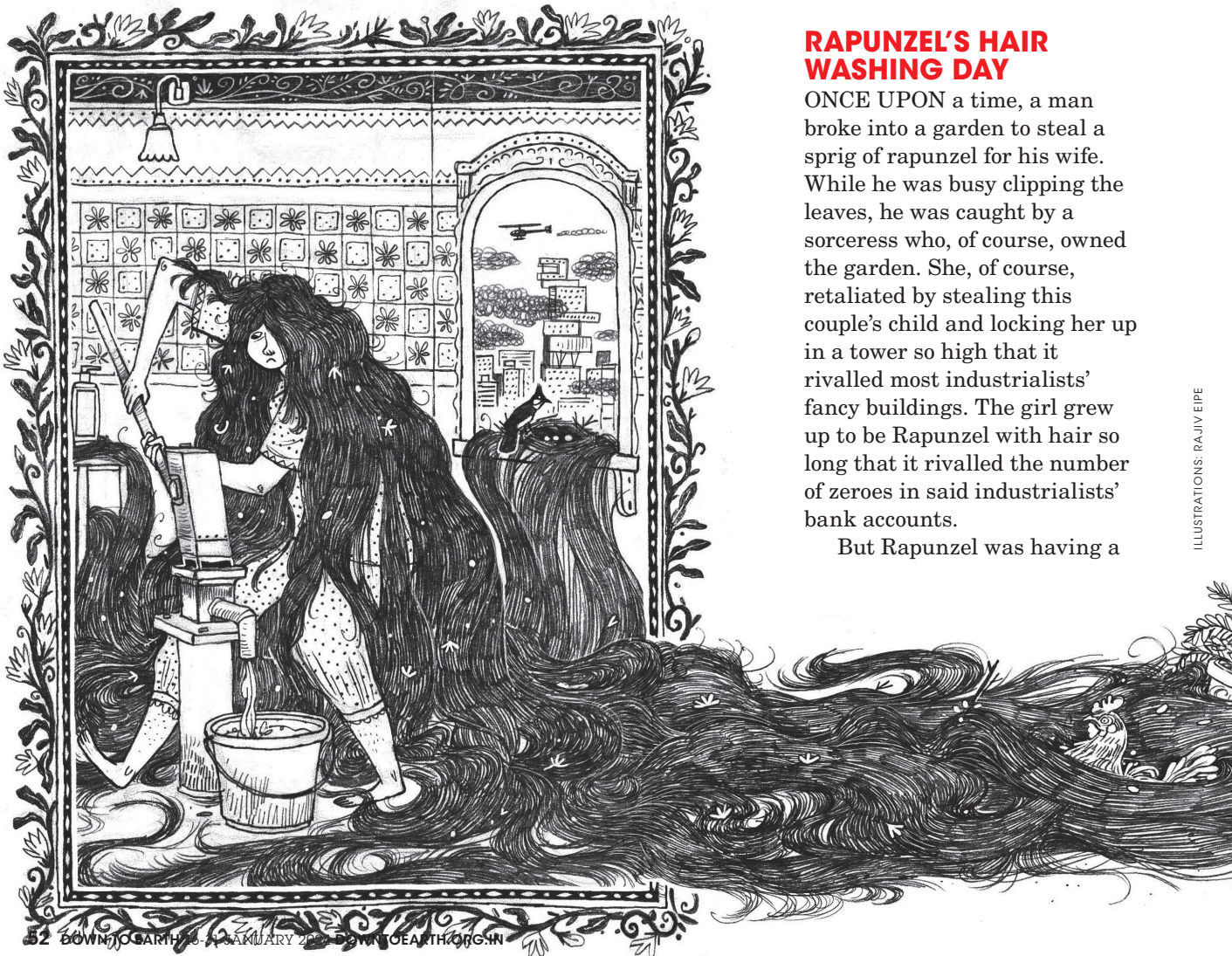
How might fairy tales read if written in today's times?

When Fairyland Lost Its Magic is an attempt at that—a retelling of eponymous fables with climate change factored in on every page. Targetted at young readers, the book can be quite relatable to adults as well. It is humourous, subtle and grim at the same time. The stories by Bijal Vachharajani are accompanied with black-and-white sketches by Rajiv Eipe. Sample them in these three fairy tales:

RAPUNZEL'S HAIR WASHING DAY

ONCE UPON a time, a man broke into a garden to steal a sprig of rapunzel for his wife. While he was busy clipping the leaves, he was caught by a sorceress who, of course, owned the garden. She, of course, retaliated by stealing this couple's child and locking her up in a tower so high that it rivalled most industrialists' fancy buildings. The girl grew up to be Rapunzel with hair so long that it rivalled the number of zeroes in said industrialists' bank accounts.

But Rapunzel was having a



ILLUSTRATIONS: RAJIV EIPE

tough time maintaining her hair, especially since the Great Water Crisis had hit Fairyland. Now, the princess could only wash her hair once a week, on Thursday between 6 a.m. and 6.25 a.m. when free-flowing water came in the tap. One such Thursday, she washed her hair and, at 6.27 a.m., opened the window of her tall tower so that she could let her hair down to dry and for a handy prince to use as a ladder. Rapunzel retched; she coughed, her eyes watered. The air outside was SO yuck! She hastily shut the window and glowered at the grey smog whirling outside her tower. Meanwhile, the prince kept waiting and waiting, but there was nary a sight of hair or hare.



NO WHITE AND HER SEVEN FRIENDS

Once upon a time, a queen was busy sewing clothes when she pricked her finger. Three drops of blood fell on the snow outside—and she wished herself a daughter whom she'd call Snow White. After many years, her child was born. But, by then, there was no snow in their part of Fairyland, so the baby had been called No White.

No White had luxurious black hair just like ebony, skin white as snow and lips red as blood, which were unfortunately hidden behind a mask. Threatened by a Stepma—long story, not important—No White left her



home and moved in with seven friends. They used to have real names but ever since they began working at the coal mines, their names had been changed to Carbon, Methane, Nitrous, Oxide, Water, Vapour, and Gas. It was unfortunate, but what to do?

Carbon was no longer happy.

Methane was sneezing even more because of all the pollution.

Dr Nitrous had so many patients at the factory, all down with a weird flu, that he had no time for anything else.

Oxide had curled up and gone to sleep.

Water was constantly roiling and boiling, just like the rising sea levels, and he was even grumpier than usual. Who knew that was even possible?

Only Vapour and Gas weren't anxious. They went around singing la-la-la. When the smog overwhelmed their lungs, they stopped and pretended like they couldn't be bothered to sing. 'Smog, what smog?' they gasped.

'Nothing is wrong,' Gas wheezed.

'It's all fine,' Vapour said with red, watery eyes.

But every smoggy cloud has a silver lining. No White discovered that she did not need rescuing from her Stepma. In fact, nature had solved her problem. She was most amused as Stepma's plans to poison her with apples bore no fruit. Fairyland was witnessing an apple scarcity because the rains had come too early and damaged most of the harvest. Then a blight had finished off the rest. The last anyone had heard of Stepma was that she was trying to inject poison into a jamun, but the fruit kept staining her hands purple. Even Mirror, Mirror on the Wall was horrified at her purple fingers. No White laughed and laughed a tinkly laugh, which at any other time would have attracted birds and butterflies. Now there were none for her to play with.

Meanwhile, the poor prince kept waiting for No White to bite into a fruit, but there was no sight of apple or jamun.

THE NOT-SLEEPING BEAUTY

Once upon a time there was a princess.

A very beautiful princess.

A very beautiful princess, beloved of her parents, and her subjects, and objects.

But alas, she was cursed. Cursed to fall into an almost-death-like sleep. Waiting for a handsome prince, who would never arrive because...

The curse would not take! The princess in question—Sleeping Beauty (SB)—wouldn't sleep. Which left her simply as Beauty—and, really, that was a name that simply would not do.

So far, the insomniac princess had tried many things to sleep—a cup of haldi doodh (sprinkled with a kiss of nutmeg), a long hot bath, a short cold bath, lavender candles, lavender cream, lavender tea, and even gross banana tea. All it had done was make SB full of calcium and feel very clean.

The reason SB could not sleep, despite cursed spindles, was that she was feeling quite anxious. Every time SB spun her cursed spindle, and pricked herself, she would fall down dramatically on the floor and wait.

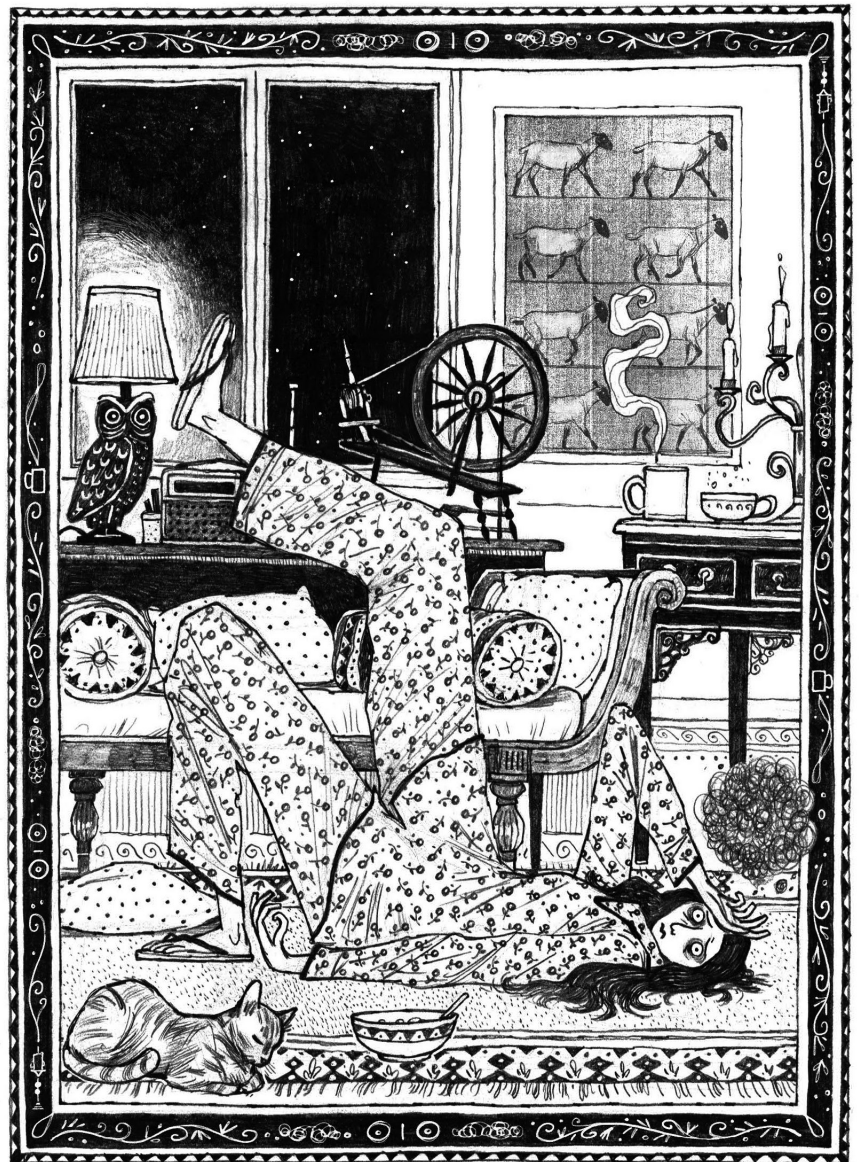
And wait.

And wait.

And nothing—still no sleep.

On the hard floor of the Sleeper and the Spindle Room, she would think and think, and worry and worry, and cry and wail, all of which made her anxiety even worse.

It had become so bad that the King and Queen were getting quite anxious too. If she didn't



sleep, then when would the handsome prince come and kiss SB and wake her up? The poor prince also wanted to know; he kept waiting, but there was no sign of a dream or a snore.

This was a very serious issue. Her parents consulted the old fairy—the good-turned-evil-turned-good-again one—who had cursed SB's family after they ignored her social media post wishing them happiness on having a baby girl. But curses,

once given, could not be returned.

Everyone kept telling her everything was fine. SB knew that things weren't all 'fine'. She was filled with dread—something her therapist had diagnosed as climate anxiety. Instead of dream clouds, a permanent black cloud hovered over her. **DTE**

⊗@down2earthindia

(Excerpted from When Fairyland Lost Its Magic with permission of HarperCollins Children's Books India)



सी एस आई आर-नीरी

पर्यावरण विज्ञान एवं अभियांत्रिकी में अग्रणी



- पर्यावरणीय समस्याओं का विज्ञान एवं प्रौद्योगिकी द्वारा समाधान
- उद्योग एवं समाज के हित में प्रौद्योगिकी हस्तांतरण

सी एस आई आर - नीरी के राष्ट्रीय लक्ष्य

- वैश्विक वैज्ञानिक प्रभाव
- प्रवर्तन-चालित उद्योग
- सामाजिक-आर्थिक विकास

वर्तमान अनुसंधान एवं विकास गतिविधियां

पारिस्थितिकी बहाली



ठोस एवं जोखिमकारी अपशिष्ट प्रबंध

जल प्रौद्योगिकी एवं प्रबंध



अपशिष्ट जल प्रौद्योगिकी

वायु प्रदूषण नियंत्रण



पर्यावरणीय पदार्थ

पर्यावरणीय प्रभाव एवं जोखिम मूल्यांकन, आडिट



पर्यावरणीय जैवप्रौद्योगिकी, जीनोमिक्स, स्वास्थ्य, विषाणुविज्ञान

उपलब्धियां



अपशिष्ट जल के उपचार के लिए फाइटोरिड प्रौद्योगिकी



जल में से फ्लोराइड के निष्कासन के लिए इलेक्ट्रो लिटिक डिप्लोरिडेशन

अनुसंधान एवं विकास प्राथमिकताएं

- राष्ट्रीय शुद्ध वायु मिशन
- शुद्ध जल के लिए दीर्घकालिक विकल्प
- अपशिष्ट जल का उपचार एवं पुनर्प्रयोग
- ठोस अपशिष्ट का उपयोग एवं प्रबंध
- स्टॉकहोम कन्वेंशन के तहत पर्सिस्टेंट ऑर्गेनिक पोल्यूटेंट की मात्रा का निर्धारण और इसमें कमी लाने के लिए प्रयास
- रूढ़िगत पर्यावरण प्रभाव एवं जोखिम मूल्यांकन से कैरिंग कपेसिटी आधारित विकासात्मक योजना अध्ययन की ओर अग्रसर
- कार्बन डाई आक्साइड सिक्वेस्ट्रेशन और वेलोराइजेशन
- जलवायु परिवर्तन
- स्वच्छ प्रौद्योगिकियों का विकास

महत्वपूर्ण परियोजनाएं



अपशिष्ट से जैवईंधन



राष्ट्रीय राजमार्ग पर हरित गलियारे का विकास

सी एस आई आर-राष्ट्रीय पर्यावरण अभियांत्रिकी अनुसंधान संस्थान

नेहरू मार्ग, नागपुर - 440 020. वेबसाइट: www.neeri.res.in

Fermenting leftover potato *sabji* with water, red mustard seeds and salt can help create a tangy and healthy drink

SOUR SURPRISE

Fermentation can help make uniquely tangy healthy dishes while also reducing food waste at home

VIBHA VARSHNEY



DURING A recent family wedding, one of the many discussions among relatives was on extra food going to waste at such events. A relative chipped in about how wastage was avoided traditionally, with the example of the simple potato *sabji* and *puri* combination. If left over, guests would simply take some of the dish home to enjoy the next day, she said. But sometimes even this would not help empty the bowl; so the leftover *sabji* would be fermented to preserve for an extra day or two.

The traditional method of fermentation involves mixing a bowl of the *sabji* with water, a spoon of ground red mustard seeds or *rai*, and salt as per taste. In two

to three days, you would have a spicy, tangy drink (see recipe). You could also adjust the water level to get the fermented *sabji* to a curry-like consistency and simply eat it with steaming hot rice.

The preservation of food occurs when lactic acid bacteria (LAB) present in the fermenting ingredients like the red mustard seeds convert the starch present in the potatoes to lactic acid. This acid is a natural preservative and inhibits growth of food-spoiling bacteria and fungi. It also provides a sourness to the food and makes it more tasty. The anaerobic conditions created by addition of water to cover the *sabji* ensure that only LAB can grow.

Such fermentation, called

lactofermentation, is prevalent in many traditional cuisines. The most common example is curd, which is prepared in households across India. Regional specialities such as *kasundi*, a spiced mustard sauce from West Bengal, and *dal vadis* or dried lentil fritters from Uttarakhand are prepared through fermentation of the ingredients to enhance taste. *Idli* and *dosa* batter also requires fermentation. Outside the country, examples of fermented food include sauerkraut, made from cabbage and traditionally consumed in eastern and central Europe, and kimchi, a Korean vegetable dish. Such food has gained popularity as it is probiotic, improves gut health and protects against diseases.



UNDERRATED FOODS

The International Scientific Association for Probiotics and Prebiotics defines fermented foods and beverages as “foods made through desired microbial growth and enzymatic conversions of food components”. Similarly, probiotics are defined by the UN Food and Agriculture Organization as “live microorganisms which, when administered in adequate amounts confer a health benefit on the host”. Going by these definitions, home fermented foods are not generally recognised, as fermentation here is not controlled and because the exact LAB microbe inducing the process is generally unknown.

LAB comprises 16 genera such as *Lactobacillus* and *Streptococcus*, 12

of which are associated with food. These genera are amongst the very first bacteria studied. In 1873, British surgeon Joseph Lister isolated the first bacterial pure culture, which he called *Bacterium lactis*. This LAB is now called *Lactococcus lactis* and is used to ferment milk to produce hundreds of dairy products.

Scientists are trying to identify all the beneficial LAB microbes that provide the distinct sour taste to different fermented foods. For example, in North India, a unique sour and spicy *kanji* prepared from black carrots is consumed during the winter months. In 2019, a study published in the *International Journal of Gastronomy and Food Science* by researchers in Delhi finds that the sour note in the *kanji* is provided by *Lactobacillus plantarum*.

Apart from flavour, fermentation also provides several health benefits. In a 2020 paper published in the journal *Nutrients*, researchers from Ireland reviewed studies on the benefits of fermented foods. They found that various studies indicate that consumption of fermented products can reduce the likelihood of developing cardiovascular disease and type 2 diabetes mellitus. Dishes such as kimchi were found to have anti-obesity and anti-diabetic effects. Fermented foods could also reduce symptoms of inflammatory bowel disease and help in its resolution. Some investigators demonstrated that LAB-associated fermented milk could help lower cholesterol and has anti-cancer properties.

The 2020 paper also mentions that several recent studies have indicated that the consumption of fermented foods can be associated with improvements in mood and cognitive function. The researchers point out that there is a growing body of evidence showing links

RECIPE

POTATO SABJI

INGREDIENTS

Potatoes (boiled): 2
Asafoetida: 1/4 teaspoon
Cumin: 1/2 teaspoon
Coriander powder: 1/2 teaspoon
Turmeric powder: 1/2 teaspoon
Chilli powder: 1/2 teaspoon
Desi ghee: 1 tablespoon
Salt to taste

METHOD

In an iron pan, heat the *desi* ghee and add asafoetida and cumin to temper. Add the peeled and smashed potatoes along with turmeric powder, coriander powder, chilli powder and salt and mix well. Add one to two cups of water to get a *sabji* of your preferred consistency.

FERMENTED BEVERAGE

INGREDIENTS

Leftover potato *sabji*: 1 bowl
Rai: 1 teaspoon
Water: 4 glasses
Salt to taste

METHOD

In a glass jar, transfer the potato *sabji* and add the water. Mix well and adjust the salt level. Add *rai* and mix again. Close the jar and keep in a sunny place. Check after two days and if it is sour enough, pour in a glass and enjoy the beverage.

between gut microbiota composition and overall health. They say gut microbiota can potentially be beneficially modulated by LAB fermentates in a target-specific manner.

This means, fermentation can not only help reduce food waste after weddings, but also help soothe the stomach if you feeling the after effects of overeating at such events. [DTE](https://www.downtoearth.org.in) [@vibhavarshney](https://www.instagram.com/vibhavarshney)

Advance warnings

THE NATIONAL Statistical Office (NSO) has released its first advance estimates of national income for 2023-24. Beating all expectations, NSO estimates, the Gross Domestic Product (GDP) will record a growth of 7.3 per cent. However, this good news hides an economic reality that is not-so-good news for the country's largest employer—the agriculture sector. The agriculture sector (including livestock, forestry and fishing) is estimated to grow at 1.8 per cent in 2023-24 (at 2011-12 prices)—a steep decline from the 4 per cent growth in the financial year 2022-23.

Among the eight economic activities taken under the NSO estimate, agriculture has the lowest growth rate. This is also one of the lowest agricultural growths in recent years. In 2021-22, agricultural growth fell to 3 per cent in comparison to 3.3 per cent in 2020-21. Before 2021, for six years, the agriculture sector grew at an average of 4.6 per cent (even though in three of the six years the rate was below 4 per cent while in the rest three years it was around 6 per cent) because the base year for comparison was 2015-16 when agricultural growth was 0.6 per cent due to severe drought.

The current year's low growth is attributed to an erratic monsoon and massive crop losses due to such weather events, partially due to the ongoing El Niño effect. According to NSO, the production of rice dipped by 5.4 per cent in 2023-24 in comparison to 2022-23. In 2022-23, rice production reported a marginal growth of 0.5 per cent in comparison to 2021-21. This translates to more than two years of low production of the staple that employs a major chunk of the country's farmers. It also means that earnings of farmers have been stagnating or growing at an insignificant farm wage growth rate of 1.3 per cent for the last one decade, coinciding with the incumbent government's

two tenures starting 2014. So, what does this low growth mean for the country's economy?

Agriculture employs more than 45 per cent of the country's workforce. Their earning defines the national GDP. The low growth projection has come at a time when individual consumption accounts for nearly 61 per cent of the country's GDP (this is termed as the Private Final Consumption Expenditure, or PFCE, in the NSO accounting). If such a percentage of the consumers do not have the capacity to spend, GDP will naturally be impacted. Moreover, so much distress for so long will also mean that people are adding debt, or slipping into a poverty trap. Per capita PFCE in 2023-24 is estimated to be ₹1,29,400 (at current prices or without factoring in the inflation rate), which is just ₹10,123 higher than what it was in 2022-23. Expenditure is usually treated as a proxy for

The agriculture sector is estimated to grow at 1.8 per cent in 2023-24—a steep decline from the 4 per cent growth in financial year 2022-23

income because people tend to spend according to their income. This meagre expenditure growth indicates a state of low income. The last few years of PFCE data shows

stagnancy, and if one factors in inflation, it may well go into the negative growth bracket.

Notwithstanding the NSO advance estimates, the agricultural growth in the second half of the fiscal year is not that encouraging, given the low acreage of the winter crops and also the crop losses due to erratic and extreme weather events since September 2023. As the revised estimates come in the next few weeks, a clearer picture will emerge.

But what this estimate shows is the behaviour of the agriculture sector in a changed climate. It also shows how a majority of Indians, who depend on agriculture, will continue to bear losses. This has a negative bearing on the national economy. **DTE**

⊗ @richiemaha

RESIDENTIAL TRAINING

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

Date
**MARCH 20-22,
2024**

Last date to apply
**FEBRUARY 29,
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. professionals

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.



ADVANCED TRAINING PROGRAMME ON ENVIRONMENTAL IMPACT ASSESSMENT

CSE has launched an integrated online and onsite training programme on EIA. The training programme comprises 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.

PROGRAMME DESIGN

PART A: BASIC LEARNING (ONLINE)

- Includes sessions on methodology for preparing an EIA, approach for baseline data collection, identification and assessment of impacts alongwith the Environmental Clearance process and understanding of EIA process and legislation from developed countries.
- Conducted on Moodle Platform where participants will be provided with reading/audio-visual training material which they are expected to self-study.
- The course material will be for the duration of 2-3 hrs/day.

PART B: ADVANCED LEARNING (ONSITE)

- Includes practical experience on assessing impacts for different sector projects and developing their Environmental monitoring & management plans
- Hands on experience of presenting case to committee members for environmental clearance
- Review of EIA reports
- Understanding of Risk assessment studies
- Working on case studies through group exercises and role play.
 - Conducted at CSE's residential campus, Anil Agarwal Environment Training institute (AAETI) in Tijara, Alwar, Rajasthan

DATES

Basic Learning (Online)
DECEMBER 5-14, 2023 (CLOSED)

Advanced Learning (Onsite)
FEBRUARY 6-9, 2024

LAST DATE TO APPLY

JANUARY 27, 2024

COURSE FEE

Part B (onsite):
₹ **25,600** (Double occupancy)
₹ **28,000** (Single occupancy)

Traning material for Part A
will be provided

WHO CAN APPLY

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

**Certificate of
Completion** will
be awarded



**FOR ANY QUERY,
KINDLY CONTACT**

Course Coordinator:
ISHITA GARG, Programme Manager, Industrial Pollution
Email: ishita.garg@cseindia.org