

1-15 APRIL, 2024

Down To Earth

FORTNIGHTLY ON POLITICS OF DEVELOPMENT, ENVIRONMENT AND HEALTH

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CLIMATE REFUGEES

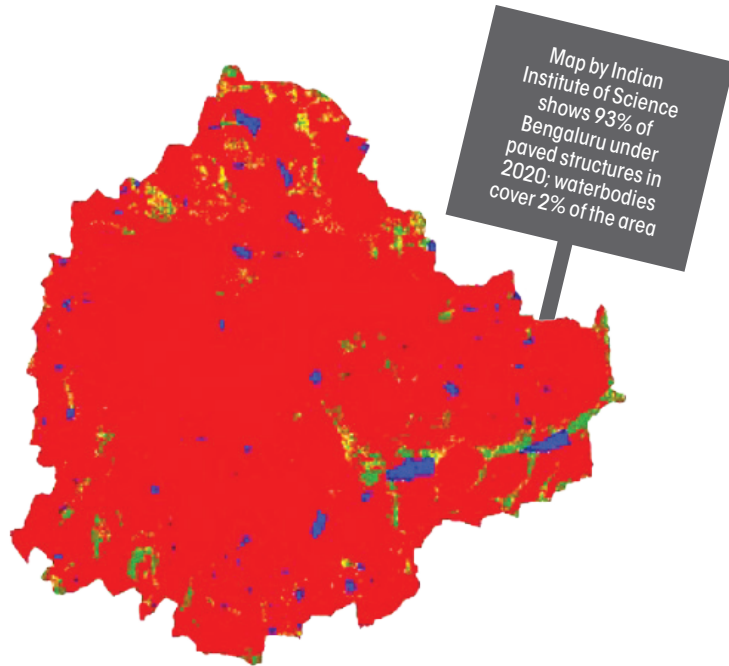
Global conventions lack legal framework

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TEVA SUES CIPLA

Israeli firm says Cipla infringes patents

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WATER CRISIS

BENGALURUED

The city almost entirely paved, with negligible area under waterbodies

Transports water over 100 km from the Cauvery; groundwater at historic low

The ongoing water crisis just a glimpse of the city's future

RESIDENTIAL TRAINING PROGRAMME

CLEAN-BUILD

PATHWAYS TO DECARBONIZE THE BUILT ENVIRONMENT

DATES: April 23-26, 2024 | **LAST DATE TO APPLY:** April 13th, 2024

VENUE: Anil Agarwal Environment Training Institute, Nimli
(near Alwar), Rajasthan

The rapid urbanization and population growth in developing economies have fuelled a construction boom. India's buildings and construction sector is responsible for about a third of the nation's energy use and related CO2 emissions. The sector is expected to nearly triple the energy use and quadruple the emissions by 2050 as the country estimates to add 21.5 billion sqm of building space by 2040 which is dominated by residential buildings. At this juncture, it is crucial to build wise and prevent hefty carbon lock-in.

Decarbonizing strategies are required to address both operational and embodied energy which contribute nearly equally to emissions in a comprehensive outlook – an ecosystem approach. While India has been addressing the operational energy with renewable offsets and standards and codes like Energy Conservation Building Code 2017 and Eco Niwas Samhita 2018, efforts for reducing embodied energy and carbon have just begun. For instance, Building Material and Technology Promotion Council has released a compendium of indigenous materials and technologies. Efforts are now needed to mainstream such materials.

Embodied energy and carbon reduction involves two key strategies: low-carbon design and construction, and low-carbon material options which further involve responsible sourcing as well as production. Processing of construction and demolition waste and use of recycled materials can enable this to a great extent. Addressing these aspects is crucial for achieving India's net-zero commitments by 2070.

CSE's Anil Agarwal Environment Training Institute (AAETI) offers a residential course aimed at providing comprehensive knowledge on decarbonizing the built environment. This course will familiarize practitioners on low-carbon materials, design and construction, recycling of materials, current market trends, existing gaps between policy interventions and ground realities, and strategies for adopting a net zero approach in the construction sector. AAETI is a sustainable, state-of-the-art campus, designed to serve as a learning tool for sustainable building concepts and design practices.

TRAINING METHODOLOGY

Classroom lectures, case studies, class exercises, discussions, and field visit.

TRAINING HIGHLIGHTS

- National policy landscape for net zero and decarbonization strategies.
- Understanding operational and embodied energy and carbon in construction cycle.
- Introduction to low embodied carbon materials, design and construction: traditional, hybrid and emerging technologies.
- Urban heat island effect and mitigation strategies.
- Enabling thermal comfort to reduce operational energy in buildings: passive design techniques, Eco Niwas Samhita.
- Introduction to recycled C&D waste materials and products.
- Economics of recycled C&D waste materials and challenges in uptake.
- Renewable energy and urban interface.

COURSE FEES

₹28,000 (sponsorships and discounts available subject to satisfactory fulfilment of application form) *

*Course fee includes tuition fee, external expert lecture sessions, training materials, boarding and lodging, transport from New Delhi to AAETI and back.

WHO CAN APPLY

Officials from urban local bodies, and other government departments, planners, architects, engineers, professionals from construction industry, academicians.

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Bengaluru's water future

I WROTE last time how Bengaluru's water crisis is human-made. This crisis is not about the lack of water, but about how the city managers have invested in a system that is both capital- and resource-intensive and how this leads to unsustainable water supply and inadequate sewage management. This crisis is then exacerbated by climate change, which is adding to greater variability in rainfall and extreme rain events. What, then, is the way ahead?

The key to a water-secure future for Bengaluru, and indeed for all our cities, is that water supply must be affordable. Only then can it be sustainable. In the case of Bengaluru, water is sourced from the Cauvery, some 100 km away, pumped up and transported. This means the cost of water is high. Worse, the longer the distance, the more is the water leakage. In the case of Bengaluru, water leakage is roughly 50 per cent. In Delhi, which also sources its water from a distance and then transports it across the length and breadth of the city, the loss is a whopping 60 per cent. This means, the water that is finally available after leakage or loss, is even more expensive to supply. This also means, industries and households either do not get the supply as the agencies cannot invest in new pipelines; or, if the cost of water is high, they prefer to look for other options—from tankers to digging borewells. In Bengaluru, it is estimated that half the water supply comes from its underground aquifers.

The problem is, groundwater is not accounted for—the water and sewage boards discount its usage because they do not control its supply. In most cases, they do not even have any estimation of how much water is being sourced from below the ground, as against the “officially” supplied and billed water. The only way to do the math is to estimate the water demand of the city—this is done on a per capita basis, assuming a quantity for each person's requirement in different classes of cities. Bengaluru and Delhi, for instance, have recommended water supply of 150 litres per capita per day and 15 per cent over and above this, for leakage. The gap between the “official supply” and demand is then assumed to be from groundwater. But this is often underestimated because the massive losses are not measured. In the case of Bengaluru, the gap is 50 per cent; it will be safely 60-70 per cent after accounting for water leakage. This is where the opportunity lies.

If city managers accept that aquifers are a critical

source of drinking water and make it part of the city's water-secure future, it will change the equation. The question then would be how groundwater can be used sustainably. This is where the answer of recharging through rainwater becomes the real kicker. Conservation of lakes, and not just cosmetic beautification, becomes a necessity. The fact is, lakes and other waterbodies are sponges of a city; they hold excess rainwater and recharge the groundwater for times of scarcity. As climate change raises the specter of more rain in fewer days, all cities will need to drain their flood. If cities do this in a way that helps recharge their aquifers, they can survive prolonged periods of water scarcity and drought.

Bengaluru, like most other cities of India, had an intricate system of lakes, so that the overflow of one would spill to the next and then the next. But this was studiously discounted because our highly trained water managers only focus on “big” engineering solutions of transporting water in pipelines. The city, over the past many decades, has been fighting a battle to protect its waterbodies—but losing to land development and also to pollution. The 2011 report on lakes submitted to the state high court estimated that there were 189 lakes in Greater Bengaluru and said that not only the lake but even the catchment and drainage need to be protected—without any real success.

Lakes can be protected only if they become part of the water-wise futures of our cities. If Bengaluru did not have the mirage of bringing water from 100-km away Cauvery, it would have invested in the protection of its local water systems—from rainwater harvesting to lake conservation. These would then have been part of the water supply infrastructure, making water supply less expensive and thus more affordable. This, in turn, would have required water boards to rework the paradigm of sewage management so that the wastewater could be intercepted locally, taken to treatment plants and then used to recharge lake water. The fact is, we discharge as much as 80 per cent of the water that is supplied as sewage. Its availability is more secure than water transported over distances. This is why excreta matters. But all this requires changing the mindset of our water managers, and I am not sure how many more droughts this will take. [DTI](#) [@sunitanar](#)

Water supply must be affordable. Only then can it be sustainable

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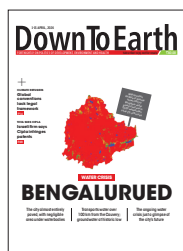
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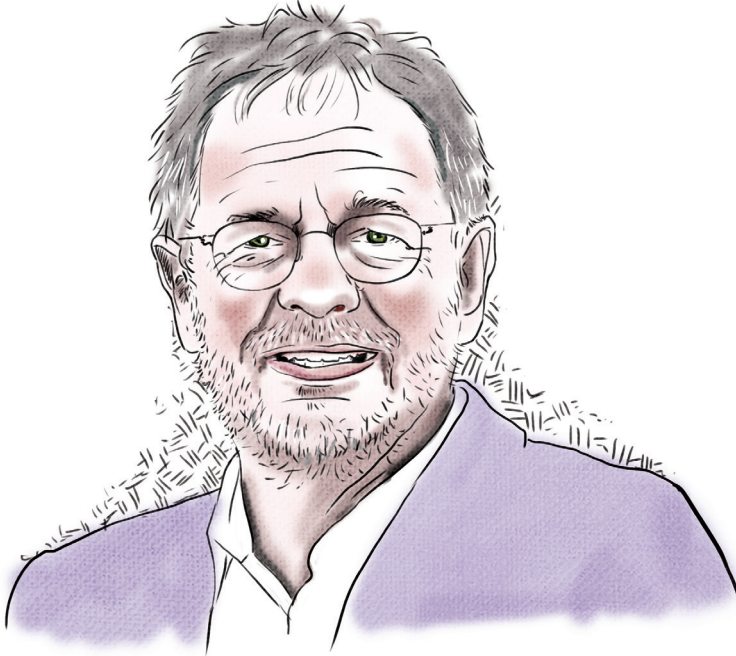
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Engage



Rethink economic measurements

This is with reference to the interview “FAO acknowledges that it neglected costs of food systems in its accounting” (1-15 February, 2024), with Alexander Muller, former assistant director-general of the UN Food and Agriculture Organization. The emphasis of modern economic activity on growth, rather than development, is the root of all major problems. Amid our irreversible obsession with growth, the GDP (Gross Domestic Product) is mistakenly equated with development. Economists also assess a country’s overall economic development by the yardstick of GDP.

In humans, the term growth refers to the increase in the physical height and weight. But, when we talk about development of a person, we take into account both physical and abstract aspects like maturity level, attitude, habit, behaviour, feelings and intelligence. By using GDP as a lens to measure economic activities, we pay attention to what is counted and tend to be oblivious to things not measured. British mathematician and philosopher Alfred North Whitehead aptly called this obsession with measurements the fallacy of misplaced concreteness. Nobel Laureate Amartya Sen, in his book *The Idea of Justice*, says: “The assessment of development cannot be divorced from the lives that people can lead and the real freedom that they enjoy.” GDP is not a good measure of economic performance. We may be able to enhance our understanding of the world by collecting and interpreting more information.

JAYDEV JANA
KOLKATA

Pioneers of Green Revolution in India

The Green Revolution was a major initiative to ensure food security globally, with the aim to introduce new technologies such as high-yielding varieties of seeds, fertilisers, pesticides, irrigation and mechanisation. Its purpose was to alleviate hunger by increasing the production and quality of food crops, especially wheat and rice.

Norman Borlaug is known as the Father of Green Revolution. In 1970, he was awarded the Nobel Peace Prize for his work in developing high yielding dwarf varieties of wheat. The initiative was a major achievement for many developing countries, especially India. Here, MS Swaminathan is known as the Father of Green Revolution. However, from the scientific point of view, it was initiated by Ram Dhan Singh of Punjab Agricultural College, Lyallpur, who developed improved wheat varieties such as C-591, and C-306 that provided a high yield without chemical fertilisers and limited irrigation facilities. His contribution was appreciated by Borlaug, and C-306 is being cultivated even 80 years after development. In the field of wheat research, notable work has been done by DS Athwal and VS Mathur. Athwal also worked on rice and developed the world’s first millet hybrid. Others who worked on rice include Gurdev Singh Khush, VP Singh, Dharampal Singh and Rajeev Varshney. NGP Rao developed the first sorghum hybrid and CT Patel the first cotton hybrid. TS Venkatraman and Janaki Ammal are remembered for their excellent research on sugarcane improvement. The Indian Council of Agricultural Research (ICAR) has also played a leading role in bringing about the Green Revolution.

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Digest

WHAT'S INSIDE

Sarpanch in Maharashtra helps his village get drinking water **P10**

Extreme weather patterns since start of 2024 **P11**

How Asian aerosols impact Atlantic ocean currents **P12**

1,000 WORDS VIKAS CHOUDHARY



Thousands of farmers sat in protest at the national capital's Ramlila Maidan on March 14, pressing for a new law to guarantee minimum support price (MSP) for 23 crops, to stabilise incomes. Free electricity for farming and loan waivers also featured in their demands. Farmers across the country have been protesting for guaranteed MSP since February this year, but despite several rounds of discussions between farm unions and the government, amid a fast-approaching general election, no agreement has been reached.

FOR MORE PHOTOS, SCAN



Taking charge for water

A DECADE AGO, the women of Hiwardhara village were always on foot, recalls Mahendra Kinake. With containers in hand, they would either walk to the few handpumps in the village, or if these were too crowded, they would go farther to waterbodies to collect drinking water for their households. Once home, they would rush to the fields to tend to crops along with their other family members. "Such was the scarcity of drinking water in the village, that households would spend most their days only arranging for it," says Kinake, the sarpanch of the Hiwardhara gram panchayat, which comprises his village and two others in Yavatmal district of Maharashtra.

But since 2020, the situation has changed. Every household in the village has access to potable water and also works to save the resource through tanks and rainwater harvesting facilities. This change is brought by Kinake, who realised the need for the village to take charge of water management after tying up with the Foundation for Ecological Security (FES), a non-profit working in the area. "Through the non-profit, I learnt how the various government schemes, like the Jal Jeevan Mission and the Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS),

A young sarpanch in Maharashtra helps his village residents avail drinking water at home

DAKSHIANI PALICHA

can help us," he says. For instance, under the Jal Jeevan Mission, water tanks had been set up in the village, but were not connected to the community wells.

So, along with a water committee set up with other residents, he prepared a water plan to improve access for all households. The plan entailed involvement of all residents. "In the initial days, we would spread awareness about what needs to be done. But there was a lot of hesitation among people as to whether the plan would work. They had to be convinced multiple times," he says.

After this, tenders were sent for connections to all households to drinking water supply through the Har Ghar Jal scheme under the Jal Jeevan Mission. Residents also built pumps and rainwater harvesting structures through works under MGNREGS.

"The access to drinking water has improved everyone's quality of life. We work together to build and improve our community water resources, which gives us a good sense of ownership," says Nilesh Khadase, a resident of the village.

As the drinking water availability and management improved, the residents encouraged Kinake to run for sarpanch. He won the panchayat elections in 2020, and continues to facilitate more development activities for the village. He also works with FES to promote similar practices in nearby areas.



Mahendra Kinake, sarpanch of Hiwardhara village in Yavatmal district, Maharashtra

EXTREME WEATHER

Shifts in global weather patterns

HIMACHAL PRADESH,

Chhattisgarh, Odisha, West Bengal, Jharkhand and Bihar are among the states that saw moderate to heavy rainfall in March. Madhya Pradesh, Chhattisgarh and Telangana also saw hailstorms.

The India Meteorological Department (IMD) attributed the rains, unseasonal in some places, to a cocktail of weather systems as well as western disturbances, or extratropical storms that originate in the



Mediterranean region, over northern India. During this period, however, the northeastern and southern regions largely reported rainfall scarcity, with some drought-like conditions in

Karnataka and Assam. IMD predicted that the Northeast would see its first pre-monsoon showers from March 20.

The change in winter and spring weather patterns is likely to get

more intense, according to a March 12 study in the journal *Weather and Climate Dynamics*. It reveals that over the past 70 years, western disturbances have been occurring more often during summer, shifting precipitation trends.

Globally, too, countries have reported extreme seasonal conditions this year, with record-breaking temperatures in 10 countries—Indonesia, South Africa, Gabon, Kenya, South Sudan, Algeria, Tunisia, Guyana, Colombia and Brazil.

HEALTH

Healthcare sector protests poor pay, work conditions

SOUTH KOREA in mid-March deployed military physicians and doctors in 20 hospitals across the country, after nearly 12,000 trainee doctors from 100 facilities went on strike against the government's new recruitment plan. The plan, announced in February, is to recruit more medical students, which the trainee doctors says will lead to treatment cancellations and delays in hospitals. Also in March, health workers under the Kenya Medical Practitioners and Dentist Union went on strike, demanding mandatory medical internship postings, which the government says it cannot afford. Europe has also seen health workers go on strike in recent months. In December and January, junior doctors in the UK launched multiple strikes to demand for better pay. Earlier in November, around 3,000 in Barcelona took to the streets in opposition against an agreement on working conditions for 55,000 staff members of the Catalan Health Institute. The agreement includes "miserable" wage increases for different staff, said the striking workers.

POLITICS

Firms with green violations on electoral bonds list

FOUR FIRMS that donated large sums in electoral bonds—instruments that companies and individuals can purchase to donate funds to political parties—have been brought up for violating environmental norms and harming indigenous communities, says *Down To Earth's* analysis of bond lists released by the Election Commission of India on March 14. For instance, Hyderabad-based Megha Engineering & Infrastructures Limited (with bonds of ₹966 crore), is involved in the Kaleshwaram Lift Irrigation Project. In 2022, the Supreme Court ordered status quo on the project after it was told Telangana was increasing capacity without environmental clearance. Utkal Alumina International Limited (₹145 crore) and Vedanta Ltd (₹400.65 crore) have refinery projects in Odisha that saw protests from local communities due to pollution and human rights violations. Mining projects by Jindal Group (₹153 crore) have also seen resistance. In 2020, the National Green Tribunal fined the group ₹160 crore for its project damaging the environment in Chhattisgarh's Raigarh district.

QUERY

Asian aerosols impact AMOC

1 **What is AMOC?**
AMOC is the Atlantic Meridional Overturning Circulation, a complex system of currents in the Atlantic Ocean. This system, like a conveyor belt, brings warm water north and cold water south in the Atlantic Ocean, and also facilitates movements of important nutrients through the ocean. The system is considered a climate tipping element, as a slowdown or collapse of its movement could impact the global climate.

2 **How do aerosols impact AMOC?**
Anthropogenic aerosols, which include pollution from transportation, coal combustion and manufacturing, work

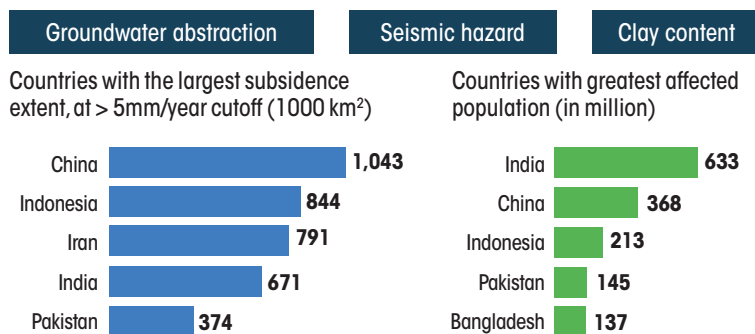
to reduce AMOC movement by shielding the solar heating and cooling the Earth's climate. So far, it was found that anthropogenic aerosols over North America and Europe, along with rising greenhouse gases, can contribute to a slowdown of AMOC. However, it was unclear whether aerosols from Asia could also impact the system. In a recent study published in *Nature Communications*, scientists have found a direct link—an increase in aerosols over Asia could accelerate the risk of an AMOC collapse.

3 **Is there a way to reverse the impact?**
The researchers of the recent study suggest that reducing aerosol emissions from Asia, which has already been touted as a solution to reduce local air pollution in the region, could also help stabilise AMOC and reduce the risk of a collapse of the ocean current system.

TRACKER

Nearly **2 billion** people globally are threatened due to land subsidence, a geohazard caused by the sudden or gradual settling of ground surface. More than **6.3 million sq km** of Earth's surface is susceptible to significant subsidence, with the primary reason being **groundwater abstraction**.

Top 3 predictors that positively affect land subsidence rate



Source: "Unveiling the Global Extent of Land Subsidence: The Sinking Crisis" *Geophysical Research Letters*, February 2024

Scan this QR code to see *Down To Earth's* analysis of extreme weather events



BITS GLOBAL

The European Commission on March 15 announced a series of changes to the EU's Common Agricultural Policy, a subsidy programme, amid ongoing farmer protests in the bloc. The changes, which will be negotiated further, include exempting farms under 10 hectares from checks and penalties under the policy conditions and removing obligations to keep parts of farmland fallow. In recent months, farmers in Poland, Belgium, France and Italy have staged protests against price distress and climate policies they deem detrimental to agriculture.



The US Environmental Protection Agency on March 18 issued a comprehensive ban on chrysotile asbestos, the only type of asbestos used in the country, found in items such as automotive brake linings and gaskets. Asbestos is known carcinogen linked to multiple types of cancer. It has already been prohibited in more than 50 countries across the world.

A dozen people were killed in China in March in two separate coal mine accidents. On March 11, seven people died and two went missing after a gas explosion at a mine in China's eastern Anhui province, while a few hours later, an underground coal bunker, Shanxi province collapsed, killing five. Two others also went missing in Shanxi. The accidents came just four months after China revamped a law on mine safety, following a surge of deaths in the coal industry in 2023.

Resistance to the antiretroviral drug dolutegravir is increasing among HIV patients, the World Health Organization (WHO) said in early March. Since 2018, WHO has recommended dolutegravir for HIV treatment. However, the body now notes evidence of resistance of 3.9-8.6 per cent among patients.

BITS INDIA

Onion production in the country will likely decline by about 15 per cent and potato by 2 per cent from last year, according to the First Advance Estimates of horticultural crops for 2023-24 released by the Department of Agriculture and Farmers Welfare on March 7. However, other crops such as cabbage, cauliflower, tomato and banana, orange and mango show an increase in production. Total horticulture production in 2023-24 is pegged at about 355.25 million tonnes, marginally lower than the 355.48 million tonnes as per the 2022-23 final estimates.

Tamil Nadu on March 8 announced the launch of the country's first marine force to protect marine resources and biodiversity in the Gulf of Mannar and the Palk Bay. The force, which comprises 12 marine watchers from the fishing community, will combat crimes such as marine wildlife smuggling and poaching, said the state. In pilot operations since 2023, the force has detected 25 cases with the seizure of 4,133 kg of illegal wildlife articles.



Himachal Pradesh in mid-March banned the production, sale and storage of cotton candy or candy floss for one year, after tests revealed the presence of a potentially hazardous colouring agent named Rhodamine B in samples. Rhodamine B is commonly used in textile, paper and leather industries and is believed to pose health risks. States such as Karnataka, Tamil Nadu and Goa have implemented similar restrictions on harmful colouring agents.

India ranked 126 out of 143 nations in the "World Happiness Report 2024" released on March 20, the UN International Day of Happiness. The country ranked lower than Pakistan, Libya, Iraq, Palestine and Niger on the index, while Finland topped for the seventh year in a row.

POLICY FRAMEWORKS

■ The Union Ministry of Heavy Industries will introduce the **Electric Mobility Promotion Scheme 2024** to accelerate the adoption of electric two-wheelers and three-wheelers in the country. This is a fund-limited scheme with a total outlay of ₹500 crore from April 1 to July 31, 2024.

■ The Union Ministry of Petroleum and Natural Gas has issued the **Petroleum (Amendment) Rules, 2024** to enhance safety, streamline import procedures, and ensure compliance within the petroleum industry. The rules exempt importation of petroleum containers for research and development purposes from certain regulatory provisions, provided they comply with international safety standards.

■ The Uttar Pradesh Cabinet has approved a **green hydrogen policy** and the establishment of 800 MW thermal power units in the state. The policy has been set for five years, and industries establishing themselves within this timeframe will receive subsidies and other incentives, totalling ₹5,045 crore.

IN COURT

NATIONAL GREEN TRIBUNAL

■ Taking cognisance of a 2023 magazine article on encroachment and pollution in lakes and water bodies in Terai region, Uttar Pradesh, the National Green Tribunal (NGT) directed a committee of Central and state authorities to visit the affected sites and file a report by May.

■ NGT has asked two individuals who allegedly took up illegal mining in Budgam district, Jammu and Kashmir, to pay environmental compensation with the Jammu and Kashmir Pollution Control Committee. The compensation will be used for restoration of the affected area.

■ Hearing allegations of excessive dumping of waste at a site in the Darjeeling municipality, which saw a fire in January this year, NGT has asked the state authorities to file a response by April and directed a committee to go on a fact-finding mission to the site.

SUPREME COURT

■ The apex court on March 19 directed states and Union Territories to ensure that ration cards are issued to 80 million migrant and unorganised workers, already registered in the eShram portal, within two months. The court had issued the order in April 2023, but noted delays due to e-KYC updation

HIGH COURTS

■ The High Court of Karnataka stayed operation of a March circular issued by the Centre banning 23 breeds of "ferocious and dangerous" dogs. Saying that the stay is only applicable in the state, the court asked the Centre to provide documents based on which the circular was issued.

■ Taking *suo motu* cognisance of encroachment on public roads, the High Court of Rajasthan slammed state authorities for inaction and ordered remedial measures.

So far...

Number of cases on environment and development tracked from January 1 to March 19, 2024

NATIONAL GREEN TRIBUNAL	SUPREME COURT	HIGH COURTS
117	24	28

FOR DETAILED VERDICTS, SCAN



Overlooked crisis

While there is much talk about climate migration, the world is without a legal framework to protect people displaced by weather disasters

AKSHIT SANGOMLA
NEW DELHI

Raynold Louima (second from left) had to flee Haiti due to the impact of recurring natural disasters on his life and livelihood. Today, he lives in Brazil and is trying to get his family out of Haiti

RAYNOLD LOUIMA'S life in Gonaives, Haiti, was upended by the devastating impact of hurricane Tomas in 2010. Already reeling from the aftermath of an earthquake earlier that year, which claimed over 100,000 lives, his farm was decimated by the hurricane. Despite toiling on his family's farm and working on others' land for three more years, a period when Haiti saw prolonged drought-like conditions, Louima, the eldest son, found it impossible to support his family of seven.

In 2013, the then 23-year-old took the decision to seek a better livelihood abroad for his family's survival. Pooling together resources,

including the sale of his grandmother's cherished bull and contributions from neighbours, Louima embarked on a perilous journey to Brazil.

Over the next one month, he travelled to the Dominican Republic, Ecuador and camped at Peru, before reaching Brazil's Acre city to stay at a centre accommodating thousands of migrants from Latin America and Africa, many of whom had left their homes for reasons similar to his.

"After facing the impacts of weather disasters in Haiti, I knew seeking residence in a foreign country was my only hope for a better future," says Louima. Next, he secured a menial job and started



learning air conditioner and refrigerator maintenance. In 2016, he married a Brazilian and in 2020—seven years after Louima left his home—he obtained Brazilian nationality. Today he works as a dental surgeon, runs his own cooling solutions company and a non-profit, Haiti Sorria, for children.

“In 2022, I managed to get one of my brothers, Woody, to Brazil. My other brother, Rogelson, has migrated to the Dominican Republic as the situation has only worsened in Haiti in the past years,” he says. According to a study by UNICEF in November 2023, floods and drought are becoming frequent in Haiti, resulting in deaths and forced displacement. It adds that tree felling, a leading contributor to climate change in Haiti, has become a means of survival for many families as the country is seeing the “gradual disappearance” of fruit crops and reduced farm yields.

Thais Alves Pinto, the lawyer who helped Woody get a visa, says that Louima and his family would not have had to go through the long struggle had there been a legal definition of climate refugees. Refugees, as defined under the Geneva Convention of 1951, are people with “well-founded fear of being persecuted for reasons of race, religion, nationality, membership of a particular social group or political opinion”. It adds that rights granted to a refugee are extended to the family. But the definition does not include climate change as a basis for seeking asylum.

The UN High Commissioner for Refugees, in a paper in 2019, says the Geneva Convention could be applied to persons affected by climate change, as long as they are already marginalised and facing or are at risk of facing persecution. But this

PERFUNCTORY ACTIONS

Seven decades after the world defined refugees, it still lacks a definition for climate refugees

1951: Geneva Convention gives a legal definition of refugees. It does not include climate disasters as a ground for seeking asylum

1985: UN Environment Programme for the first time broadly defines environmental refugees as people who are forced to leave their traditional habitat, temporarily or permanently, due to “environmental disruption”

2011: Nansen Conference on Climate Change and Displacement in Norway formulates 10 principles on climate change and cross-border displacement

2013: European Commission downplays climate-induced migration into Europe

2015: The Paris Agreement calls for a taskforce to recommend approaches to avert, minimise and address climate change-related displacement

2018: The UN Global Compact on Refugees has a reference of climate refugees, but lacks actionable commitments from countries

2022: Kampala Ministerial Declaration on Migration, Environment and Climate Change allows people affected by weather events to move safely across the borders in the Horn and East of Africa regions

2023: Pacific island countries agree on a framework to allow cross-border movement of people due to climate change. Australia and Tuvalu sign a treaty which allows some people from Tuvalu affected by climate change to migrate to Australia and work there

Source: Based on information from news articles and reports

is easier said than done.

Ioene Teitiota from the island nation of Kiribati has been trying to get asylum in New Zealand since 2013 due to the adverse effects of climate change, particularly sea level rise. In 2015, Teitiota approached the UN Human Rights Committee, alleging that New Zealand, by refusing him asylum, had violated his right to life under the International Covenant on Civil and Political Rights adopted by the UN in 1966. He argued that rising sea levels in Kiribati had led to conflicts and reduced freshwater access, posing a threat to his life. In 2020, the UN committee upheld New Zealand’s decision, citing insufficient proof of a direct threat to Teitiota’s life.

The struggles of Louima and Teitiota highlight the complexities surrounding climate-induced displacement and the limitations of existing legal frameworks in addressing such challenges.

Mamadou Goita, executive director at the African think-tank Institute for Research and Promotion of Alternatives in Development, advocates for a consensus on the distinction between climate change and variability. “Mali has witnessed rapid desertification since the 1970s and this has forced many people to move to France. Still, many believe that the desertification is due to climate variability and can reverse in the future. So this distinction between climate variability and climate change is critical,” says Goita.

IN DENIAL

Without a legal definition, international efforts have focused on establishing climate change as a catalyst for human mobility, without explicitly addressing the question of climate refugees (see ‘Perfunctory actions’). The Global Compact for

Migration, the first inter-governmental agreement reached in December 2018, acknowledges that climate change is a “deep cause” for the movement of people, but is silent on the impacted communities, says Goita. The Compact, agreed upon by all the 193 UN member states, is non-binding.

Similarly, the 2022 Kampala Declaration, adopted by 48 African countries in August 2023 to address the link between climate change and human mobility in the continent, does not mention the term climate refugee. “All these measures can offer some kind of protection to people, but do not provide a legal definition,” says Alice Baillat, policy advisor to the Geneva-based non-profit Internal Displacement Monitoring Centre (IDMC) and the Norwegian Refugee Council.

Beyond the regional treaties, the issue of climate refugees hardly features in global climate negotiations. The recently adopted text outlining the Global Goal on Adaptation, a significant outcome of the 28th Conference of the Parties to the UN Framework Convention on Climate Change (COP28) in 2023, fails to mention climate migration, mobility or refugees. The global goal, enshrined under Article 7.1 of the 2015 Paris Agreement, pledges to “enhance [the world’s] adaptive capacity, strengthen resilience, and reduce vulnerability to climate change.”

The adopted text for the establishment of the Loss and Damage Fund, another key outcome of COP28, acknowledges climate-induced migration within a country, but has no explicit mention of climate refugees. “If the global negotiation texts do not address people displaced by

climate hazards, they will always be incomplete. Many definitions within these documents, either adopted or in the process of adoption, remain vague,” says Goita.

Cristina Dragomir, a researcher at the New York University in the US, says the problem lies in the fact that international organisations feel that now is not the time to open up international conventions on climate refugees. “They say work must happen at the local level. But both must be done together,” says Dragomir. This is important as a single international convention alone will not be able to address all the different situations faced by climate change, says Balliat, adding that different tools and migration poli-

COUNTRIES GRANT REFUGEE STATUS ON AN INDIVIDUAL BASIS, BUT CLIMATE CHANGE OFTEN AFFECTS ENTIRE COMMUNITIES. THE WORLD IS ILL-PREPARED TO HANDLE SO MANY REFUGEES

cies are needed to address the different needs of the affected people.

UNPREPARED STILL

A consensus on the legal definition of climate refugees is just the first step, as identifying the people will be the next big challenge. “Currently, no credible number is available on climate refugees. The world has a few estimates of internal displacement of people due to impacts of climate change, but even they do not capture the magnitude of the challenge,” says Goita. In 2021, the World Bank, in its Groundswell report, estimated that by 2050, some 216 million people worldwide would be internally displaced due to the impacts of climate change. IDMC estimates that in 2023 alone there were

more than 32 million displacements because of natural disasters.

The other challenge is that countries currently provide refugee status on an individual basis, but climate change affects entire communities or even nations. “In the future, we may witness entire island nations succumbing to rising sea levels. The world is ill-prepared to handle the influx of so many refugees,” says Balliat.

Fearing such a situation, Tuvalu forged the world’s first climate migration pact with Australia in November 2023. Under the provisions, Australia pledges to grant residency to up to 280 Tuvaluans annually, extending sanctuary to those facing dangers due to climate change.

“Countries currently view refugees as a security and economic threat to their citizens. We know that climate-induced migration will only increase in the days to come. If approached with proper legal provisions and planning, climate migration can be an effective adaptation tool, carried out in a sustainable fashion to benefit both the affected countries and those providing refuge,” says William Clark from the Harvard University, US.

One such example is the Pacific Island Climate Mobility Framework. Forged in November 2023, it allows people to move legally between island countries in the Pacific region. It also encourages labour migration schemes among countries as an adaptation measure for people affected by climate change. The framework, though not legally binding, attempts to create migration pathways to enable Pacific people to move safely in the context of climate change. **DTI**

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On guard

Communities in Chhattisgarh and Uttar Pradesh reduce human-elephant conflicts using technology and proactive on-ground monitoring

PURUSOTTAM THAKUR
IN CHHATTISGARH AND
VIVEK MISHRA IN NEW DELHI

IN THE heart of the dense forests of Chhattisgarh, an important initiative is underway to safeguard elephants and the human settlements living on the fringes. This unique endeavour involves members of the local community, known as *hathi mitras* or friends of elephants, who work round the clock to maintain a vigilant watch on the movement of the elephants and warn village residents if the animal is in close proximity.

Jitendra Kunjam, a *hathi mitra* stationed at the Udanti-Sitanadi Tiger Reserve that spreads across Gariaband and Dhamtari districts, shares his recent experiences. For the past two months, elephants have been residing within the forest, feeding on roots, bamboos and lush green leaves. During a recent expedition, Kunjam, along with fellow trackers, encountered elephants from a safe distance as they rested in the afternoon shade.

“Elephants are not typically found in the reserve. So when a herd of 20-30 elephants migrated



Hathi mitras trek 5-15 km every day inside the Udanti-Sitanadi Tiger Reserve in Chhattisgarh to track the movement of elephants and alert village residents if the animals are in close proximity. A *hathi mitra* (below) checks fresh rinds of a tree left behind an elephant herd in the tiger reserve

from Odisha to our forests in 2019-20, we were tasked with monitoring their movements,” says Narendra Mandavi, who earlier used to monitor forest fires.

“Due to the overpopulation of elephants in Odisha’s forests, we are witnessing their displacement to Chhattisgarh and Jharkhand. Such displacements often lead to conflicts, as people attack the elephants out of fear, prompting aggressive behaviour from the animals. The *hathi mitra* initiative that was started in 2021 has played a crucial role in preventing such conflicts,” says Varun Kumar Jain, deputy director of the tiger reserve. He adds that the reserve can accommodate around 200 elephants.

“We have learnt a lot about elephants,” says Dheluram Sahu, another *hathi mitra*. “We know that before they begin to walk, elephants scratch their leg on the ground, raise their trunk and move their ears. We also know that elephants generally move forward. This is the

reason we always station ourselves behind the herd,” says Sahu. Elephants use their trunks to spray dust in the air to warn us if we are too close, he adds.

“Elephant tracking is a demanding task. During the day, when elephants typically rest, the *mitras* monitor them on foot, while at night, when they move around for food, the *mitras* accompany the forest department’s patrolling van,” says Devdutta Taram, ranger of the Arsi-Kanhar section of the reserve.

Initially, *hathi mitras* alerted village residents of elephant threats through *munaadi*, the traditional practice of hooting to raise an alarm. But in early 2023, the Chhattisgarh forest department introduced the “Chhattisgarh Elephant and Alert” mobile application in the state. Now *hathi mitras* update the location of the herds on the application, which identifies the villages within a radius of 20 km to the herds and sends alerts on the mobile phones of the village residents through voice notes and WhatsApp messages.

Since the application’s implementation, confrontations have decreased, with no human deaths reported in the area, says Jain. The presence of elephants in the region has also enriched the ecosystem. “They have made the forests less vulnerable to fires and reduced illegal tree felling and encroachment,” says Jain.

BEYOND BORDERS

Over 1,000 km from the Udanti-Sitanadi Tiger Reserve, another community-led initiative is underway in the Katarniaghat forest sanctuary. Unlike Udanti-Sitanadi, Katarniaghat in Bahraich district of Uttar Pradesh is a part of the Terai Elephant Reserve and the Indo-Nepal Khata elephant corridor.



PATHS TO PRESERVE

Tap into the advancements of landscape ecology, not just expert knowledge, to identify and restore elephant corridors

Jean-Philippe Puyravaud, Samuel A Cushman and Priya Davidar

POPULATION FRAGMENTATION is the split of a large single population into smaller, isolated units, which increases the risk of extinction for endangered species due to population isolation. The Asian elephant is a flagship species; protecting its habitat and ensuring connectivity through corridors will help maintain a genetically viable population and conserve biodiversity. However, efforts to reconnect elephant corridors must be carefully planned.

Landscape ecology in the 1960s defined a corridor as an elongated stretch of land joining two reserves. The landscape was conceived as a patchwork of habitat "patches", usually reserves, within a "landscape matrix" used by humans. A corridor would help animals cross the matrix in a relatively safe manner to go from one protected area to the next. In the absence of better techniques, experts would rely on field knowledge and mark a typically long and narrow passage to be preserved or restored as a corridor.

This conception guided the "Right of Passage: Elephant Corridors of India" report (ROP) by the Wildlife Trust of India in 2005 and 2017. ROP has limitations, such as the lack of a working definition of corridor. The passages that are identified in the document as corridors are based on expert knowledge.

This older concept of corridor began to be questioned in the 1990s. A corridor seen or designed by humans may not hold true for animals, because their sensory world and physiological requirements are entirely different from

ours and they decide their movement based on many variables unknown to us.

Moreover, expert identification of corridors is fraught with difficulties as experts know some parts better than others and thus do not have a synoptic view of larger landscapes, which leads to a bias. Humans may also overlook disruptions, such as a noise barrier that may deter animals from crossing and render the reconnection effort ineffective. Thus, there is no guarantee that a

EXPERT IDENTIFICATION OF CORRIDORS IS FRAUGHT WITH DIFFICULTIES AS EXPERTS KNOW SOME PARTS BETTER THAN OTHERS AND THUS DO NOT HAVE A SYNOPTIC VIEW OF LARGER LANDSCAPES

corridor proposed by an expert is the best possible choice or will even work at all.

From a scientific point of view, personal expertise does not allow the test of hypothesis. To verify variables that can predict the path a roaming elephant would take or the landscape features that would prevent elephants from staying within a corridor, one must put animal movement at the centre of investigations. This realisation influenced a new era in the early 2000s. Landscape ecology became more accurate and new frontiers of scientific exploration opened up to include aspects of animal behaviour, physiology and evolutionary biology.

The advancements in detecting core areas and corridors are now based on

three factors: intensive use of field data; improvement in GIS (Geographic Information Systems) and availability of geospatial data; and adapted algorithms.

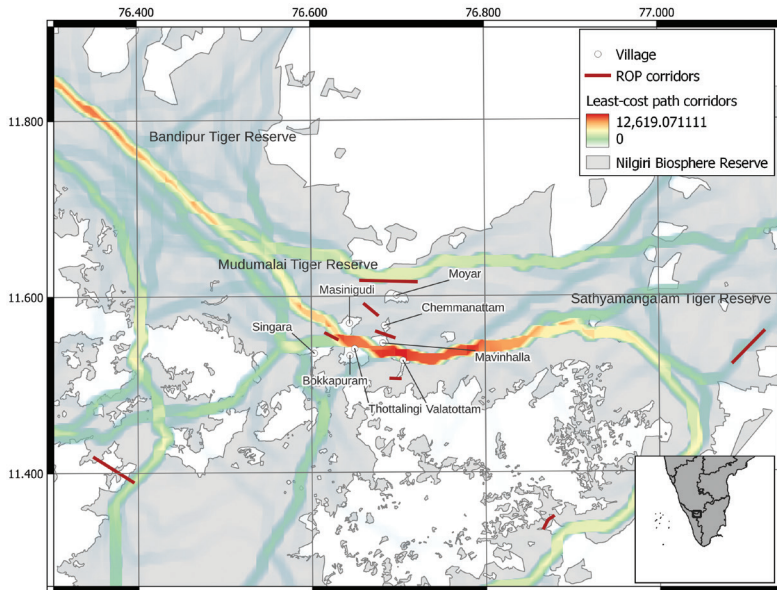
Field data helps collect essential knowledge on animal presence, movement records where they go and genetic profile indicates patterns of genetic exchange between sub populations. These can be used independently or together for better prediction of elephant movement. Animal presence is obtained from camera trapping or from georeferenced indices, movement paths by radio or satellite telemetry and genetic makeup is derived non-invasively from dung piles.

Parallel to the field data, environmental data are now easily obtained at the landscape scale in the form of rasters (such as elevation images) or vectors (such as road maps). Scientists try to gather as many candidate GIS layers as they deem valuable. With the raster or vector images, they can calculate a landscape distance among the same individuals. For example, with slope, they calculate the easiest path between two points, which is usually where the gradient is gentler. Genetic data, similarly, helps establish a genetic distance among individuals, which could be correlated with the landscape distance along least-cost paths (a path that costs the least to traverse in terms of time, distance or other variables).

The correlation process is repeated for each selected variable and then for a mix of variables. With careful selection,

Reconnection potential

Using information from field data, GIS and adapted algorithms can help identify functional corridors to target for restoration



In this figure, connectivity is represented in the form of factorial least-cost paths. Corridors are calculated over a composite resistance map including land use, slope, elevation and habitations. The corridors start from core areas (the tiger reserves) and sometimes extend beyond the limits of the Nilgiri Biosphere Reserve, where “structural” corridors should be established and eventually restored. Areas with highest connectivity in red are essential to elephant populations. In comparison, expert corridors, as identified in the “Right of Passage: Elephant Corridors of India” report (ROP) by the Wildlife Trust of India, do not display an overall logic regarding connectivity. Most are in protected areas or reserved forests, a few cut across villages and most seem to be placed at random. Corridors have not been prioritised based on their relative importance
Source: “Predicting landscape connectivity for the Asian elephant in its largest remaining subpopulation”, *Animal Conservation*, October 2016

one ultimately creates the best possible composite image called a resistance map, which optimally summarises resistance to animal movement in two dimensions.

The resistance map can be compared to a road map with speed limits: which road the vehicles choose depends on the road capacity and speed limit. The same way, animal movement is modelled on the resistance map through several algorithms known to specialists such as circuit theory, factorial least-cost paths or resistant kernel that connect the dots of animal locations and extrapolate it over the landscape. This analyses will provide the final document, the connectivity map.

In the connectivity map, regions with

highest connectivity start in the core areas, usually within reserves, and extend into the landscape matrix, guided by the animal’s biology rather than expert knowledge. In a 2016 study published in the journal *Animal Conservation*, we have created a connectivity map of factorial least-cost path elephant corridors in the Nilgiris Biosphere Reserve.

If two reserves need to be reconnected, it is better to restore a “functional corridor”, known to be used at present or in the past, using analysis. Consequently, a more modern definition of “corridor” is “a place where connectivity is higher”. Whether it is inside or outside protected areas is irrelevant as it reflects the biology of a

species, which is the ultimate reality to consider for effective conservation.

The identification of elephant corridors has become a point of debate in India. Only half the corridors in the Nilgiri Biosphere Reserve as per ROP could be validated with modern techniques. In 2023, the Union Ministry of Environment, Forest and Climate Change released another report on elephant corridors that attempted validation with field data, an improvement over ROP.

But during a standing committee meeting of the National Board for Wildlife in August 2023, Raman Sukumar, senior scientific editor of ROP, defined a corridor as “a small patch of land that provides connectivity for elephant movement across habitats, largely within a landscape of the elephant reserve” (“Elephant corridor report plagued with inconsistencies, could escalate conflict with humans, says expert”, *Down To Earth* website, November 2, 2023). This definition is no longer valid in landscape ecology. It oversimplifies reality, largely ignores animal behaviour and increases risk of accepting corridors that do not work.

Both ROP and the recent, more accurate Union environment ministry report are interesting efforts to identify corridors. But it is urgent to develop a national framework based on recent scientific methods that use movement data to secure habitat connectivity and conservation of a key species. **DTT**

(Jean-Philippe Puyravaud is landscape ecologist with The Sigur Nature Trust, Nilgiris. Samuel A Cushman is senior fellow at the Wildlife Conservation Research Unit, University of Oxford, UK. Priya Davidar is retired professor of ecology and fellow of the American Association for the Advancement of Science, US)



An elevated watch tower to track elephants on the edge of the Katarniaghat forest sanctuary in Uttar Pradesh

As a result, the communities in and around the reserve have voluntarily started tracking the movement of elephants, along with the help of wildlife organisations. When an elephant herd nears a village, the volunteers, called *gaja mitras*, camp atop temporary elevated watch towers, and the village residents use firecrackers to wade them off.

In February this year, the *gaja mitras*, along with their counterparts in Nepal, started a WhatsApp group, “Indo Nepal Human Animal Conflict Group”, for sharing elephant movement across the border. “Elephants cause loss of life and property in both the countries. The solution lies only with the community living in the forest. Creating the WhatsApp group is a step taken in this direction,” says Dabir Hasan, project officer, World Wide Fund for Nature (WWF), India, which helped set up the WhatsApp group that has *gaja mitras*, forest officials and community members from Nepal.

The volunteers have been identified on the basis of a baseline survey

conducted by the Nature Environment and Wildlife Society in 2020, in which the non-profit identified the five most vulnerable villages. “The villages recorded 12 deaths and crop loss across 16 hectares in 2018-20. Next, 89 *gaja mitras* were trained in the villages,” says Abhishek, project manager of the non-profit. He adds that after the Terai Elephant Reserve was formed in 2022, the number of vulnerable villages have increased to 10. We are training *gaja mitras* there, he adds. The volunteers are trained in understanding elephant behaviour, and are given reflectors and torches for patrolling the forest edge at night.

One of the reasons behind the initiative is the fact that the forest officials in Terai, the most recent of the 33 elephant reserves in the country, have till date not received any funds from the government. The other is the increase in elephant population in the area in the past decade. “In 2006, only one or two elephants used to come here through the Khata corridor. Since 2010, the

arrival of these elephants has increased and now a significant number of them have migrated to the forests of Katraniya itself,” says Irfan Ahmed, the former deputy ranger at the Katarniaghat sanctuary.

The reason for this change, he says, is that while Nepal has stopped growing sugarcane around the corridor, its farming has picked up in India in the recent years. According to the “Elephant Corridors of India” report released in 2023 by the Union Ministry of Environment, Forest and Climate Change (MOEFCC), 56 elephants regularly use the corridor and another 66 elephants roam regularly in the wildlife sanctuary.

The success of the two initiatives highlights the potential to engage communities in conservation efforts, which is critical as India is witnessing an increase in human-elephant conflicts. According to MOEFCC, the country recorded 97 human deaths due to elephant attacks in 2022-23, up from 52 in 2018-19. In the five years, such conflicts claimed over 389 human lives in the country. **DTE**

THE/NUDGE Prize

DCM SHRIRAM
FOUNDATION

Small Farms, Big Tech: How Drones and IoT Are Transforming Indian AgWater Space

In the urban world, data analytics has become a cornerstone of business operations, influencing everything from supply chain management to factory operations and customer engagement. However, its application in the agricultural sector isn't as widely discussed, despite the sector's inherent complexity and the need for meticulous decision-making. Farmers routinely face complex choices – determining the optimal timing for watering crops, deciphering the fine line between too much and too little, pinpointing the ideal moments for planting and harvesting, and making calculated decisions on pesticide and fertiliser usage, all while contending with unpredictable weather patterns and unforeseen events. These tasks are daunting for anyone, but more so for smallholder farmers who lack access to extensive data and often rely on instinct or traditional knowledge, which may falter in a world of rapid climatic shifts and market changes.

Read through, to understand the crucial role of data in the AgWater sector.



While government initiatives have aimed to provide better advisory and information services, tailoring these to the unique demands of small-scale farming has been a formidable challenge. However, a promising wave of startups is emerging to bridge this gap. Utilising an array of technologies from drones to the Internet of Things (IoT), coupled with mobile applications, they are poised to revolutionise small-scale farming.

The DCM Shriram AgWater Challenge, launched in partnership between The/Nudge Prize and DCM Shriram Foundation, has spotlighted 16 promising business models since its inception in June, 2023. The challenge aims to uncover a range of scalable AgWater tech solutions that are accessible and cost-effective for smallholder farmers while also ensuring profitability. This initiative covers a broad spectrum of innovations, from tech-based

information and advisory services to diverse areas such as irrigation services. Among these innovations, several startups are addressing the critical issue of limited access to real-time data, which is vital for effective irrigation and crop management. This lack of data can lead to reduced crop yields and financial losses for small-holder farmers. BharatRohan, PhyFarm, CensaNext, and Manna (Rivulis) are a few startups tackling this problem through complementary approaches.

BharatRohan uses advanced drones with hyper-spectral imaging to capture detailed field images, which are analysed to identify waterlogged and water-scarce regions, crop health, and blight patterns. This technology has been deployed in Uttar Pradesh and Rajasthan, leading to significant water savings of up to 215,000 litres per acre per season and an average profit margin increase of ₹30,000 per acre. PhyFarm complements BharatRohan's aerial prowess with on-ground sensors linked to a central platform by IoT technology. The company offers a three-tiered approach: community-level irrigation scheduling advice, precision irrigation starter kits, and advanced automation systems for remote control of irrigation and fertigation. This saves time and resources while optimising crop health, demonstrating an 11% increase in farm output and a 12% reduction in water and energy inputs for sugarcane in Maharashtra.

In water-scarce regions, CensaNext steps in with its IoT and AI-powered solutions, delivering daily irrigation recommendations via SMS in six vernacular languages. This ensures farmers in water-stressed areas receive timely, accurate advice to optimise water use for various crops, helping them make the most of limited resources.

Manna (Rivulis) combines micro-irrigation and remote sensing technologies, providing farmers with precise irrigation schedules based on hyper-local weather data collected

through satellite imaging and field sensors. This approach has dramatically enhanced crop yields and water efficiency across 18+ states, working with water-intensive crops like cotton and sugarcane, resulting in a 30-50% increase in crop yield and significant water savings of 40-60%.

While these solutions cater to different regions, crops, and water scarcity levels, they share a common goal: empowering farmers with real-time insights and capabilities that were once exclusive to large-scale operations. However, information availability does not guarantee accessibility. Farmers may be unaware of these services, underestimate their value, or feel hesitant about using advanced technology. Organisations must work consistently to build trust, address social and behavioural factors, and demonstrate the benefits of these interventions on the ground.

Overcoming these challenges is critical because no solution to India's impending water crisis can exist without the participation of smallholder farmers, who make up 86% of agricultural households and consume 78% of India's water resources. Their well-being and livelihoods are deeply intertwined with the health of our water reserves, and the success of companies like BharatRohan, PhyFarm, CensaNext, and Manna in empowering them will decide if we can achieve and hold on to water security as a nation.

The DCM Shriram AgWater Challenge aims to uncover a range of scalable AgWater tech solutions that are accessible and cost-effective for smallholder farmers while also ensuring profitability. This initiative covers a broad spectrum of innovations, from tech-based information and advisory services to diverse areas such as irrigation services.

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



WATER SCARRED CITY

Bengaluru's water crisis was long in the making. The city has grown at the cost of its lakes and ponds that are key to its water security. Over 93 per cent of the city is built-up, which makes groundwater recharge difficult. Inadequate sewage systems pollute the limited water available. Over the decades, the city has become dependent on the Cauvery, 100 km away, for 70 per cent of its water needs. This makes water unaffordable. It's time Bengaluru broadened its water resource base beyond the Cauvery and focused on recharging groundwater and reusing treated wastewater.

An analysis by **Sushmita Sengupta in Delhi,**
with **Swati Bhatia, M Raghuram and**
Coovercolly Indresh reporting from Bengaluru

Workers collect drinking water from a private water tap at Krishnappa Layout, Bengaluru





SAUBHAGYA MISHRA, who works for an outsourcing major in Karnataka's capital city Bengaluru, manages distribution mechanism for many water utilities in Australia and the US. "I have coded flawless mechanism to deliver water to thousands of houses thousands of kilometres away from here. But in February, I got a notice from my apartment management informing complete cessation of water supply. This was a first for me," he says. "Without water, what supply solution can one think of?" he says.

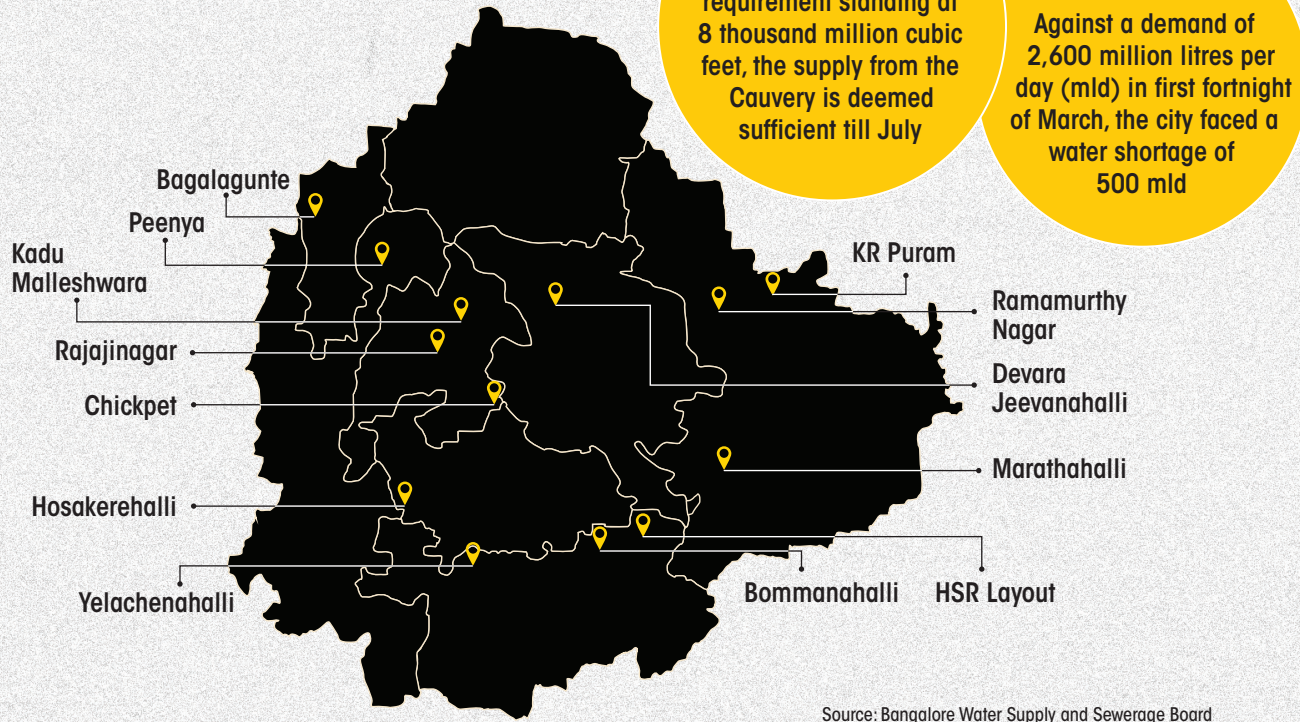
In mid-March, Mishra sent his wife and daughter to their hometown Lucknow, Uttar

Pradesh. With the family gone, he could bring down water use by two-thirds. He somehow procures 10-15 litres of "mineral water" from a vendor daily that he uses for all purposes. But he has worries: "How long the crisis would continue? More importantly, why did it happen?"

India's prime information-technology hub and the country's third most populated city, Bengaluru is facing its worst water shortage. On March 18, after a high-level meeting on the crisis, Karnataka Chief Minister Siddaramaiah told the media that the city was facing a water shortage of 500 million litres per day (MLD) against a daily de-

Shortage epicentres

Bangalore Water Supply and Sewerage Board has identified 13 areas facing water scarcity in the city



Source: Bangalore Water Supply and Sewerage Board

Map not to scale

mand of 2,600 MLD. Of the 14,000 government-registered borewells in Bengaluru, some 6,900 had dried, said Siddaramaiah.

A total of 257 areas in the city have been identified as water stressed. Besides, 55 of 110 villages under the Bruhat Bengaluru Mahanagara Palike (BBMP) face water crisis.

A week before, on March 12, the Bangalore Water Supply and Sewerage Board (BWSSB) reduced water supply to major consumers—companies, hospitals, railways and airports—in the city by 20 per cent. Previously, it had been supplying them 95-100 per cent of their allotted quota of water.

From March 15, BWSSB, which provides 1,450 MLD water from the Cauvery river to Bengaluru to meet 80 per cent of the city's water needs, gradually decreased the supply by 1 to 20 per cent. V Ram Prasath Manohar, chairperson of BWSSB, told media, "Approximately 0.3 million individuals with large water connections in Bengaluru must support the decision in the collective interest of the city's 14 million residents."

On March 20, BWSSB banned the use of Cauvery water and borewell water for activities like pool dances and rain dances during Holi celebrations in the city. It has enforced installation of aerators—a device to regulate the flow of water, thereby reducing its wastage—used by major consumers by end of March. Manohar informed the media, "A voluntary 10-day period from March 21 to 31 is provided for aerator installation. After this, the buildings that are non-compliant with the directive will face mandatory installation." Manohar also said, "With Bengaluru's projected requirement for the next five months standing at 8 TMC (thousand million cubic feet) of water, the supply from the Cauvery is deemed sufficient until July."

The worst hits are the medical facilities, from large hospitals to small neighbourhood clinics. Some have turned to using treated water for flushing toilets, while others are exploring the option of drilling new borewells. However, the reliance on tanker water remains predominant across most hospitals, underscoring the severity of the situation. B C Subramanya, the head of a private hos-

pital in Ramamurthy Nagar, talks about the dire situation faced by his hospital that has a daily water requirement of a staggering 50,000 litres. The only borewell on which the hospital depended has dried up in February, making the facility depend on costly tanker water. Though the government has fixed charges for tanker water (₹1,200-1,500 for 6,000 litres), the supply is not on time and the supplier also charges more than the fixed rate, he says.

Similarly, schools, with examinations in full swing, have restricted water uses to the extent that students and staff have been told to bring in their own drinking water. "The main issue is not drinking water, but water for toilets," says principal of a school in Vyalikaval. "Due to the worsening shortage, many schools have resorted to using drums filled with water in toilets instead of relying on running tap water," he adds.

The situation is particularly worrying for private schools in outlying areas, especially the villages incorporated into BBMP in 2008. Most of them lack piped water infrastructure entirely. "The water shortage has struck us suddenly, leaving us dependent on water tankers. Unfortunately, examinations and evaluations are ongoing, and we cannot reschedule them," the teacher says.

A BWSSB notification on March 8 explicitly prohibits the use of potable water for activities such as car washing and watering plants. Under the new directives, individuals found using drinking water for non-essential purposes face a hefty fine of ₹5,000. The notification has sparked apprehension among residents. BM Ramesh, a resident of K R Puram in Bengaluru East, says he has no choice but to utilise precious drinking water for his plants. Vijay Prakash, a resident of Dodda Bommasandra, questions the process of monitoring usage of drinking water. "Do they have sufficient staff for that? The government should first create awareness for judicious use of water," he says.

The water shortage has even hit crematoriums, graveyards and cemeteries. Many grieving people had to cut short the post-funeral rituals that require bathing.

IMMEDIATE SOLUTIONS

Water conservation, wastewater treatment hold key

T V Ramachandra

WITH CONTINUED fragmented governance due to involvement of too many para-state agencies and lack of coordination, the city has witnessed unplanned and irresponsible urbanisation. There has been a 1,055 per cent increase in paved surfaces (such as buildings) and a substantial reduction in porous surfaces (88 per cent decline in green cover and 79 per cent reduction in waterbodies). Once, the city landscape of 740 sq km had 68 per cent green cover; today, it is less than 3 per cent, with 85 per cent surfaces paved.

The city administrators ignored the welfare of citizens, as is evident from the abuse of natural spaces. In 1980, the groundwater table was less than 100 feet (1 feet equals 0.3 m). Today, residents have gone up to 1,900 feet and there is no water. The grim situation in most parts of the city necessitates immediate corrective measures.



Bengaluru receives annual rainfall of 700-850 mm, which means it gets 15 thousand million cubic feet (TMC) of rainwater. The city requires 18 TMC of water, which means rainwater would suffice about 70 per cent of the demand. The best option is to harvest rainwater in individual households (rooftop harvesting) and in rejuvenated lakes. Retaining water in rejuvenated lakes would aid groundwater

recharge and enhance the water storage capacity.

Wastewater treatment is another viable option. Economical, nature-based solutions for wastewater treatment is the best option. One way to do this is to integrate constructed wetlands and algal ponds with secondary treatment plants to achieve a tertiary cleaning, as has been done in Jakkur lake. Constructed wetlands have vegetation to trap sediments and chemicals, while algae ponds clean through natural oxidative processes. We have monitored Jakkur lake for the past 12 years and the process removes 85-90 per cent nutrients and chemicals. Treatment of 18 TMC of wastewater with this method would provide 16 TMC of tertiary treated water. This means the city would have 31 TMC of water (15 TMC with harvested rain and 16 TMC with treated wastewater).

A few options to deal with the current crisis are: (i) Advocating and ensuring water conservation at all levels; (ii) Ensuring tertiary treatment because the city has wastewater treatment capability, and filling select dry lakes to facilitate groundwater recharge; (iii) Making bureaucrats accountable for dereliction of prudent management of natural resources and pushing irresponsible urbanisation for short term gains; and (iv) constituting think tanks with experienced experts and not industrialists.

(T V Ramachandra is head of Centre for Ecological Sciences, Indian Institute of Science, Bengaluru)

CRISIS MANAGEMENT

In a bid to alleviate the situation, the government extended the deadline for registration of water tankers, offered as a temporary solution, from March 7 to March 15. Chief Minister Siddaramaiah, in his media briefing, said that some 600 water supply firms with a fleet of over 1,600 tankers have been on duty round the clock. Besides, he instructed that more private tankers as well as tankers belonging to the Karnataka Milk Federation be pressed into service, particularly in slums and areas that depend on borewells. After a directive from the chief minister, the state authorities have started a programme to recharge the groundwater level by filling 14 major lakes in the city with treated wastewater. At the same time, government will soon drill 313 deep borewells and revive 1,200 inactive ones.

SOURCE OF RISK

In many new apartment complexes across the city, residents fear questioning the quality or pricing of the water provided. A committee member overseeing water management at Springfield Apartment on Sarjapur Road voiced the common sentiment: "We are at the mercy of water tanker operators. If they stop providing water, we will be in trouble." One of the most concerning aspects is the lack of clarity regarding the source of water. Tankers draw water from various sources, including borewells near lakes, paddy fields, private residences and even burial grounds, where pollutants may seep into the groundwater. The potential for contamination is alarmingly high. Despite these risks, water tanker operators often fail to produce adequate laboratory test results confirming water quality. Even when such results are provided, they are often vague, leaving consumers in the dark about the safety of the water they receive.

In the core areas of Bengaluru (municipality area before 1965), there are some dug wells owned by individuals. These were in disuse after the Cauvery II stage pipeline was laid and water started flowing to Bengaluru from the reservoir in Mandya dis-



trict. These were the wells that are holding water even now and the owners have allowed the tanker owners to draw water from them. “If things go worse, we might even take over those wells to ensure equitable distribution in the areas of their locations,” says a senior official of BWSSB.

RELOCATE, WORK FROM HOME

The worsening water crisis in Bengaluru is making many of the city’s 14 million residents explore various solutions. Those who can afford to relocate are considering leaving the city. Potential home buyers, on the other hand, are reconsidering their plans. A resident of Uttarhalli in southern Bengaluru, who earlier contemplated buying property in the area, now vows to avoid such an investment due to the water situation. Information-Technology professionals—many of whom have come from outside the city and state—have called for work-from-home arrangements.

^ Since tankers draw water from various sources, including borewells near lakes, paddy fields, even burial grounds, the potential for contamination is quite high

Radha Krishna, a resident of Kengeri Upanagara and an employee at a multinational corporation in Global Village, both in the western part of the city, says that a severe water shortage in his apartment forced him and his wife to temporarily relocate to his ancestral home in Mandya. He says his company agreed to work-from-home arrangement for a short period, but many companies have not. Digant Bandopadhyay, who also works at a multinational company in the upmarket eastern neighbourhood of Whitefield, questions the point of working from office when basic needs like bathing are a constant concern. “In a crisis like this, allowing employees to work remotely from their hometowns makes perfect sense,” he says. Many residents of water-scarce areas argue that work-from-home could significantly contribute to water conservation efforts and allow employees to relocate to their hometowns, easing the strain on the city’s water resources.

PHOTOGRAPH: REUTERS

NEEDLESSLY PARCHED

The city must recharge, reuse and recycle its water

ON MARCH 13, when *Down To Earth* (DTE) met Rajiv K N, chief engineer at Bangalore Water Supply and Sewerage Board (BWSSB), he was busy chalking out strategies to get the city through the worst water crisis in recent times. Rajiv was however confident that the situation was not that grave. “The issue has been politicised. We have enough water to last us until July, when the reservoirs get replenished with monsoon rains,” he said. The city authorities blame the prevailing water crisis on the deficit rainfall in 2023. But what if the city fails to receive adequate rainfall this year as well? None of the BWSSB officials DTE spoke with was willing to respond to that question.

In the 1800s, Bengaluru had an intricate system of 1,452 waterbodies. In 2011, the number had reduced to just 193

v

The fact is, Bengaluru’s crisis is not a water problem but a management problem.

Bengaluru has never been a water surplus region. The city’s location in the semi-arid peninsular plateau region makes it naturally water-scarce. The Vrishabhavathi, a minor tributary of the Arkavathi, is the only stream originating within and flowing through the city. Its hard rock terrain makes the catchment impermeable, resulting in high surface runoff. So historically the city had depended on lakes, tanks and ponds for all its water needs. Kempe Gowda, who founded the city in the 15th century, was among the most prominent builders of tanks and ponds in the region. These waterbodies were designed to collect rainwater, and



thereby recharge groundwater and mitigate floods by allowing surplus rainwater to cascade from one lake to another. A 2017 report by the Indian Institute of Science (IISc), Bengaluru, estimates that during the 1800s, Bengaluru had an intricate system of 1,452 waterbodies, spread over 741 sq km and with storage capacity of 35 thousand million cubic feet (TMC) or 990,000 million litres.

Modern Bengaluru discounted this security system. "Excreta Matters", a report published by the Centre for Science and Environment in 2012, notes that the government had wilfully and deliberately taken over many waterbodies and built over them by 2011. For instance, the city corporation built the city terminus after filling the Dharmambudhi tank; the Kanteerva Stadium is built on another tank; while the Siddikatte tank has been turned into a local market. By 2011, according to the 2017 IISc report, the city was left with 193 waterbodies with 5 TMC or 140,000 million litre storage capacity, which reduced to 1.2 TMC or 33,000 million litres by 2017 because of siltation—this is 76 per cent reduction in storage capacity in just six years. "Field studies during 2015-16 of 105 lakes revealed that 98% of the lakes have been encroached for illegal buildings (high-rise apartments, commercial buildings, slums, etc) and 90% of the lakes are sewage-fed. Also, lake catchments are being used as dumping yards for either municipal solid waste or building debris," notes a guest editorial in the June 2016 edition of *Current Science*. The editorial was co-authored by T V Ramachandra, head of Centre for Ecological Sciences at IISc, who also led the 2017 IISc study. His assessment further shows that between 1973 and 2017, paved surface or concretisation in the city increased by 1,028 per cent; consequently, green spaces declined by 88 per cent and wetlands by 79 per cent.

FALLOUT OF A PIPE DREAM

At 76 per cent, Bengaluru's growth rate was the fastest in Asia, according to the 2017 report by IISc. By 1988, the city emerged as India's software capital and has grown

DELAYED PROJECTS, LONG DRY SPELL BEHIND THE CRISIS

Conserve Cauvery catchment area and use the city's lakes exclusively for groundwater recharge

S Vishwanath

BENGALURU'S DEPENDENCE on the Cauvery river is foundational. The city should start to recognise its role in the basin and protect the forests in the catchments of the river and all its major tributaries. Bengaluru gets its 1,470 million litres per day from the river and there is enough water in the Cauvery reservoirs to ensure this supply. The number of piped connections receiving the Cauvery waters stand at approximately 1.1 million and these taps will not run dry. However, the Bangalore Water Supply and Sewerage Board (BWSSB) should have completed the fifth phase of the Cauvery project (Cauvery Stage V) last year. Delay in the additional 775 million litres per day reaching the city has caused a dependence on groundwater, which is being met through private borewells and tankers.

Of the 186 "live" lakes under Bruhat Bengaluru Mahanagara Palike (BBMP), some of the larger ones, such as Bellandur and Varthur, have been drained and are being desilted for the last four years. Currently, they have little or no water. If they had been full, they would have recharged the aquifers in their zone of influence and borewells would have had more water, which would have meant substantially less pressure on the supply from tankers.

All the lakes of Bengaluru, at their peak capacity, will only have enough water for 15 days of the metropolis' requirement. Lakes are crucial as ecological, social, cultural and recreational space, not as water sources. They should only be used for their potential of converting rainwater or treated used water into groundwater.

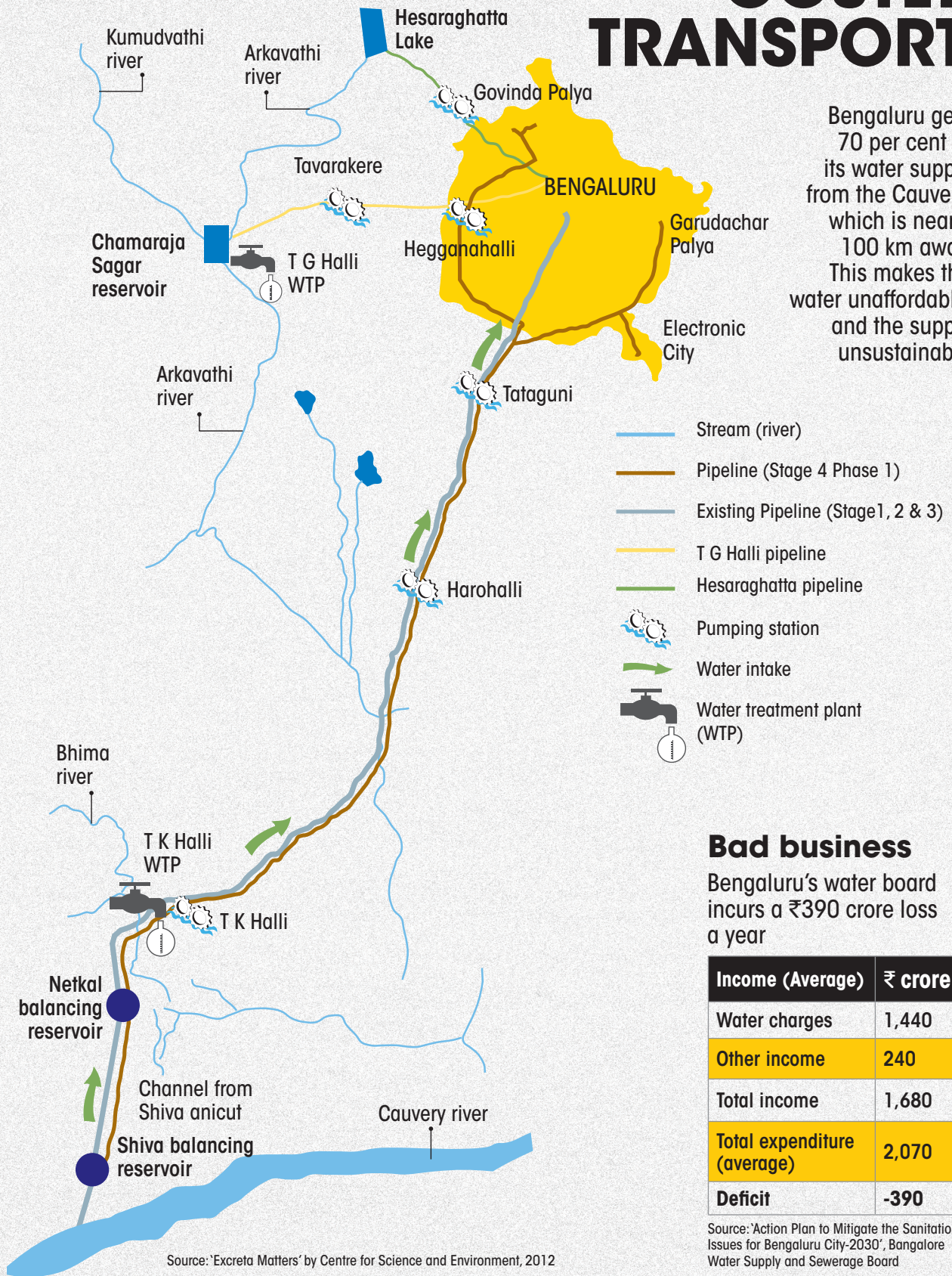
The delay in completing both these massive projects, coupled with a long continuous dry spell of no rain since November 2023, has caused a crisis in certain pockets of the city, especially those not connected to piped network, where dependence is completely on groundwater.

(Vishwanath S is Advisor, Biome Environmental Trust, Bengaluru)



COSTLY TRANSPORT

Bengaluru gets 70 per cent of its water supply from the Cauvery, which is nearly 100 km away. This makes the water unaffordable, and the supply unsustainable



Bad business

Bengaluru's water board incurs a ₹390 crore loss a year

Income (Average)	₹ crore
Water charges	1,440
Other income	240
Total income	1,680
Total expenditure (average)	2,070
Deficit	-390

Source: 'Action Plan to Mitigate the Sanitation Issues for Bengaluru City-2030', Bangalore Water Supply and Sewerage Board

Map not to scale

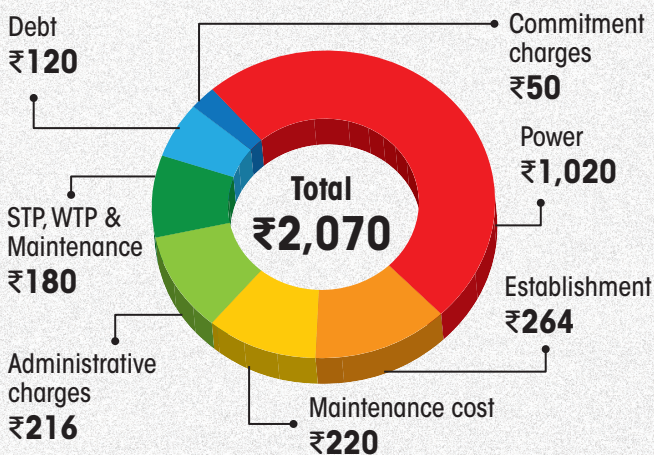
Unaffordable, unsustainable

Water tariff charged by Bangalore Water Supply and Sewerage Board (BWSSB) among highest in India

Category	Bengaluru tariff (per kilo litre)	Hyderabad tariff (per kilo litre)
Domestic	₹7 (for first 8 kl)	₹7 (first 15 kl)
	₹45 (above 75 kl)	₹40 (above 200 kl)
Non-domestic/ Commercial	₹50 (first 10 kl)	₹20 (first KL)
	₹87 (above 75 kl)	₹50(above 200 kl)
Industrial	₹90	₹15 (first 25 KL)
		₹60 (above 200)
		₹100 (for water based units)

Source: 'Action Plan to Mitigate the Sanitation Issues for Bengaluru City-2030', Bangalore Water Supply and Sewerage Board; Hyderabad Metropolitan Water Supply and Sewerage Board

BWSSB's water supply expenditure exceeds its income (in ₹ crore)



Source: Action Plan to Mitigate the Sanitation Issues for Bengaluru City-2030' by Bangalore Water Supply and Sewerage Board

BWSSB unable to handle city's sewage

Year (All fig in mld)	Sewage generated	Sewage treated/ proposed treatment (Gap)	Sewage treated as per CPCB inspection
2024	1,480	1,381.5 (-98.5)	919.8
2025	2,008	1,779.5 (-228.5)	--
Post-2025	2,188	2,079.5 (-108.5)	--

Source: 'Action Plan to Mitigate the Sanitation Issues for Bengaluru City-2030', Bangalore Water Supply and Sewerage Board; National Inventory of Sewage Treatment Plants, March 2021' by Central Pollution Control Board

exponentially since then. To accommodate this surge, driven by new and old businesses, the city extended its reach repeatedly by acquiring new territories in the neighbourhood and expanding its search for a “reliable” water source. Around 1974, the ambitious Cauvery Water Supply Scheme was conceived, which required water from the river to be pumped up to a height of 490 metres and then transported over 90 km. Over the past 50 years, BWSSB in four stages has augmented water supply from the Cauvery to 1,450 million litres per day (mld). Yet it has failed to meet the demand of the city.

Today, Bengaluru metropolitan region is spread over 800 sq km—Bengaluru core area (245 sq km), eight urban local bodies (330 sq km) and 110 villages (225 sq km)—with a population of 13.2 million. BWSSB estimates that the total water demand of the city is 2,100 mld, but it is able to provide only 80 per cent of it—1,450 mld from the Cauvery and another 300-400 mld from groundwater. Almost 110 villages and business centres in the city periphery remain outside its water supply network and heavily depend on groundwater. So BWSSB is working on stage 5 of Cauvery Water Supply Scheme to secure another 750 mld for the peripheral areas.

But BWSSB's own estimates show that the city may still not be able to cater to the needs of its population. For instance, by 2031, the city would have a population of 14.29 million, with a water demand of 2,900 mld. Even with the 750 mld secured through stage 5 of the Cauvery Water Supply Scheme, BWSSB will be able to supply only 2,600 mld (1,450 mld from stage 4 Cauvery scheme+750 mld from stage 5 Cauvery scheme+400 mld from groundwater).

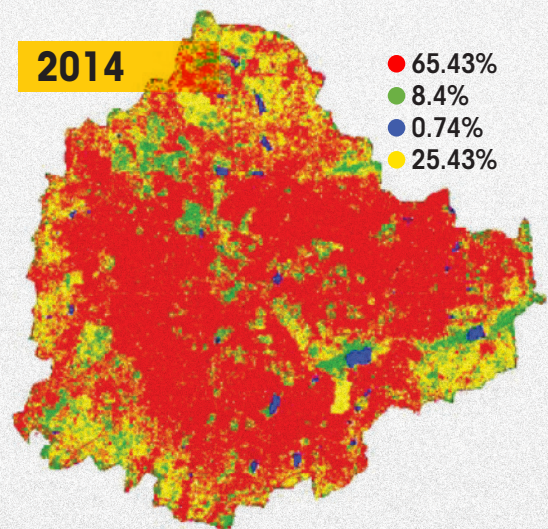
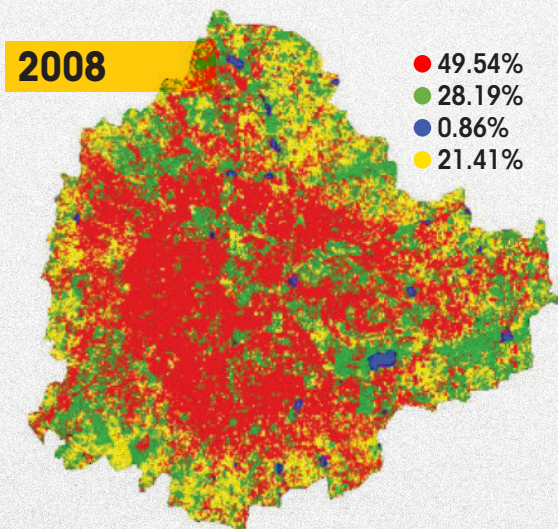
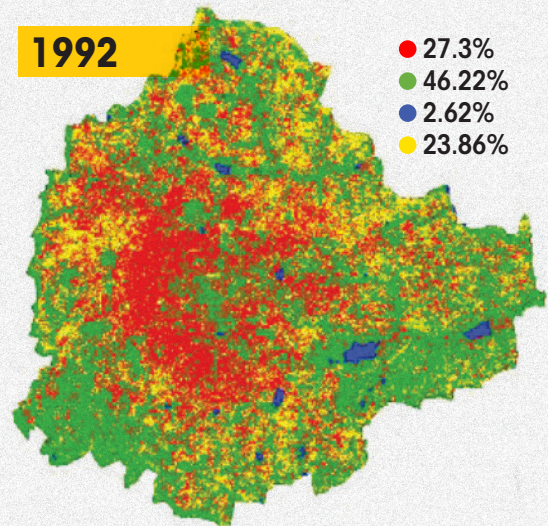
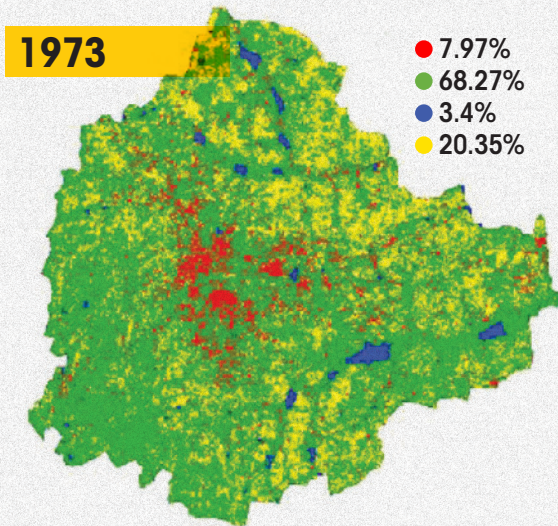
What's worse, as Bengaluru continues to chase its “pipe” dream, it has created a supply system that is capital- and resource-intensive. This exacerbates its water crisis.

Bengaluru at present depends on the Cauvery, located 100 km away, for most of its water requirement. But the longer the water distribution network, the more is the water leakage. As per a research in *International Journal of Research and Analytical Reviews*

Flaming red

Once overwhelmingly green, nearly all of Bengaluru is now marked by built-up structures

■ Built up ■ Vegetation ■ Water ■ Others



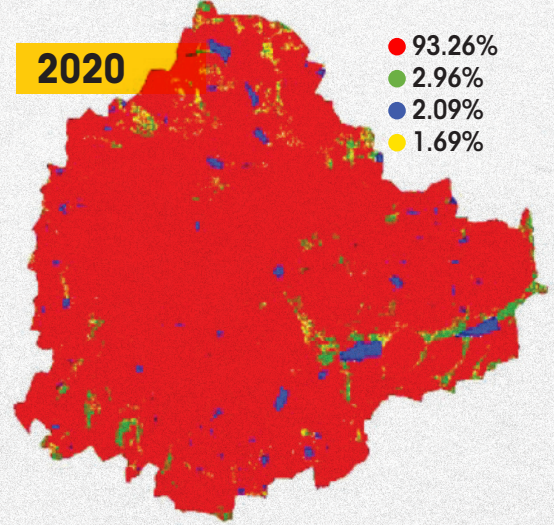
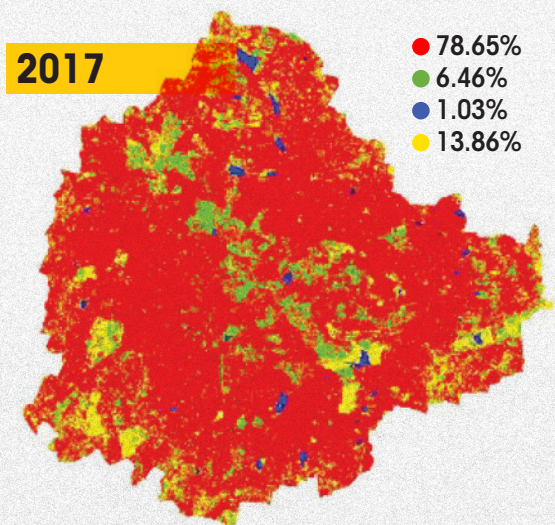
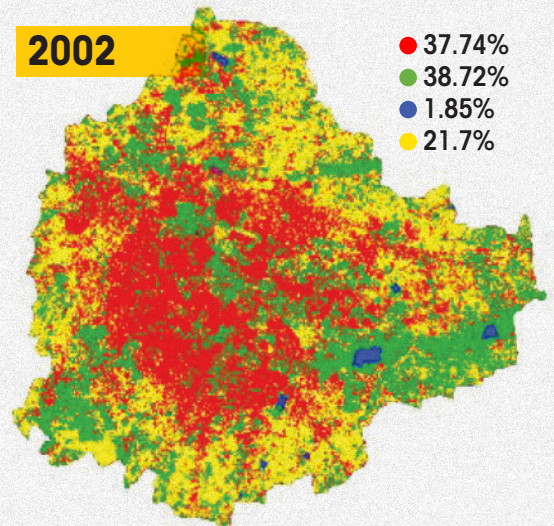
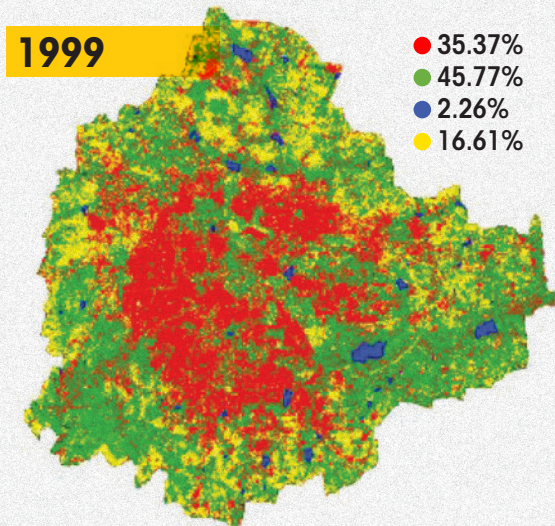
Map not to scale

Source: Frequent Floods in Bangalore: Causes and Remedial Measures, ENVIS Technical Report 123, Environmental Information System, CES, Indian Institute of Science, Bengaluru

published in 2019, water loss due to leakage is 35-40 per cent in Bengaluru. This means, while BWSSB claims to supply 1,450 MLD, a back-of-the-envelope calculation suggests that only 1,053 MLD gets delivered. In other words, a person in Bengaluru receives only 81 litres per day. This is much less than the standard set by the Central Public Health and Environmental Engineering Organisation (CPHEEO), which says a person in a metropolitan city should have access to 150 li-

tres per day, or than the claims of BWSSB, which says the water consumption of a person in Bengaluru is 108 litres per day.

A 2014 study published by the International Symposium on Integrated Water Resources Management in Kozhikode, Kerala, raises the concern of unequal distribution. In core areas of the city, supply coverage is 100 per cent, whereas in peripheral areas, it varies between 10 and 60 per cent. Per capita water availability varies between 100 to



125 litres per day and 40-45 litres per day. Southern and western parts close to pipelines get more water compared to those in northern parts.

While there is an urgent need to improve distribution network and plug leakages, BWSSB is cash-strapped. As per BWSSB, the power required to pump the enormous quantity of Cauvery water to the city costs about ₹1,020 a year, or half of its annual expenditure. BWSSB on average incurs a loss of ₹390

crore per year. This is despite the fact that water tariff in Bengaluru is among the highest in the country. For domestic use, BWSSB charges ₹45 per litre if usage is above 75 kilo litres, while in Hyderabad, the tariff is ₹40 per litre for usage above 200 kilo litres.

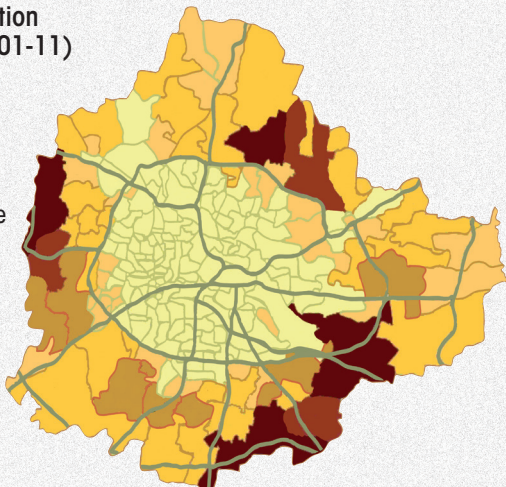
Inadequate water supply, skewed nature of distribution and high water tariff has increased dependence on groundwater. And this is where lies the other layer of water mismanagement.

Bengaluru's water patterns

Population rise, groundwater dependence is more in the city peripheral areas, which lack piped supply

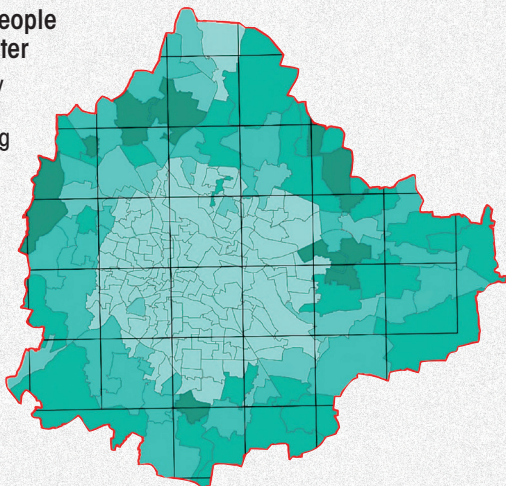
Decadal population growth rate (2001-11)

- Less than 50%
- 51-100
- 101-150
- 151-200
- 201-250
- 250% and more
- Major roads



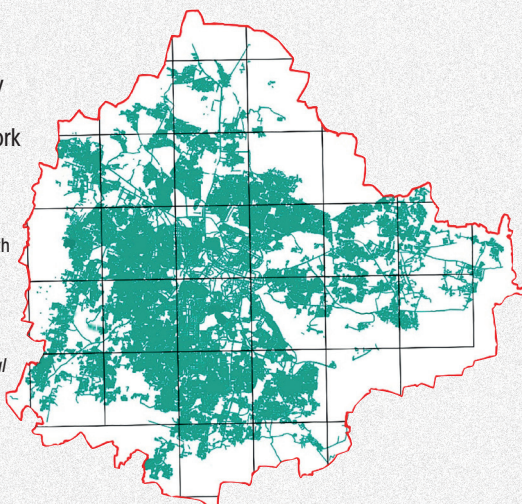
Percentage of people using groundwater

- BBMP boundary
- Grids
- % population using borewell
- 0-10
- 10.0-20.0
- 20.0-30.0
- 30.0-40.0
- 40.0-50.0



Water pipeline network

- BBMP boundary
- Grids
- Pipeline Network



Source: "Analysing Urban Sprawl and Shifting of Urban Growth Centre of Bengaluru City, India Using Shannon's Entropy Method", *Journal of Settlements and Spatial Planning*, volume 8, number 2 (2017); "Groundwater Level Dynamics in Bengaluru City, India", *Sustainability* 2018

Map not to scale

COST OF POOR MANAGEMENT

V S Prakash, former special director of the Karnataka State Natural Disaster Monitoring Centre, an autonomous body affiliated to the Department of Science and Technology, Government of Karnataka, says the crisis has its genesis in the poor management of groundwater. "Any water resource need an assessment and for this, we need monitoring. Unfortunately the state does not have enough data on groundwater," Prakash says, adding that the newly developed areas of the city largely depend on borewell. But there is no monitoring on how much water is being extracted. "I live in HSR Layout, which is close to the electronic cities. Multistorey buildings in the area depend heavily on borewells. The tankers fill up every day from the borewells and supply to the buildings. As many as 150 tankers extract water from my neighbourhood borewells everyday. A back-of-the-envelope calculation shows that these tankers must be extracting 1.5 million litres of water every day only from my neighbourhood," says Prakash.

A 2017 report published in *Sustainability* notes that over the past decades, the depth of borewells has increased, particularly in rural and peri-urban areas that do not receive supply water from BWSSB. But yield from the borewells have either remained the same or has negligibly increased. Between 2000 and 2010, the slope of drilling depths was steepest, ranging from 4.8 m/year to 17.1 m/year. In the next decade, slopes in drilling depths decreased in the northern catchments, the rural areas, and the peri-urban zone. There was no significant trend detected in the southern catchments of Vrishbhavathi and Bommasandara-Attibele catchment. This may be explained by unequal distribution in the water supply pipeline in Bengaluru after 2010 and some recharge in the southern catchments.

The study tries to link the increase in borewell installation with the urban sprawl. It points out there has been an increase in urbanisation in the northeastern and south-eastern parts of the city—which fall in Western Hoskote catchment and Kormangala-

Challaghatta catchment. In each catchment, built-up area has increased by more than 20 times between 1973 and 2016. This is where the city has planned many multi-storied and commercial complexes.

Sat Kumar Tomar, co-founder, Satyukt Analytics, a firm in Bengaluru that provides solutions to the agriculture, banking, and financial services industries sectors, also points out that groundwater dependence is low in the central part of Bengaluru that receives piped water supply. The best part is water leaking from the distribution network, which is around 50 per cent in these areas, recharges groundwater at many places. The groundwater crisis is acute in the outer parts of the city, where the development is concentrated and which is heavily dependent on groundwater. Recharge of the groundwater is very low—in fact, only once in a few years does it get naturally recharged due to heavy rainfall, says Tomar.

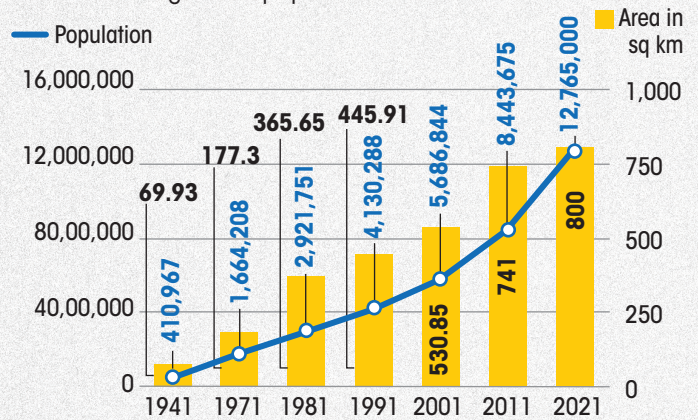
Latest data from the Karnataka Groundwater Directorate shows that there has been a drop of 5 metres in the groundwater level between 2014 and 2020 in Bengaluru district. A slight increase was observed around 2021 and 2022, because of good rainfall, but the groundwater table has shown a drastic drop of 10 metres between 2023 and 2024.

Jayasree Vaidyanathan, senior scientist at the Centre for Earth Research and Environment Management, Kochi, calls for monitoring the activities of two other sectors that could be responsible for the alarming dip in groundwater. Projects mainly Bangalore Metro Rail Corporation Limited (BMRC) and flyover construction works consume a lot of water. Estimates suggest that there are over 20,000 small, medium, and large-scale industries in Bengaluru. These industries rely more on groundwater due to the high cost and limited availability of bulk water from municipal sources. Industries such as textile, paper, and chemical manufacturing, which are water-intensive, are particularly drawn to groundwater, Vaidyanathan adds.

In 2016, the Karnataka government issued an order that mandates use of treated

The city and its people

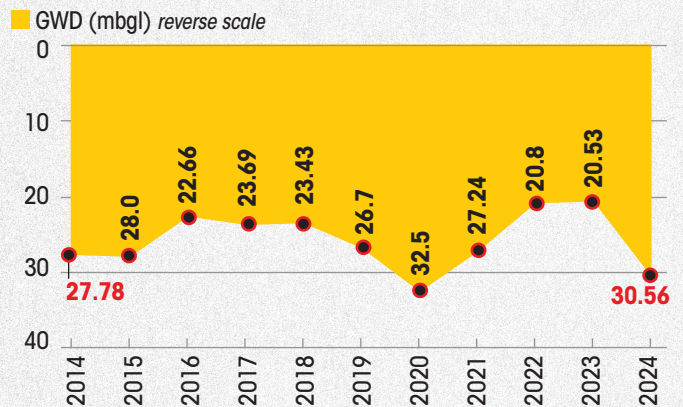
Growth in Bengaluru's population and area in 1971-2021



Sources: "Excreta Matters" by Centre for Science and Environment; Bangalore Water Supply and Sewerage Board

Fluctuating resource

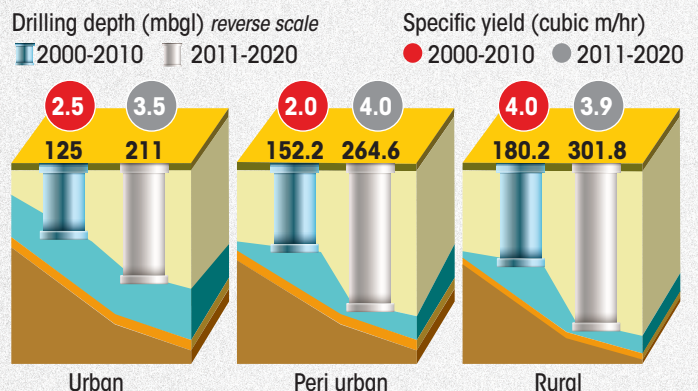
Average groundwater levels of Bengaluru district in February



mbl: meter below ground level; Source: Groundwater Directorate

Dig deep

Drilling depth has increased with negligible change in yield



mbl: meter below ground level



wastewater for non-potable uses in Bengaluru. However, a senior official from the state pollution control board tells DTE on the condition of anonymity that the city is only using 40 per cent of the treated wastewater.

HOPE IN WASTEWATER

Improper management of sewage and wastewater presents a bigger threat in the face of fast depleting groundwater and a looming water scarcity.

A 2018 study published in *Applied Water Science* reported high nitrate concentration in groundwater samples of urban Bengaluru. The report states nitrate concentration in the study area ranges from 2 to 252 mg/l in pre-monsoon and 2 to 262 mg/l in post-monsoon seasons. As per the study, the majority of pre-monsoon samples showed nitrate concentration above the permissible limit of 45 mg/l, which can be attributed to contamination from septic tanks and sewage effluent as there is no agricultural activity nor application of nitrogenous fertilisers in an urban area. A 2017 study published in *Current Science* also points to the presence of high nitrate and *E coli* in peri-urban areas of Bengaluru that depend on groundwa-

Residents in a south Bengaluru neighbourhood get their containers filled with drinking water from a tanker supplied by Bruhat Bengaluru Mahanagara Palike on March 11, 2024

ter. Of the studied 29 peri-urban villages of Bengaluru, 80 per cent and 93 per cent of water samples were unfit for human consumption as per the standards of the World Health Organization. The scientists indicated moderate to high risk of diarrhoea for the population in these areas.

Such contamination was also reported in the early 2000s, when the Department of Mines and Geology found high concentration of nitrate—ranging from 50 mg/l to 747 mg/l—in more than 35 per cent of the borewell samples studied. The researchers had identified leachate from sewage drains, septic tanks, agricultural run-off and industrial effluents as the sources of nitrate pollution. Contamination of coliform bacteria was particularly high in areas that do not have sewage system. As untreated sewage flows from houses into open drains, it reaches lakes and waterbodies and percolates into water flowing below the ground.

At present, the city generates 1,480 MLD of sewage and has installed 33 sewage treatment plants (STPs) that treat 1,381.5 MLD of sewage. By 2025, the city plans to add 14 more STPs with a capacity to treat 398 MLD of sewage. But this too will not be sufficient to

handle the 2,008 mld sewage that the city is projected to generate, as per an estimation by BWSSB.

What's worse is that BWSSB's claims appear to be an overestimation of the actual wastewater getting treated.

For instance, a 2021 report by the Central Pollution Control Board (CPCB) shows that the STPs in Bengaluru function only at 75 per cent capacity.

Besides, BWSSB's calculations of sewage generated is based on the Cauvery water supply and output of borewells monitored by BWSSB. The volume of sewage generated by the city would increase manifold once the groundwater generated by the tens of thousands of private borewells is taken into account. Different estimates have pegged the number of private borewells in Bengaluru at 400,000. Around 80 per cent of the water discharged by these borewells get converted into sewage. BWSSB officials do not appear to have plans to treat the sewage. A scientist from the state pollution control board, who does not want to be named, says "Owing to the terrain, collection of entire sewage is challenging. We are also not able to control the influx of industrial waste."

BWSSB's Action Plan for 2030, released in 2023, states that there is a need for wastewater treatment plant of 148 MLD capacity along with lateral sewer network for the 110 villages in the periphery. Otherwise the lakes in these areas will be filled with sewage and this may cause health hazards. The report indicates a shortage of fund and that the state government has approached international agencies like World Bank for funds.

J C Babu, scientist with CPCB based in Bengaluru, highlights the importance of treated wastewater for a water-stressed area like Bengaluru. He says the sewage has to be treated as per the norms and that BWSSB has to ensure that the treated wastewater can be used for irrigation and other purposes. However, some STPs do not comply with the norms and a lot of time they just discharge the untreated water in the open. At other STPs industrial wastewater is getting mixed with the sewage water or the

SAVE STORM WATER

Conserving this resource can serve the water needs of a quarter of Bengaluru's population

K C Subhash Chandra and G V Hegde

BENGALURU MEGA city, spreading 800 sq km with a population of around 10 million, has no water resource of its own, except the 66,400 hectare metre (23.45 TMC) rainwater that it gets during its normal annual monsoon of 830 mm. Of this, nearly 17,500 hectare metre (6.18 TMC) or 25 per cent of annual rainfall is the precious surface run-off that flows through the storm water drains which have now become the perennial flow path for untreated and/or partially treated urban waste water/ sewage. Original storm water drains are mostly tampered and encroached.

The centuries-old lakes, interconnected with cascading effect, constructed by the erstwhile rulers across the natural storm water drains to conserve water, to recharge groundwater and to serve the irrigation and domestic water needs of the people during lean season, have now become the repositories of urban sewage/ wastewater discharges. If action is taken to protect and conserve the 17,500 hectare metre of storm water, instead of allowing it to get polluted from the city waste water discharges, it can serve the water needs of about 2.5 million people at 51 m³/ head/year (at 140 litre / head /day).

Bengaluru is also susceptible to the vagaries of rainfall. People may face water scarcity in El Niño years, which could, at times, continue for 4-5 successive years, resulting in a drought.

Our study suggests that the authorities need to: (i) prevent and plug the enroute leakage and transmission loss of 30-40 per cent of the Cauvery river water getting pumped to Bengaluru to meet the city's water needs; (ii) conserve, protect and free from pollution the city's 17,500 hectare storm water; (iii) implement rooftop rainwater harvesting in all buildings with a rooftop area of more than 100 sq m; and (iv) treat 70 per cent of the sewage/wastewater generated in the city to potability levels after tertiary level treatment.

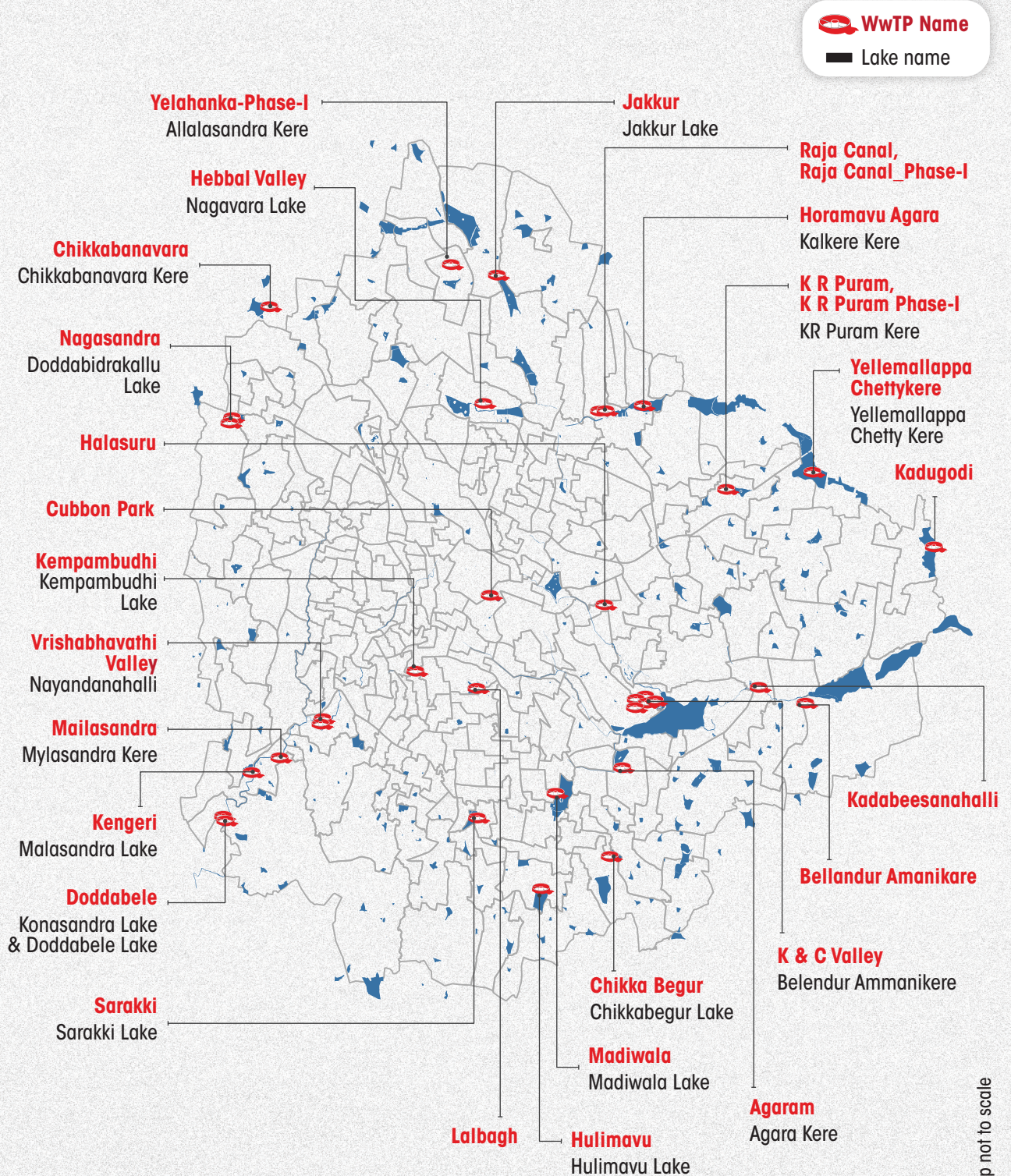
The authorities should also treat and make potable the only available source of water—the major lakes, such as Ulsoor, Hebbal, Yele Mallappa Shetty and Agara. If people are hesitant to use the water for domestic purposes, it can serve other needs.

(K C Subhash Chandra and G V Hegde are hydrogeologists)



EASY RECHARGE

Bengaluru has several wastewater treatment (WwTP) plants whose water can be used to fill up the city's lakes, which will, in turn, recharge the groundwater in waterbodies' area of influence



Source: opencity.in

Map not to scale

treated water. “However, we do not have data to establish this,” Babu says. In 2020, a study was conducted on heavy metals in vegetables in Bengaluru, following the order of the National Green Tribunal. Although high concentration of heavy metals was detected, no one knows the source of water used for agriculture and where the mixing was happening. “Industries discharge their waste cleverly which is very difficult to track,” Babu says.

Recycling wastewater and using treated wastewater to replenish lakes for groundwater recharge is crucial in a climate-risked world, when rainfall is becoming highly variable. But implementing these will require city authorities to go back to the blackboard, and introduce some revisions.

•**Check water losses:** The city is serious about reducing the loss of water in its distribution system. In 2008, BWSSB reopened its meter servicing and testing laboratory in Malleswaram, which it shut down in the early 2000s. The objective is to calibrate new water meters and cross-verify reading accuracy. The agency is also working to install multi-jet water meters in Bengaluru. These have much higher accuracy levels than single-jet meters. In the face of the prevailing water scarcity, BWSSB has issued an advisory, asking people to inform them in case of faulty meters and water leakage. While this is appreciable, the authorities need to keep in mind that water loss is high because of long-distance transport of water. So steps should also be taken to depend on local water resources as much as possible, by recharging groundwater and using treated wastewater.

•**Harvest rainwater:** In 2009, Bengaluru amended the Bangalore Water Supply and Sewage Act to notify the Bangalore Rainwater Harvesting Regulations. It made it obligatory for house owners to provide rainwater harvesting structures in all existing buildings with a built-up area of 2,400 sq feet and new buildings of 1,200 sq feet. If this is not done, BWSSB “may cause such rainwater harvesting structure and recover the cost from the owner or occupier as arrears of

WATER SOURCES NEEDED

Jaipur has exhausted its groundwater and now depends on the Bisalpur dam, 135 km away

Manohar Singh Rathore

ADEQUATE, SAFE and sustainable water supply to the fast-growing urban population is emerging as the major challenge in India. Bengaluru is a live example of this, and Jaipur is not far behind. With insufficient planning and management of water resources, the city has already exhausted its groundwater and now depends on a single source of surface water 135 km away, the Bisalpur dam.

The drastic change in water supply to Jaipur warns of the need for remedial measures. In 1990, the share of surface water in the total water supply was 6.6 per cent while that of groundwater was 87.57 per cent. In 2020, this changed to 74.4 per cent of surface water and 25.6 per cent of groundwater. During this period, there was excessive exploitation of groundwater.

The initial source of surface water for Jaipur was the Ramgarh lake, 35 km away, which dried due to various reasons. The Bisalpur dam was built to provide drinking water to some 3,209 villages, 6,674 habitations and more than 20 cities. It has an active capacity of 104 million cubic metres with a gross storage at full reservoir level (FRL) of 1,096 million cubic metres and live storage of 1,041 million cubic metres. Of this, only 50 per cent is used for drinking water. The main part of Jaipur accounts for nearly 311.5 million cubic metres or around 34 per cent of the total drinking water supply from the dam, while the rest of the city depends on groundwater and tankers from private tubewells in peri urban areas. In summers, a water market operates in most areas. With further increase in urbanisation (the population has increased from 3 million in 2011 to 4.2 million in 2021) and industrialisation, groundwater overdraft (when groundwater use exceeds the amount of recharge into an aquifer) will rise. Also, as the built-in area increases, the scope for local groundwater recharge declines. Since the current level of replenishment of dynamic water resources is not enough for urban Jaipur and its agglomerate area, there is an urgent need to recharge groundwater.

Climate change will affect the availability of surface water from the Bisalpur dam. Jaipur cannot depend on this single source. Measures like rooftop rainwater harvesting, recycling and reuse of treated wastewater and reduction in distribution losses from 45-50 per cent to 15 per cent, need to be implemented immediately.

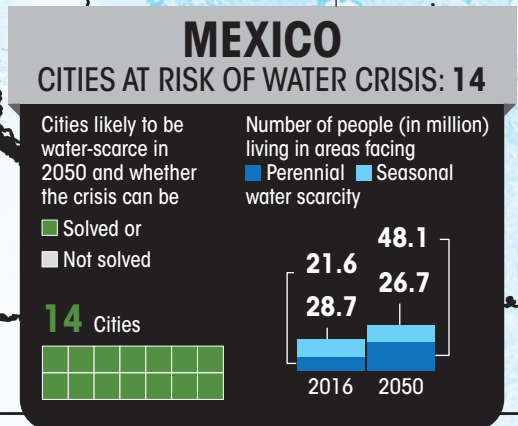
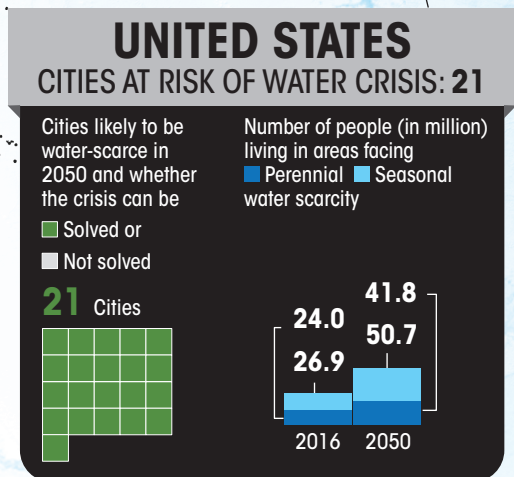
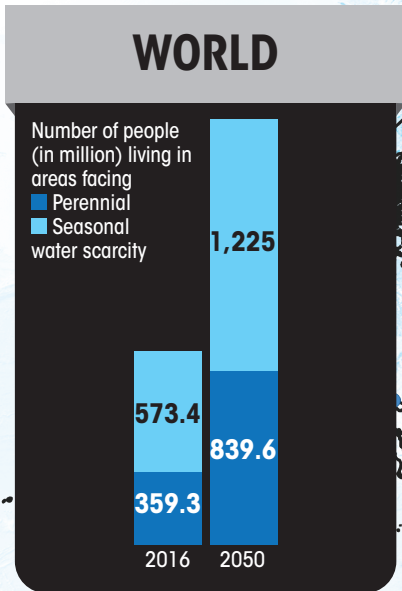
(Manohar Singh Rathore is director of Centre for Environment and Development Studies, Jaipur)



SCHEDULED FOR DAY ZERO

The cities with population above 1 million in 2016, which would face water scarcity in 2050

● Solutions* available ● Solutions not available



Map not to scale

PAKISTAN

CITIES AT RISK OF WATER CRISIS: 6

Cities likely to be water-scarce in 2050 and whether the crisis can be

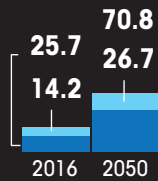
■ Solved or
■ Not solved

3 Cities



Number of people (in million) living in areas facing

■ Perennial
■ Seasonal water scarcity



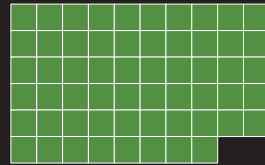
CHINA

CITIES AT RISK OF WATER CRISIS: 58

Cities likely to be water-scarce in 2050 and whether the crisis can be

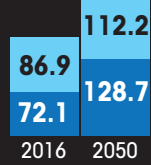
■ Solved or
■ Not solved

58 Cities



Number of people (in million) living in areas facing

■ Perennial
■ Seasonal water scarcity



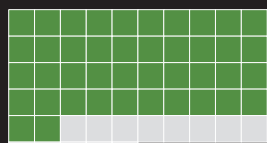
INDIA

CITIES AT RISK OF WATER CRISIS: 55

Cities likely to be water-scarce in 2050 and whether the crisis can be

■ Solved or
■ Not solved

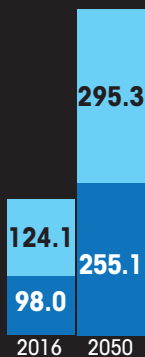
42 Cities



13

Number of people (in million) living in areas facing

■ Perennial
■ Seasonal water scarcity



*Solutions

1. Shared Socioeconomic Pathway-1 (SSP1) and Representative Concentration Pathway-2.6 (RCP2.6), which are the most sustainable development pathway of low climate change mitigation challenges and low social vulnerability, as per IPCC
2. Desalination of sea water
3. Groundwater exploitation
4. Reservoir construction
5. Inter-basin water transfer
6. Domestic virtual water trade
7. International water transfer / virtual water trade

Source: www.nature.com/articles/s41467-021-25026-3

JAIPUR CLOSE TO DAY 0

Residents still lack awareness about crucial water conservation practices

Rohit Goyal

IN RECENT years, several news reports have highlighted an impending water scarcity and a potential “Day Zero” crisis for various urban centres. Day Zero, a term that first gained traction during a water crisis in Cape Town, South Africa in April 2018, represents a critical point when a city or region’s water reserves plummet to alarming levels. It’s a stark reminder of the need for sustainable water management and conservation efforts.

India faces its share of water challenges. The ongoing crisis in Bengaluru has no clear resolution in sight. Chennai, too, despite being one of the world’s wettest major cities, has faced a severe water

shortage in recent years. Jaipur is headed in a similar direction, with news reports from January 2024 showing localised water shortages in the city.

Several factors contribute to water crisis in urban areas, such as unprecedented growth of cities that often outstrips infrastructure development. Inadequate urban planning also exacerbates water scarcity, especially when implementation falls short. Third, inefficient distribution networks and ageing water supply systems lead to high losses and strain resources. At the same time, surface water lakes, rivers and groundwater in urban areas see pollution and

neglect. Finally, with the rising impacts of climate change, existing water scarcity in cities could be exacerbated by prolonging periods of drought.

Ancient Jaipur, once renowned for its innovative rainwater collection and water supply system, now stands perilously close to experiencing “Day Zero.” Despite efforts in wastewater treatment and reuse, the surge in domestic and industrial wastewater generation has outpaced these initiatives. Rainwater harvesting structures exist, but their effectiveness is hampered by inadequate maintenance. Non-revenue water (NRW)—water lost before it reaches consumers—plagues Jaipur more than the average NRW observed in Indian and international cities. A successful pilot project in the Mansarovar area has significantly reduced NRW, but this model has not been implemented across the city.

While workshops and conferences on water management are held annually, residents still lack awareness about crucial conservation practices and the significance of preserving this resource. The urgency of addressing Jaipur’s water challenges cannot be overstated. By fostering awareness, implementing sustainable practices and improving existing infrastructure, Jaipur can and should avert crisis.

(Rohit Goyal is professor of civil engineering, Malaviya National Institute of Technology, Jaipur)



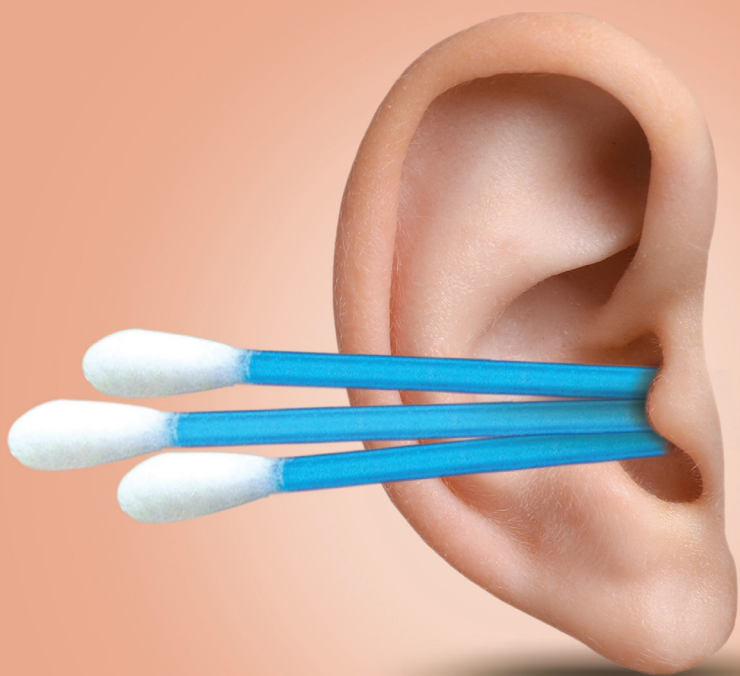
land revenue”. To save the Cauvery water, in 2021, the Legislative Assembly further passed a bill that makes it mandatory for large properties in Bengaluru to install rainwater harvesting infrastructure. The main challenge is now to ensure implementation of the bill. Monitoring of the impact of the groundwater recharge projects, both in terms of quantity and quality, developing the database of these projects and making the database publicly available. The city also needs to develop an aquifer management plan, especially for peripheral area where the dependence on groundwater is high. Such a plan would help assess recharge and extraction volumes and thereby ensure that the groundwater is not being overexploited.

•**Protect lakes:** Driven by the civil society and mandated by the judiciary, the city is being forced to pay attention to the preservation of its waterbodies. The challenge now is to ensure that not only the water structures, but also the connecting channels are protected. Sewage needs to be treated so that these sponges of the city—that replenish groundwater—do not become the receptacles of its waste.

•**Recycle wastewater:** BWSSB has mandated the use of treated wastewater for their construction purpose since 2019. As per this circular, before the issuance of no-objection certificate, the applicant or builder should provide an undertaking to use the treated wastewater for construction purpose. Recently BWSSB has started supplying treated water through tankers for non-potable purposes. Now, a check on the quality should be done as the city cannot afford to replenish its waterbodies with untreated sewage.

The city needs to learn how to reuse and recycle, so that it can make water from wastewater. This will make its future water-secure. But this means city planners will have to ensure the quality of treated water. Bengaluru already has regulations and guidelines in place for water recharge, reuse and recycle. It’s time the Silicon Valley of India started implementing those. **DTE**

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DROUGHT AND DELUGE

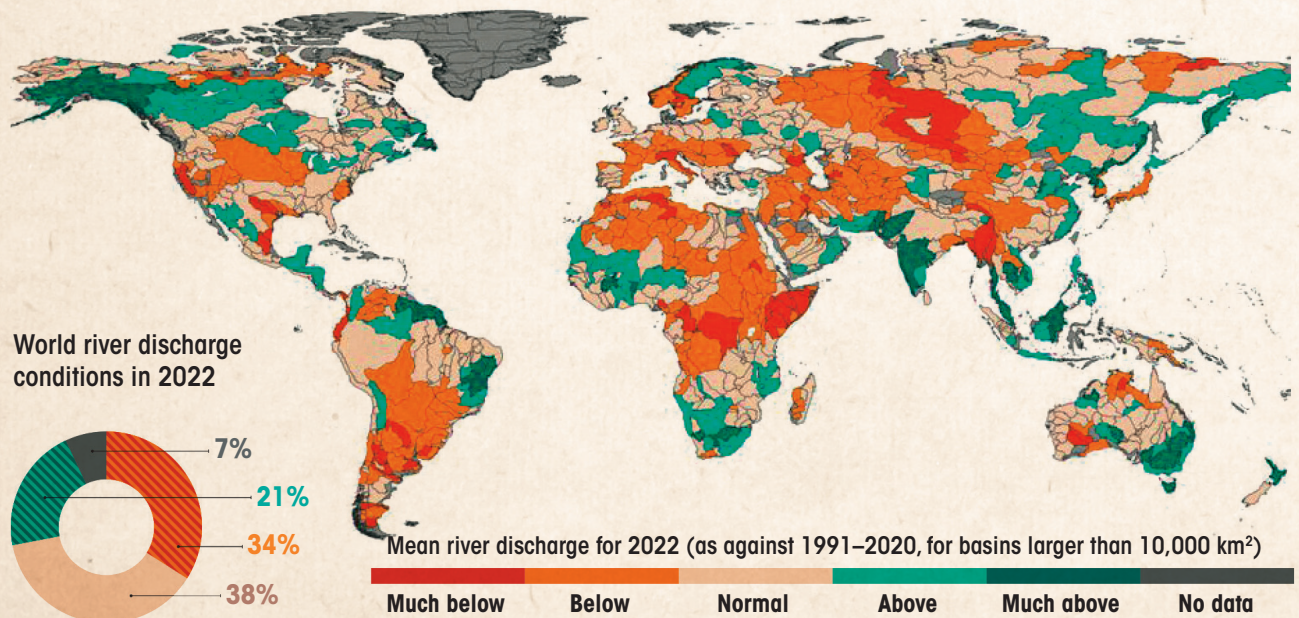
Future water demand will be generated not by population, but by economic growth

Every second person on the planet experiences severe water scarcity, says the UN in a new report released on March 22—commemorated as World Water Day. “The United Nations World Water Development Report 2024: Water for prosperity and peace” says that over the last two decades, from 2002 to 2021, droughts affected over 1.4 billion people and killed more than 21,000. Floods, on the other hand, affected 1.6 billion people and caused more than 100,000 deaths during the same period. “With more than 733 million people currently living in areas of high or critical water stress and a projected 30% increase in global water demand by 2050 compared to 2010, the role of water access, allocation, and management is key for sustainable economic development,” warns the report.

Water demand is set to increase. But, the report estimates, this will not be due to a steep increase in population. “The effects of population growth on global water demand are not as prominent, as the places with the fastest-growing populations, including several countries in Sub-Saharan Africa, are often those where per capita water use is the lowest,” it says. Rather, most of the increase in water demand will come from cities, countries and regions reporting high economic growth that is changing consumption patterns and lifestyles.

Conditions for water availability, stress

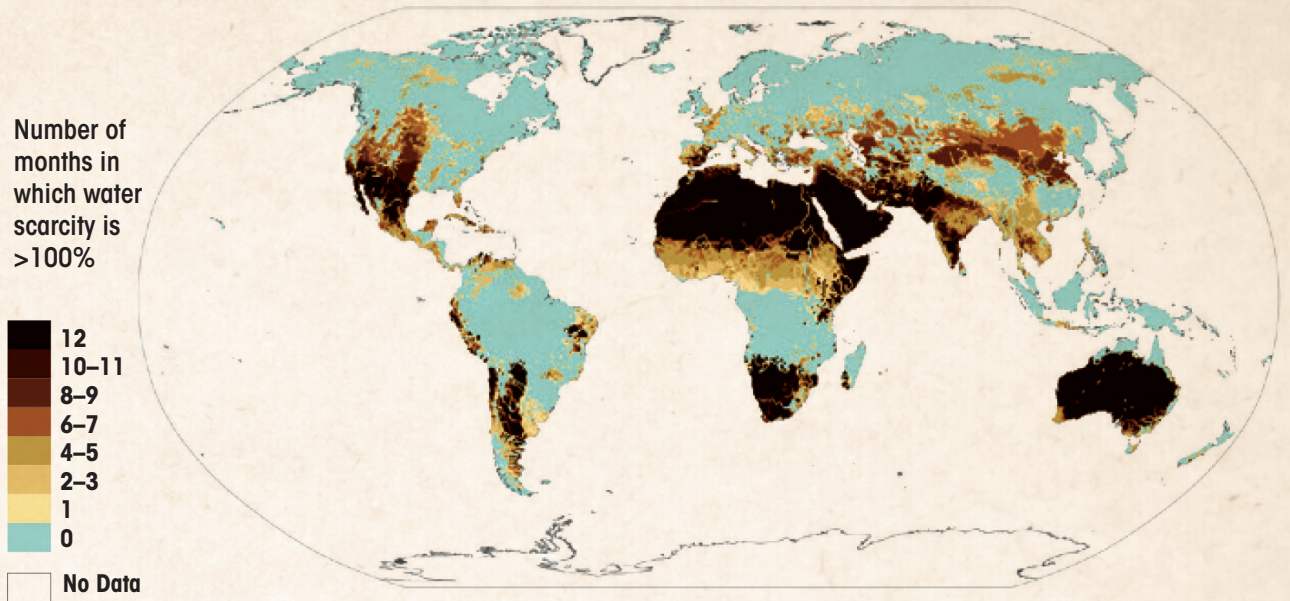
The natural distribution and availability of water resources is characterised by high or extreme variability, as evidenced by increasing or decreasing river discharge



Note: Results are based on simulation, obtained from the ensemble of eight global hydrological modelling systems

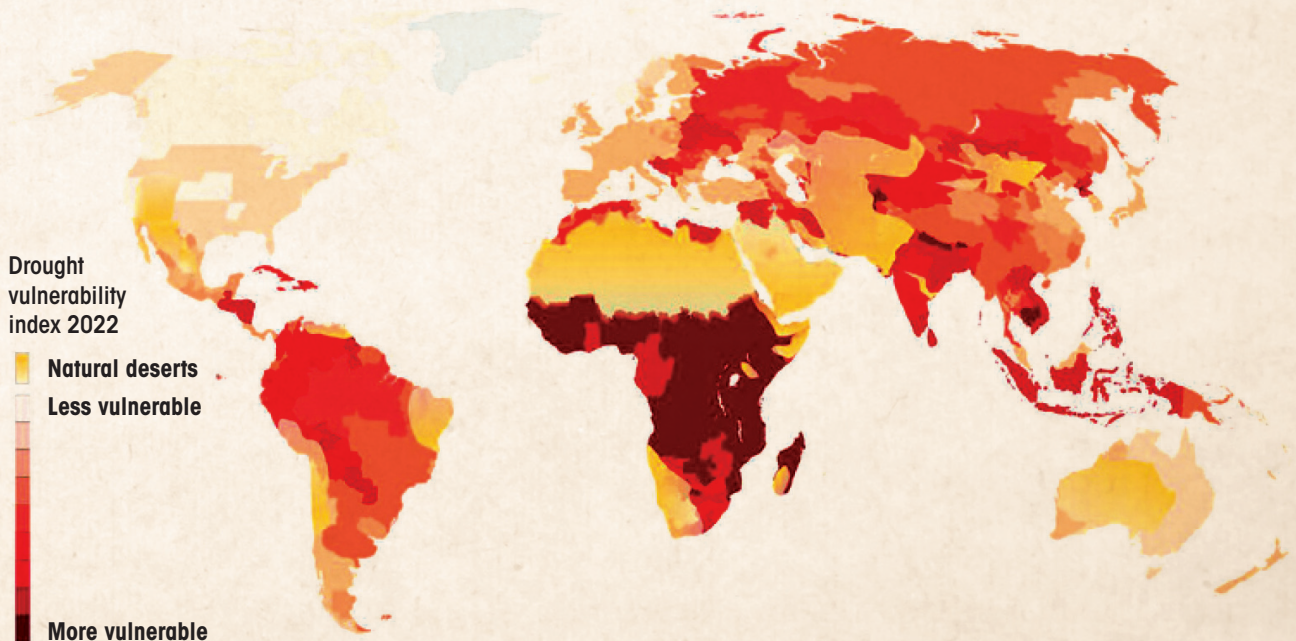
Widespread crisis

Roughly half of the world's population sees severe water scarcity, either for a few months or throughout the year



Disastrous impacts

Drought is one of the major drivers of global food and water insecurity, and has strong links with land use, land use change and resilience



Source: "The United Nations World Water Development Report 2024: Water for prosperity and peace"

Suspect claims in Teva's suit against Cipla

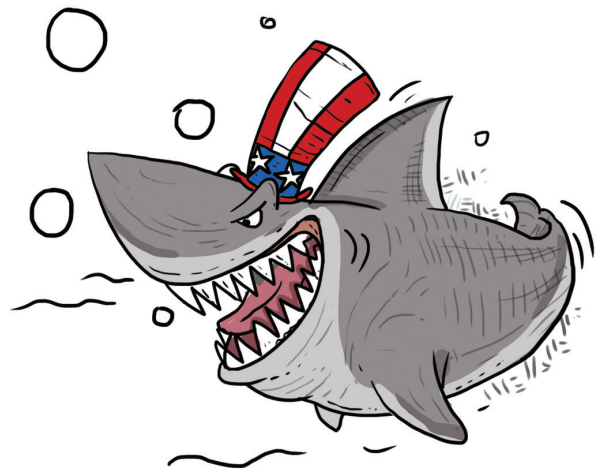
The US Federal Trade Commission has warned the Israeli drug firm its patents are wrongful as it sues Cipla aggressively

PATENT INFRINGEMENT cases are inevitable in the pharma industry. Lawsuits are filed more often than new drugs are discovered and every modification of a drug results in more patents and, predictably, more infringement suits. These take years to be settled, but since the damages awarded by the courts can be astronomical in the US, well-heeled drug majors have an incentive to pursue aggressive litigation. Legal costs don't matter much to the big firms, since their market monopoly allows them to rake in millions, if not billions, of dollars in profit.

Developments in recent months may well alter the course of litigation, and it could perhaps make the drug patent battles less problematic for Indian generics, for whom the US is the most lucrative market. This is the entry of the US Federal Trade Commission (FTC) in the knotty question of patents. FTC's primary role is to enforce consumer protection laws aimed at preventing fraud and unfair business practices, but it also enforces federal anti-trust laws that "prohibit anticompetitive mergers and other business practices that could lead to higher prices, fewer choices, or less innovation." Possibly because of the Joe Biden Administration's interest in bringing down healthcare costs, FTC is now looking at drug patents from the latter aspect.

In September last year, it cracked the whip on drug companies, asking eight of them to withdraw improperly listed patents in the federal registry of approved drugs. This is the Orange Book, where the drugs and pharmaceuticals approved as both safe and effective by the US Food and Drug Administration (FDA) are listed after innovator companies file New Drug Application (NDA). The Orange Book is the holy grail of drug companies. It helps generic-drug makers assess which of the innovator drugs can be made safely and effectively as generic alternatives. The snag is that many of these patents are intended to create a thicket that makes it difficult for competitors to cut through. This delays cheaper generics and has become a cause of concern for FTC in recent months.

And it is here, with the Orange Book, that Israeli firm Teva's suit against Cipla begins, as do many of the cases involving generic firms. Apart from innovator companies, generics manufacturers planning to market and sell a generic drug must file what is termed an Abbreviated New Drug



Application or ANDA with FDA to prove that its drug is a bio-equivalent to the original drug. If ANDA is approved, the generic drug will be listed in the Orange Book.

When generic firms list their ANDA for a specific drug, it is usually the signal for the innovator company to launch legal action, claiming infringement of patents so that competitively priced generics are kept out of the market. In 2020, based on an Orange Book listing, Teva Pharmaceutical Industries said Cipla's proposed generic version of its Qvar inhaler, used to treat asthma, infringed six patents. Teva sought a court injunction against the manufacture of Qvar generics until the patents expire in May 2031 and in January 2032. If Cipla chose to enter the market before that, Teva demanded cash compensation. At the time, Qvar's sales in the first half of 2020 were US \$97 million, according to the company. Cipla countered that Teva's patents were either invalid or would not be infringed.

The patent suit has since then wound its way through the courts, but FTC's September announcement put drug companies on notice, when FTC chairperson Lina Khan said patent abuse to stop competition would be dealt with strictly. It warned that the agency would scrutinise and act against improper patent listings in the Orange Book to ensure cheaper versions of branded drugs, including asthma inhalers and epinephrine auto-injectors, were not delayed, according to a *Bloomberg* report.

FTC appeared to be getting tough with the patenting practices of innovator companies when it issued warning letters to the companies after issuing a policy statement, with the support of FDA, on the same lines. Both actions underscored FTC's determination "to use all its tools to halt unlawful business practices that contribute to high drug prices". Significantly, it would include FDA's regulatory process for disputing a brand company's patent listing and potentially pursuing relief under the antitrust laws.

This should have provided cheer all round, but it begs the question of why FTC has not acted so far to curb such practices. The rot in the US system has continued for decades, as FTC's statement

reveals. The September policy statement says FTC examined the anti-competitive effect of improper Orange Book listings as part of a 2002 study, when "it identified numerous instances in which the 30-month stay was used to block competition".

The strategy of getting a 30-month stay is what Teva is using to stop Cipla in its tracks, in what appears to be a brazen defiance of the FTC warning. Of the eight firms put on notice by FTC in September, Teva is the only one to continue on its belligerent path. In February, it sued Cipla for allegedly infringing 12 of its asthma treatment patents, seven of which have been targeted by FTC.

The question is whether the new-found resolve of FTC will deter pharma companies on misuse of patents for the Orange Book listing. News reports say three of the eight firms have pulled most or all of their FTC-targeted listings. This includes GlaxoSmithKline, which has pulled out three of its four patent listings in the Orange Book.

On the other hand, companies like Teva and Boehringer Ingelheim International are continuing to assert their patent claims, say legal experts. All that it will entail is just the cost of litigation. Drug companies appear to be betting on their assessment that FTC will not sue them if they refuse to retract. There is also a question mark over how far FDA would go to help FTC in its campaign to weed out wrongful patents. As one drug company said, it was up to FDA to change its regulations on listing.

What may put more pressure on drug companies is anti-trust suits filed by private funds. A Massachusetts workers' health fund has filed such suits against Boehringer and Teva. The class action suit says Teva manipulated the US patent and drug-approval process to maintain a monopoly for its Qvar asthma inhaler for nearly a decade by keeping out cheaper generics. It says the Israeli firm piled up improper patent applications for slightly tweaked products, and also engaged in false litigation to block competition from cheaper generic makers. Boehringer has already cut the prices of its inhalers in the wake of the class action suit. Monopolies are clearly on notice. [DTE](#)

⊗ @ljishnu

The US Federal Trade Commission appears to be getting tough on patent misuse by innovator companies. The question is whether this will deter the pharma companies



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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

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

Course fee

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Registration closed

Part B:

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(Indian participants)

Training material for Part A will also be provided

AWARD OF CERTIFICATES

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For any query, contact: **Shobhit Srivastava**, Deputy Programme Manager
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Palette

WHAT'S INSIDE

Poacher narrates the story of a 2015 ivory smuggling racket **P52**

Bhanga Mela reduces e-waste, helps improve incomes **P54**

Inequality in India at a level last seen before 1922 **P58**

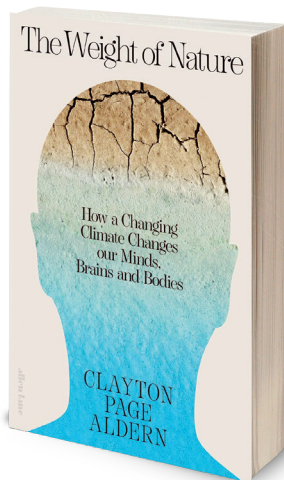
RECOMMENDATIONS

SHORT FILM

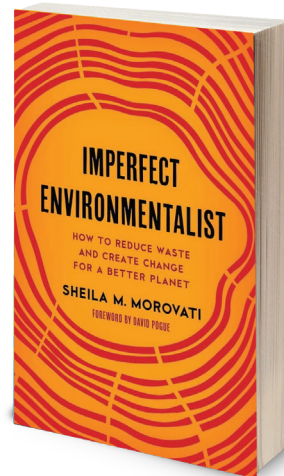


With rapid rise in urbanisation, the flora and fauna of cities are relegated to the shadows. In the absence of conservation efforts, they may disappear from the landscape altogether. Alarmed at such a trend in the National Capital Region, where many amphibian species are struggling for survival, conservationists and community initiatives have sprung up to rewild and sustainably maintain urban forests, with support from the Wildlife Trust of India (WTI)'s Rapid Action Project. WTI highlights these movements in a short film, *The Vanishing Croaks of Delhi NCR*, available to view on its Youtube channel now.

BOOKS



Climate change has a myriad impacts on the health of humans and the environment. Often, focus is on how global warming, extreme weather events and environmental shifts affect the physical well being of humans. However, these also quietly impact our brain health, behaviour, productivity and decision-making. In *The Weight of Nature: How a Changing Climate Changes Our Minds, Brains and Bodies*, neuroscientist-turned-environmental journalist Clayton Page Aldern explains how climate change is affecting us from the inside.



Humans generate huge volumes of waste on a daily basis. Often, an individual's drive to try and reduce his or her own impact on the planet is held back by doubts on whether this will make any difference at all. In *Imperfect Environmentalist: How to Reduce Waste and Create Change for a Better Planet*, environmentalist Sheila Morovati shows how anyone can lower the global waste burden and make a difference by simply adopting a few changes in perspective and behaviour.



A wild chase

BASED ON A 2015 PROBE THAT BUST A MAJOR IVORY SMUGGLING RACKET IN INDIA, *POACHER* PROVIDES A RARE GLIMPSE INTO THE WORK OF FOREST OFFICIALS

DAKSHIANI PALICHA AND MIDHUN VIJAYAN

EXPLOITATION IS the price wildlife pays, as one character in *Poacher* puts it, “for being on the same planet as us”. The eight-episode series on Amazon Prime Video is the story of a group trying to reverse this punishment—by catching the exploiters and securing the future of a vital species.

Directed by Richie Mehta, who has also helmed the documentary *India in a Day* (2016) and series *Delhi Crime* (2019), *Poacher* is a dramatised narrative of Operation Shikar, a 2015 investigation to bust a large poaching and ivory smuggling racket. The operation recovered nearly 500 kg of ivory obtained from the illegal hunting of wild elephants in the forests of



Poacher

Cast: Nimisha Sajayan, Dibyendu Bhattacharya, Roshan Mathew, Kani Kusruti, Sanoop Dinesh, Noorudheen Ali Ahmed, Ranjitha Menon, Sooraj Pops

Director: Richie Mehta

Platform: Amazon Prime Video

Malayattoor, Kerala.

The series portrays how a confession on the prevalence of the illegal hunting in Kerala—a state that prided itself for eliminating elephant poaching in the 1990s—by Araku (played by Sooraj Pops), a guilt-ridden forest watcher who was helping the illegal hunters, caught the forest department off guard and drove it to find the perpetrators. Leading the charge are range officer Mala Jogi (Nimisha Sajayan), field director Neel Banerjee (Dibyendu Bhattacharya), and analyst Alan Joseph (Roshan Mathew) of the Wildlife Trust of India, a Delhi-based non-profit that aided Operation Shikar.

For those well versed in the aspects of wildlife conservation, *Poacher* touches several familiar themes. These include understanding the role that each species—from the smallest of frogs to the mightiest of elephants—plays in the ecosystem, human-wildlife conflict with fragmentation of habitat, dwindling food and forest resources, and the plight of communities that have depended on the jungle for generations.

What's different is the glimpse it provides into the lives of forest officials, an underexplored section of law enforcement in films and series. Nimisha Sajayan is brilliant in her portrayal as Mala—a headstrong officer that reminds one of Vidya Balan in *Sherni* and even Shefali Shah in Mehta's *Delhi Crime*—for whom finding the poachers is in some way, atonement for the sins of her father, who was also a hunter. But as nuanced as the character is, at times, she fails to see beyond her own bias. For Neel, justice and integrity

prevail over everything else, even at the cost of his own health. For Alan, the case is a way to realise his true passion for wildlife conservation, which his family may accept, but cannot understand. Another notable character is forest officer Dina (Kani Kus-ruti), who manages to nab a key player in the poaching ring but must then deal with allegations and internal enquiries on her “methods”. What keeps them all going is their conviction that the survival of elephants—engineers of the forest who help in making pathways and in dispersing seeds, among other things—is vital.

The series reminds one of the importance of this animal, and of

WHILE TOUCHING SEVERAL FAMILIAR THEMES IN WILDLIFE CONSERVATION, POACHER ALSO PROVIDES A GLIMPSE INTO THE LIVES AND WORK OF FOREST OFFICIALS, AN UNDEREXPLORED SECTION OF LAW ENFORCEMENT IN FILMS AND SERIES

nature itself, through visually stunning effects and cinematography by Johan Heurlin Aidt. The beauty of the Western Ghats is starkly contrasted with metropolitan Delhi. Wildlife, even apart from the majestic yet vulnerable elephants, appears in several poignant scenes. But the situations are sometimes a bit overdone—such as a scene where a high-speed vehicle chase is paused to let some ducks safely cross the road.

The narrative is also slowed down by the hurdles in the investigation due to procedural inefficiencies, powerful and connected people trying to erase their links to the crime and most of all, jurisdictional conflict in finding the poachers: “Too many people [departments]

hunting the same animal [poachers],” as Neel explains.

The bureaucracy, in particular, is justifiably panned at the end of the series. The officials spend a painstakingly long time just trying to figure out how to work with, or sidestep, other agencies as well as the public, who are unable to wrap their minds around the seriousness of the crime. Perhaps, it is an attempt to give the viewers a sense of the convoluted protocols that exist in these cases.

For those familiar with Operation Shikar, the climax of the series does not hold many surprises. But the epilogue brings up unanswered questions, the most resounding of which is asked

by Mala: “Can poachers be reformed?” Conversations on ending the illegal hunting and smuggling of wildlife always include the need for behavioural change and community involvement. But there is little exploration in the series on how this could

be done. It does dwell into the lives and struggles of these illegal hunters, who are not just portrayed as villains consumed by greed, but also as people who are working to escape deprivation. But the solutions shared to deal with the poachers do not dwell too much on their reform, and seem to start and end at tighter law enforcement. Araku the whistle-blower, for example, was forced to participate in the poaching activity by financial need and threats to his life, yet must face harsh judgement by the forest officials.

Perhaps, a spiritual sequel with greater focus on the perspectives of the poachers and the local communities is in order. **DTE**

⊗ @down2earthindia

IF IT AIN'T BROKE, DON'T FIX IT

West Bengal's Bhangra Mela (scrap fair) has pushed the limits of recycling. Organised every January at Mathurapur village in 24 South Parganas district, shops at the fair sell discarded electronic items, antiques and even non-functional goods that are in repairable condition.

In 2024, the fair had some 1,000 stalls selling scrapped computers, televisions, radios, phones, vintage cameras, musical instruments, bicycles, furniture and clocks. "The month-long event provides an opportunity to individuals who may not have the means to purchase new items to indulge in a semblance of luxury," says Ezazul, a seller.

Most of the sellers are residents of Mathurapur and nearby villages, who collect scrapped items through the year and store them in their houses for sale at the fair. For the duration of the fair, they set up makeshift stalls that work as their living space, storage area as well as shop. The income generated not only sustains their livelihood, but also caters to



essential expenses such as funding marriages and maintaining homes.

The fair sees a footfall of about a thousand visitors a day, most of whom are from the nearby areas, say shopkeepers. On average, a shop earns ₹1,000 a day, says one seller.

Since a significant portion of India's e-waste is handled by the informal sector, fairs such as Bhangra Mela can be a major source of recycling. But they also come with environmental risks and health hazard due to handling and dumping of electronic waste, especially because the site of the fair is the ecologically sensitive Sundarbans Wetlands. A photo essay by **SUBHAJIT NASKAR**



◀ RECYCLE AND REUSE

Every year in January, a 370 sq m ground in Mathurapur village becomes the site of Bhanga Mela, a scrap fair. The fair has been held at the village for some 40 years now. Many stalls are operated by second and third generation sellers. Unofficial estimates say that this year the month-long fair witnessed sales of goods that ran into crores of rupees.

CIRCULAR ECONOMY ▶

Bilal sells a personal air cooler to a visitor from the nearby village of Bishnupur.

"People wait the entire year for the fair. On a good day, we can make a sale of ₹10,000," says Bilal.



WINDOW SHOPPING ▶

A family visits the fair to purchase lights and electronic items. The fair is quite huge and people sometimes spend the entire day surfing for items of choice.



◀ **HARD BARGAIN**

Ashraf Sardar with two gadgets he bought at the fair—a small personal television that receives signals over the air, and a radio—for his family. "I visit the fair every year to purchase old items at low cost. Bargaining is key. I got the TV for ₹500 instead of the initial ₹1,000 the seller was asking for, while the radio's price came down from ₹150 to ₹50," he says.



Pollution Control Board, Assam Launching of the Golden Jubilee in June 2024

Pollution Control Board, Assam has been relentlessly working towards sustainable environmental management in Assam and facilitating industrial growth.



The Board is glad to share some of the milestones achieved during last 2 years.

- ▶ 41 Business Reform Action Points (BRAPs) have been integrated with Ease of Doing Business (EoDB) portal and granted more than 18,000 consents and authorizations to various industrial and service sector units in the State in the last two years
- ▶ Successful implementation of the National Clean Air Programme (NCAP) in the State in Guwahati, Nalbari, Nagaon, Sivasagar and Silchar. Integration of Mission LiFE with NCAP
- ▶ Assessment of Ambient Air Quality of the State through 53 Manual Monitoring Stations and 9 Continuous Ambient Air Quality Monitoring Stations. The process of installation of another 10 manual monitoring stations is in progress
- ▶ Adopted use of e-tools (e-Office, GeM, e-Auctioning through MSTC, etc.) for improvement of office functioning
- ▶ Water quality is monitored in more than 237 locations in the State under the National Water Quality Monitoring Programme
- ▶ For management of Industrial hazardous waste, the first Transport, Storage and Disposal Facility (TSDF) is being established in Lekai, Dibrugarh
- ▶ Facilitated establishment of Common Bio-Medical Waste Management Facility (CBWTF) at Panikhaiti and Bajali for management of Bio-Medical Waste generated in various Health Care Facilities
- ▶ Awarded with coveted NABL Accreditation for the Central Laboratory with a scope of 69 Air and Water Quality Parameters
- ▶ Restoration of the plinth area of Baghjan Well No. 5 by planting about 35,000 saplings of native trees following Miyawaki method of plantation
- ▶ Collaborating with Institutes of repute (IIT-Guwahati, Gauhati University, Bhattadev University, CIPET (Assam), Kanoi College, MNC Girls' College, B. Borooah College, Sonapur College, Arya Vidyapith College, etc.) and NGOs (Centre for Cultural Integration, Earthful Foundation, etc.) to work in the field of Pollution Control and Environment Management



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Neocolonial Raj

IN 2022, Lucas Chancel, co-director at the World Inequality Lab of the Paris School of Economics, and lead editor of the “World Inequality Report 2022”, told me in an interview that democratic countries emerging out of colonisation in the 1940s and 1960s made significant progress in bridging inequality. On India, he said, “The country came out of colonisation and adopted policies that ensured interventions to regulate the economy and to bridge inequality. A few instances are the five-year plans, high tax rate and strategic economic management policies like inheritance tax (abolished in 1985).” Does this mean democracy helps fix inequality? He answered: “After the 1970s, the view that high tax rates and regulation would not help in wealth generation, saw global acceptance. Hence, inequality does not question democracy or its efficacy, but rather the choices we make under democracy. Inequality hurts democracy, which is why governments need to intervene to fix this trend.”

In March, Lucas, with Thomas Piketty and Anmol Somanchi of the World Inequality Lab, released a working paper titled “Income and Wealth Inequality in India, 1922-2023: The Rise of the Billionaire Raj”. This paper builds on the “World Inequality Report 2022” and updates on inequality in India up to 2022. “Billionaire Raj” sounds a rather elevating phrase to an aspirational Indian since we are high on a dreamy path to become a developed economy. “Fastest growing economy” is already a superlative that has become a poll slogan on the eve of the general elections. To make this growth look inclusive, the government has claimed to have helped 250 million escape poverty (the estimate is for multidimensional poverty, since India does not have an estimate of income poverty since 2012).

The latest update from the World Inequality Lab dissects this economic growth, its widening inequality and extreme concentration of wealth in a few hands. The paper analyses income inequality in India for 1951-2022. Interestingly, for three decades starting 1951, inequality came

down. “The share of national income going to the top 10% fell from 37% in 1951 to 30% by 1982,” says the paper. But after this, income concentration went up. From the 1990s, the share of the top 10 per cent in national income leaped to 60 per cent in recent years. At the same time, the share of the bottom 50 per cent continues to be minimal. In 2022-23, inequality in income and wealth is staggering: the top 1 per cent earn 23 times the average income of an Indian. The richest 10,000 Indians earn an average ₹48 crore, which is 2,069 times the Indian average. “By 2022-23, top 1% income and wealth shares (22.6% and 40.1%) are at their highest historical levels and India’s top 1% income share is among the very highest in the world.”

Why were the 1990s a period when inequality seemed to start widening very fast? What are the reasons for inequality to decline in independent India’s first three decades? To the latter question, the paper has the answer: “This

Current levels of inequality were last seen before 1922, during the British Raj

was likely the consequence of the broadly socialist policy agenda pursued by the Indian government till the 1980s.” For the former question, the paper reasons, “Since the early-1980s, when the Indian government began initiating a broad range of economic reforms leading up to the liberalization in 1991, the decline in top 1% shares halted. From the early-1990s onward, top 1% shares have consistently increased over the next 30 years to reach an all-time high of 22.6% in 2022.”

The number of billionaires in India has been increasing. In 1991, India had just one billionaire. By 2011, the number reached 52 and in the next one decade it more than tripled to 162 in 2022. “Over this period, the total net wealth of these individuals as a share of India’s net national income boomed from under 1% in 1991 to a whopping 25% in 2022,” finds the paper. This level of inequality was observed before 1922, during the British Raj. This is why the authors have named their paper “Billionaire Raj”. [DTE](#) [@richiemaha](#)



INTEGRATED ONLINE AND ONSITE TRAINING ON ENVIRONMENTAL IMPACT ASSESSMENT

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

PROGRAM DESIGN

PART A

BASIC LEARNING (ONLINE)

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

PART B

ADVANCED LEARNING (ONSITE)

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



PART A

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

PART B*

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

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



ONLINE PART

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

ONSITE PART

September 17-20, 2024

February 18-21, 2025

WHO CAN APPLY

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

SPECIAL DISCOUNT

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

CERTIFICATE OF COMPLETION WILL BE AWARDED FOR BOTH PROGRAMMES

FOR ANY QUERY, KINDLY CONTACT

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