

**DIA, DEOGHAR IAS ACADEMY**

# ***Daily News Feed***

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# Has the environmental crisis in India exacerbated?

What are the major factors which contribute to the current environmental crisis?

**Tikender Singh Panwar**

## The story so far:

**A**s we observe June 5 as World Environment Day, one takes stock of how the previous decade has exacerbated/mitigated existing environmental crises.

## What are main environmental crises?

The world is grappling with three deeply intertwined planetary crises: carbon emissions, biodiversity loss, and pollution. Over the last 10 years, these crises have deepened, despite growing awareness and international efforts.

Between 2015 and 2024, global CO<sub>2</sub> emissions rose from around 34.1 billion metric tonnes to 37.4 billion metric tonnes, a nearly 10% increase. In the same period, India's emissions surged from 2.33 billion to 3.12 billion metric tonnes, persistent dependence on coal

and oil. On the biodiversity front, mass extinctions and ecological disruptions are becoming the norm. India, with its mega-diverse ecosystems, faces growing threats from deforestation, wetland degradation, and monoculture agriculture. Meanwhile, pollution, particularly air pollution, has remained stubbornly high. India consistently ranks among the world's most polluted countries, with Delhi topping global lists.

## What are the root causes?

There are myriad causative factors. First is fossil fuel dependency. Most global carbon emissions are driven by coal, oil, and gas consumption in power generation, transportation, and heavy industry. In India, coal still accounts for nearly 70% of electricity generation. Second, we have deforestation and land-use change. In India, forest clearances for roads, mining, and dams have increased, especially in

biodiversity-rich regions like the Western Ghats and the northeast. Third, agricultural intensification. High-input monocultures, especially driven by agribusinesses, destroy habitats and pollute water bodies with nitrates, pesticides, and plastics. Waste mismanagement and unchecked urbanisation is also a major factor causing environmental degradation. Unregulated landfills, untreated sewage, and industrial effluents have polluted rivers like the Ganga and Yamuna. India generates 62 million tonnes of waste annually, of which barely 20% is scientifically processed. And finally, overconsumption and industrialisation. The Global North's high consumption and global supply chains externalise pollution and ecological damage to the Global South.

## How is India positioned?

As a developing economy, India has a smaller per capita carbon footprint (-1.9

its aggregate emissions are rising due to rapid industrialisation and urbanisation. The poor bear the brunt of pollution and climate shocks – whether in Delhi's smog-choked slums or drought-stricken villages in Maharashtra. Yet India is also a victim of the environmental damage caused by global forces. Climate change, largely driven by the historical emissions of richer nations, has intensified India's monsoons, floods, and heatwaves, while biodiversity loss has weakened India's food systems and health infrastructure.

## What needs to be done?

A meaningful response must include accountability from nations of the Global North. Wealthy nations must drastically cut emissions, provide climate finance, and stop outsourcing dirty industries. Large polluting corporations must also be held accountable through strict laws and carbon taxation. Moreover, the future of development must be based on ecological concerns. For example, corporations that do not adhere to the 'green policy' should not be allowed to trade in the market. Creating such protocols will pave way for systemic changes. Sustainable development should be encouraged with a shift toward low-carbon livelihoods, ecological agriculture, and community-led conservation.

*Tikender Singh Panwar is former deputy mayor of Shimla, and member of the Kerala Urban Commission.*

## THE GIST

▼ The world is grappling with three deeply intertwined planetary crises: carbon emissions, biodiversity loss, and pollution.

▼ As a developing economy, India has a smaller per capita carbon footprint (-1.9 tonnes/year vs. the U.S.'s 14.7 tonnes), yet its aggregate emissions are rising due to rapid industrialisation and urbanisation.

▼ A meaningful response must include accountability from nations of the Global North.



# Is global warming becoming a distraction?

Why are climate models for the distant future unreliable? Does an inordinate focus on global mean warming levels take away importance from climate disasters and mitigation strategies? What are some of the immediate measures that one must focus on to tackle climate-related catastrophes?

## EXPLAINER

Raghu Murtugudde

### The story so far:

A global mean temperature rise of 2°C is enshrined in the Paris Agreement as a safe level of global warming by 2100 with respect to the pre-industrial baseline. This threshold was reduced further to 1.5°C due to the demand from the Alliance of Small Island and Developing States. The climate community has since been trying to quantify climate change and its consequences relative to these warming levels. Unfortunately, the models scientists use for climate projections aren't perfect, which affects the uncertainties in global mean temperature rise estimates. To make predictions for years far beyond 2050, the models need to know the greenhouse gas emissions at the time. Modellers create these figures by imagining energy sources of the future, population growth, and climate actions and policies by then. However, it is anything but easy to simulate societies of the distant future. Thus, projections of global warming in the distant future depend heavily on uncertainties inherent to these speculative scenarios.

### Is global mean warming important?

After 2023 and 2024 turned out to be record warm years, the spectre of crossing the 1.5°C threshold looms large. However, the 2°C warming threshold emerged from a rather arbitrary assumption rooted in the work of economics Nobel laureate William Nordhaus in the 1970s.

There has been much debate since as to what this figure represents in real terms, because the two warming levels – 1.5°C and 2°C – aren't particularly special in climate science. In fact, there are uncertainties about the magnitude and/or duration of warming overshoot required for it to be catastrophic. The onslaught of climate-related disasters also makes it



**Need to refocus:** Residents clean up a mud-and-debris-covered street after flooding hit large parts of the country, in the Paiporta municipality of Valencia, Spain on October 31, 2024. GETTY IMAGES

clear that any additional warming should be avoided. The exact amount of warming, whether 1.5°C, 1.75°C or 2°C, hardly matters for disaster management and adaptations required today.

### Did the world really cross 1.5°C?

Global temperature estimates are prepared by blending observations and models. Also, multiple groups produce multiple models, which produce multiple estimates – and they are not alike. Two such models of late have claimed the world exceeded 1.5°C of warming in late 2024 whereas one has estimated the world didn't. Be that as it may, the question remains as to whether 2025 will continue to warm or if the rate of warming will drop. Rapid warming events in the past suggest that the rate of warming after sudden jumps tends to decline after a few years. For example, 2024 started out warm following the

record warmth of 2023 before the rate of warming dropped. The rate in 2025 has already fallen below that seen in 2024 for the same months. Considering the uncertainties in warming plus irreducible uncertainties in estimating today's temperatures, it is confusing why global mean warming levels remain relevant.

Climate adaptation and resilience require large investments. We also need reliable local information to avoid maladapting. Thus, climate mitigation must continue, in fact even accelerate while global mean warming is a distraction we can do without. But with the back-peddalling on climate action in some countries, short-and medium-term predictions, from days to a decade or two, are most urgent now, especially at the hyperlocal scale.

### What about climate disasters?

Climate disasters like heatwaves, floods,

and droughts are becoming more protracted, frequent, and intense. Insurance losses, number of lives, and number of livelihoods lost worldwide are rising year on year. These disasters are a reminder that unless researchers can pinpoint which disaster is likely to occur where and with sufficient actionable lead time – for example, a few days to few weeks for most extreme events – focusing on global mean warming can be wasteful, if not misguided.

Early-warning systems and disaster management are becoming better overall and global plans under the UN, such as Early Warnings for All, promise to ensure poorer countries are not left out. If we are to manage day-to-day crises better even as the risks of climate hazards increase, we also need predictions at the decadal timescale to allow countries to plan ahead for adaptation and resilience. This in turn demands that we focus on tracking disasters, preparedness, management and recovery.

The earth's tropics are a hotspot of climate change's consequences since they are warmer to begin with. So catastrophic floods outside the tropics, such as those in Valencia in 2024, are a stark reminder that good early warnings are worthless unless they are actionable up to the last mile. It has become common in the wake of disasters for some research groups to claim it was caused by global warming. However, we need to focus on more important questions: whether a given forecast was accurate and whether all disaster management agencies on the ground received it in time. If a forecast fails, they need to be recorded and documented as such; if a forecast was accurate but the government failed to prepare for it in time, the points of failure must be quickly identified and corrected.

This acknowledges that climate risk and uncertainties are never zero, that risks are not predestined, and that we have agency in mitigating them.

Raghu Murtugudde is retired professor, IIT Bombay, and emeritus professor, University of Maryland.

## THE GIST

After 2023 and 2024 turned out to be record warm years, the spectre of crossing the 1.5°C threshold looms large. However, the 2°C warming threshold emerged from a rather arbitrary assumption rooted in the work of economics Nobel laureate William Nordhaus in the 1970s.

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IAS Academy



# BESS in India's clean energy transition

**T**he climate crisis has changed the idea of energy security. A country's energy sources must stand firm on four planks: availability, accessibility, affordability, and environmental acceptability. Environmental acceptability focuses on the trade-offs policymakers and the public are willing to make in terms of pollution, biodiversity loss, and greenhouse gas emissions. In this context, renewables have strengthened their position as an energy source that provides affordable power with lower emissions. They are important for the fulfillment of Sustainable Development Goal 7, which focuses on access to clean energy.

The case for integrating green energy into power systems is further strengthened by looming climate risks and geopolitical tensions. However, increasing renewable energy capacity may not have the desired results due to the intermittent nature of the resource. Energy storage technologies, such as Battery Energy Storage Systems (BESS), offer a crucial solution to mitigate the variability of renewable energy while enhancing grid stability.

## Why energy storage matters

With the potential to enhance grid operations, enable large-scale integration of renewables, and provide reliable power, energy storage systems are critical to the energy transition. Among the technologies available, BESS stands out for its affordability, scalability, rapid deployment, and geographical flexibility.

By stabilising the grid, balancing demand-supply fluctuations, and enabling peak load management, BESS plays a foundational role across all forms of energy storage. Integrating BESS into the grid with renewables can considerably reduce greenhouse gas emissions from the power sector. Further, its ability to support decentralised energy solutions and microgrids ensures renewable energy reaches where it is needed most, making BESS a key enabler of a cleaner, more resilient, and equitable



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Director, IndiGrid

Among the technologies available, BESS stands out for its affordability, scalability, rapid deployment, and geographical flexibility

energy ecosystem.

Declining costs and technological advancements lead to the accelerating expansion of BESS. Over the past 15 years, the average cost of batteries has fallen by nearly 90%. However, despite this progress, utilisation of its full potential is impeded by regulatory, technical, financial, and market barriers.

## India's BESS Landscape

Emerging economies such as India can lead by example in BESS deployment through a combination of financing and policy measures. India has set a target of 500 GW of installed power capacity from non-conventional fuels by 2030. As of January 2025, the country had already achieved 217.62 GW. To achieve full results, BESS deployment must be accelerated.

In this regard, the government has committed to installing 47 GW of BESS by 2032 to enable increased renewable deployment and its integration with the grid. Schemes such as Viability Gap Funding and waiver of interstate transmission system charges for BESS projects commissioned by June 2025 have been enacted to support BESS projects.

But progress has been slow. In the Economic Survey 2024-25, the Indian government highlighted the challenges associated with scaling up renewable energy and energy storage deployment – including the lack of investment for grid upgradation, speed of BESS deployment by large customers, access to critical minerals needed for indigenisation of storage technology, and delays in large-scale BESS agreements. The survey called for focusing on innovation and investment for resolving challenges in procuring battery storage, grid infrastructure, and critical minerals.

Innovative partnerships can help scale up BESS deployment. Using an alliance of public, private, and philanthropic entities can provide concessional funding

and technical assistance for BESS.

Following the idea of leveraging collaboration to bring results, the BESS pilot project was initiated in Delhi by BSES Rajdhani Private Limited in partnership with IndiGrid Infrastructure Trust and Global Energy Alliance for People and Planet (GEAPP). The project marks a significant step forward toward India's goal of 47 GW of energy storage by 2030, creating a technical playbook for BESS adoption, supporting regulatory reforms, and incentivising future BESS projects.

Facilitating more such initiatives will be key to increasing BESS deployment in India, fulfilling SDG 7 commitments, enhancing energy security, and improving grid stability.



## Emerging as a leader

India has been emerging as a leader in renewable energy deployment. The reasons for increasing renewables in the energy supply are to reduce emissions and create independence from imports of conventional fuels. However, the full potential of renewable energy cannot be achieved without energy storage. To become energy secure, India must complement its renewable energy capacity with BESS.

With partnerships, expeditious large-scale BESS projects for central and State grids, concessional financing, technological aid, manufacturing localisation, and recycling opportunities, India can utilise BESS to its fullest extent. This can make India a leader among emerging economies in terms of BESS projects.

As a member of the BESS consortium, founded by GEAPP, India has been focusing on deploying energy storage to ensure any increase in renewable energy power capacity can be utilised to its full potential. With more alliances, India can emerge as an energy-secure nation with flexible grids and increased renewable deployment.

# Falling short

## India must ensure technology transfer in the EV segment

**I**n June 2, India took a turn for the better in its transport electrification journey by offering a concessional import duty of 15% on completely built-up units. This is contingent on the EV manufacturer investing a minimum of about ₹4,150 crore over three years to localise manufacturing in India, with a base domestic value add of 25% in three years, going up to 50% in another two years. The notification, under the Scheme to Promote Manufacturing of Electric Passenger Cars in India (SPMEPCI) announced in March 2024, allows for a maximum import of 8,000 completely built units annually for each manufacturer for five years. The SPMEPCI adds to the bouquet of policies that attempts to boost EV adoption and manufacturing. However, these policies put together fall short of addressing a pressing issue in India's journey to decarbonise and transform mobility – technology transfer. India began this journey in 2015, about five years later than most large economies. An outlay of ₹895 crore for the Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles in India (FAME) scheme, for five years, expanded to ₹10,000 crore in 2019. China announced its ambitious New Energy Vehicle subsidy programme in 2009, which, coupled with mandatory joint venture manufacturing of EVs until 2022, enabled technology transfer. In addition, a reduced import duty on EVs (25% in 2010 to 15% in 2018), and cumulative incentives of about \$230 billion in the past 15 years – the most by any country – enabled China to achieve the highest global EV adoption rate. This also supported rapid charging infrastructure deployment, making China the largest producer and consumer of EVs.

The U.S. began this journey in 2010 with an initial outlay of \$25 billion for its Advanced Technology Vehicles Manufacturing Loans Program. This was greatly expanded under the Biden administration's Inflation Reduction Act. But its EV adoption rate is much lower than China's. In 2024, out of 17 million global EV car sales, China alone accounted for 11.3 million, followed by Europe with 3.2 million, the U.S. with another 1.5 million, and the rest of the world accounting for the remainder. China's vertical integration of battery manufacturing, from mining, processing to assembling, has aided economies of scale with competitive pricing of EVs against conventional ICE vehicles. For now, the 25% DVA that India could aim for under the just announced scheme would be repurposing locally made auto components meant for ICE vehicles to EVs and layering it with Software-as-a-service. But to obtain the crucial technology for the heart of the EV – its battery – India must replicate its approach to localising ICE manufacturing, which is to mandate joint ventures with local ICE or EV makers, and gradually allow for a complete open market.





# Exposomics for better environmental health

**T**he focus for World Environment Day in 2025 (June 5) is on ending plastic pollution. Micro-plastics represent one of the many thousands of chemical, physical and biological hazards that lurk in the air, water and living spaces for which we have neither the sensory capabilities nor sensing technologies to measure exposure and assess health risks. Thus, reducing the environmental disease burden continues to be a daunting challenge for public health.

In India, rapid economic growth is increasing the scale and the complexity of environmental exposures and the interdependencies between the living environment and lifestyles. With India already accounting for nearly 25% of the global environmental disease burden, there is a need to develop newer paradigms for environmental management that rest on integrated health risk assessments.

These must include all environmental factors into the study of disease development. The piece-meal approaches that define our current framing on environment or health indicators are likely to exaggerate environmental health inequities and result in spiralling health costs. We must embrace new and cutting-edge scientific developments in the field of “exposomics” to gain a more complete picture of disease etiologies over the life course and develop holistic prevention strategies. Strategic investments in long-term environmental health surveillance that integrate novel environmental and biomonitoring efforts with digital health and data science platforms are critical.

## Environmental disease burden

The World Health Organization (WHO) began estimating the environmental disease burden in 2000, which is the basis for the modern estimation approach being adopted in the Global Burden of Disease, Injuries, and Risk Factor (GBD) study. Each cycle of the GBD identifies risk factors with the greatest attributable health burden. In the latest cycle (2021) that included 88 risk factors, environmental and occupational (OE) risk factors in the GBD were responsible for 18.9% (12.8 million) of global deaths and 14.4% of all disability-adjusted life years (DALYs), led by ambient PM<sub>2.5</sub> air pollution (4.2% DALYs, 4.7 million deaths) and household air pollution from the use of solid fuels for cooking (3.9% DALYs, 3.1 million deaths).

In India, nearly three million deaths and 100 million deaths are attributable to occupational and environmental health (OE) risks. OE risk factors in India are also estimated to account for more than 50% of the attributable burden for non-communicable diseases including ischemic heart disease, stroke, chronic obstructive lung disease, lung cancer, asthma and, more recently, diabetes and chronic kidney disease. Risk factors such as lead exposures can have grave developmental health impacts for children under five, with India accounting for up to 154 million or 20% of the total estimated IQ points lost globally in children under five.

What are we missing? The GBD results provide



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Scientific developments in the field of exposomics will also help get a better picture of disease etiologies and craft holistic prevention strategies

a strong and robust body of evidence to initiate actions for cleaner air, safer water and better sanitation. However, the current environmental burden of disease addresses only a limited number (around 11) of categories of environmental risk factors as there is a paucity of human exposure data. Several environmental risk factors that can contribute to significant health burdens are currently not included in the GBD. These include various chemical exposures, risks from complex mixtures such as micro-plastics and solid waste and physical hazards such as environmental noise.

More importantly, environmental risk factors interact in complex ways with metabolic (high blood pressure or high fasting plasma glucose) and behavioural risk factors (smoking and unhealthy diets) as well as underlying genetic susceptibility and upstream health determinants (such as socio-economic status) to produce a health impact within populations. Risk estimates are often derived for single risk factors; while confounding is often well adjusted in long-term cohort studies and, complex mixtures and interactions over a life course have not been adequately explored.

Finally, climate change can magnify hazards posed by multiple environmental risk factors, such as heat, air pollution, vector-borne diseases, storms and flooding, and wildfires. Climate change may reduce crop yields, reduce agricultural worker productivity, disrupt food security and affect food supply chains. Depression, anxiety and other mental health outcomes, driven by both ecological concerns and direct health impacts of climate-sensitive environmental risk factors such as fine particulate matter, are also important to consider. Several of these risk factors can occur together, resulting in compound events and synergistic effects. These hazards can further amplify health impacts among populations with inadequate access to health systems or healthy food systems. Methods and data are not yet available to support inclusion of these important risk factors in the global burden of disease assessments.

Thus, the current environmental burden of disease estimates are not only a conservative underestimates but also do not provide an adequate means of prioritising against competing risk factors to develop holistic, scalable preventive health strategies.

## The human exposome

The global human genome project (1990-2003) revolutionised our ability to explore the genetic origins of disease. However, it also revealed the limited predictive power of individual genetic variation for many common diseases. Genetic factors for example, contribute to less than half of the risk of heart disease, which is a leading source of mortality.

The success in mapping the human genome has fostered the complementary concept of the “exposome”. The exposome is defined as the measure of all the exposures of an individual in a

lifetime and how those exposures relate to health. Traditional environmental health studies include hypothesis-driven methods which have focused on one or a class of environmental exposures at a few time points. These fail to account for the complex interactions of exposures across the lifespan, on human health.

Exposomics aims to bridge this gap by understanding how external exposures from physical, chemical, biological and psycho-social environments interact with diet and lifestyle and internal individual characteristics such as genetics, physiology, and epigenetics to create health or disease. This would allow the generation of an atlas of exposure wide associations (EWAS) to complement genome-wide associations (GWAS) and enable discovery-based analysis of environmental influences on health. The exposome requires synchronisation of several inter-disciplinary technologies which



include real time sensor based personal exposure monitoring with wearables; untargeted chemical analyses on human biomonitoring samples; testing on human-relevant micro-physiological systems (also known as organs-on-a-chip) wherein in vitro models replicate the structure and function of human organs or tissues to understand the mechanistic basis of biological response; and big data, and artificial intelligence (AI) to mine data and generate integrated pieces of evidence.

Given that capacities and resources to generate exposomics data are not widely available, an immediate need for the exposomic framework to become a reality is also the creation of a data ecosystem in which harmonised data can be found, accessed, and shared through sustained and interoperable data repositories.

## Mainstream environment within health

Exposome frameworks may seem implausible or irrelevant in India where the implementation of environmental health management programmes faces numerous hurdles. But, leapfrogging to technology and data-driven approaches is not new to the health sector. Exposomics offers unprecedented potential to mainstream environmental risks within public health programmes by generating more accurate predictive models for many chronic diseases while also enabling precision medicine. Unbridled investments in capacity building and synchronising available analytical, environmental and public health infrastructure offer the promise of addressing the concerns of our populations with unprecedented cost-effectiveness. The time is ripe for the Indian environmental health community to engage and contribute to the global momentum on the science of exposomics.

Future celebrations of World Environment Day may soon focus on why the human exposome project can be the best prescription for holistic prevention efforts that preserve and promote health equity.



The Andromeda galaxy is about 2.5 million lightyears away and moving towards the Milky Way galaxy at around 110 km/s. UATOUR (CC BY-SA)

## Clash between Andromeda and Milky Way may not happen after all: astronomers

Associated Press

It turns out that the looming collision between our Milky Way and Andromeda galaxies might not happen after all.

Astronomers reported Monday that the probability of the two spiral galaxies colliding is less than previously thought, with a 50-50 chance within the next 10 billion years. That's essentially a coin flip, but still better odds than previous estimates and farther out in time.

"As it stands, proclamations of the impending demise of our galaxy seem greatly exaggerated," the Finnish-led team wrote in a study appearing in *Nature Astronomy*.

While good news for the Milky Way galaxy, the latest forecast may be moot for humanity.

"We likely won't live to see the benefit," lead author Till Sawala of the University of Helsinki said in an email.

Already more than 4.5 billion years old, the sun is on course to run out of energy and die in another 5 billion years or so, but not before becoming so big it will engulf Mercury, Venus, and possibly the earth. Even if it doesn't swallow the earth, the home planet will be left a burnt ball, its oceans long since boiled away.

Sawala's international team relied on the latest observations by NASA's Hubble Space Telescope and the European Space Agency's Gaia star-surveying spacecraft to simulate the possible scenarios facing the Milky Way and next-door neighbour Andromeda. Both already collided with other galaxies in their ancient past and, according to many, seemed destined for a head-on crash.

Past theories put a collision between **The probability of the two spiral galaxies colliding is less than previously thought, with a 50-50 chance within the next 10 billion years**

the two – resulting in a new elliptical galaxy dubbed Milkmeda – as probable if not inevitable. Some predictions had that happening within 5 billion years, if not sooner.

For this new study, the scientists relied on updated galaxy measurements to factor in the gravitational pull on the Milky Way's movement through the universe. They found that the effects of the neighbouring Triangulum galaxy increased the likelihood of a merger between the Milky Way and Andromeda, while the Large Magellanic Cloud decreased those chances.

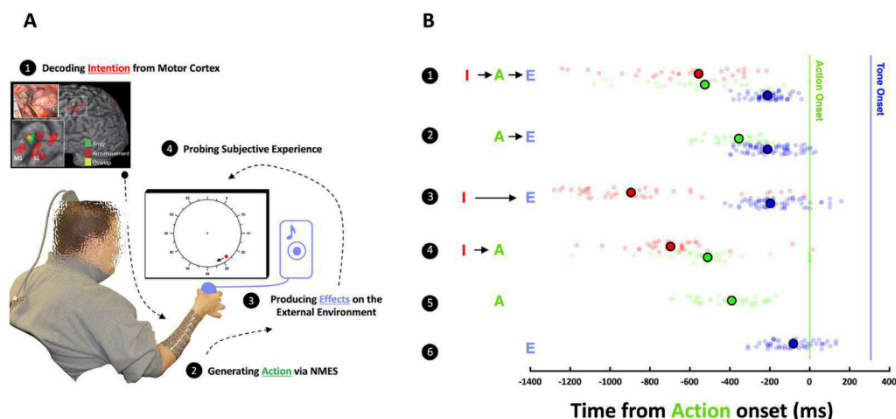
Despite lingering uncertainty over the position, motion, and mass of all these galaxies, the scientists ended up with 50-50 odds of a collision within the next 10 billion years.

A full-on collision would transform our home galaxy from a disk of stars seen as a milky band of diffuse light across the sky into a milky blob, said Raja GuhaThakurta of the University of California, Santa Cruz, who was not involved in the study. A harmless flyby of the two galaxies could leave this stellar disk largely undisturbed.

More work is needed before the Milky Way's fate can be predicted with accuracy, according to the researchers. Further insight should help scientists better understand what's happening among galaxies even deeper in the cosmos.

While our galaxy's fate remains highly uncertain, the sun's future is "pretty much sealed," according to Sawala. "Of course, there is also a very significant chance that humanity will bring an end to itself still much before that, without any need for astrophysical help."





The neural recording and experimental setup (left). The behavioural responses are displayed on the right. Row 1: full intentional chain where the BMI user indicates time of intention (I, red), action (A, green), and an effect (E, blue) in the external environment. Row 2: estimates of the timing of actions and effects in the absence of intention. Row 3: estimates of the timing of intentions and effects in the absence of an effect. Row 4: estimates of the timing of intentions and actions in the absence of an effect. Row 5: estimate of the timing of actions in the absence of intentions and effects. Row 6: estimate of the timing of effects in the absence of intentions and actions. PLOS Biol 23(4): E3003118.

# When you want to move, does your brain know before you've decided?

In the early 1980s, the American neuroscientist Benjamin Libet published his pioneering work exploring what scientists now call the intentional chain. Due to the technical challenges involved, it wasn't possible for scientists to study the intentional chain from beginning to end – until now

Reeteka Sud

It is the end of a long, hard work day and all you feel like doing is flopping on the sofa and watching TV. Your eyes move to something on the screen, and you watch it for a few minutes, then you think to yourself: "I wonder what's on elsewhere..." So you reach for the TV remote and switch the channel.

At this precise moment, let's freeze frame and ask: how did this simple decision unfold?

Which happened first: the conscious recognition of the intention to move your arm or the brain activity required for the movement?

For a long time, people grappled with this as a "chicken or egg" question and arrived at only philosophical answers, not scientific ones. Indeed, for many years the question was actually believed to be outside the purview of science.

## The international chain

In the early 1980s, American neuroscientist Benjamin Libet published his pioneering work exploring what scientists now call the intentional chain.

In its entirety, the intentional chain entails an intent (the desire to change the channel in the example above), an action (reaching for the remote), and an effect (e.g., sounds/sights from a different channel). Due to the technical challenges involved, it wasn't possible for scientists to study the intentional chain from beginning to end – until now.

In a study published recently in *PLoS Biology*, Jean-Paul Noel from the University of Minnesota in the US and collaborators from the US, the UK, and Switzerland, reported an experiment in which they selectively targeted each element of the intentional chain, one by one.

They found that conscious recognition of the intent to move coincides with activation in the M1 cortical area, the part of the brain controlling voluntary limb movements. One surprise was a difference in the timing of conscious recognition: the perception of movement and the brain activity corresponding to this intent.

## First study of its kind

The study's participant was a tetraplegic person outfitted with a brain implant in his M1 area (a.k.a. the primary motor cortex). Electrical impulses from the implant stimulated the area. This setup, called a brain-machine interface, used with a device called a neuromuscular electrical stimulator (NMES), which activated forearm muscles to cause hand movements, made it possible for the researchers to activate or inactivate individual components of the intentional chain in the study.

A particular hand movement was of interest in this setup. The participant held a ball in his hand. When he squeezed it, a sound was emitted exactly 300 ms later. This was the environmental effect, the last piece of the intentional chain. During the experiment, the participant was asked to watch a clock on a computer screen. Depending on the specific trial, he had to

report the reading on the clock – at the time he felt the urge to move his hand, the time he moved his hand or the time he heard an audio tone.

This was the first study to look at the M1 area in the context of the subjective intention of voluntary actions. The researchers found that the timeline of activity in this area was somewhat different than that reported for other brain areas in previous research.

Specifically, all the other areas had been activated prior to intention and action – whereas M1 showed activity before but also during a voluntary action.

This makes sense given that M1 is the final stop in the brain before the signal moves to the spinal cord and finally to the muscles of the hand.

## Rearing up

Normally, when you intend to move your right hand to pick up an object or lift your foot up to kick a ball, the desire for voluntary movement is reflected as electrical activity in specific parts of the brain. Even before Libet conducted his foundational work, German scientist Hans Helmut Kornhuber placed electrodes along the heads of participants in a study who each made a voluntary decision – to press a button any time they felt like it. He conducted this study in the 1960s. Kornhuber found that in the moments leading up to an individual pressing the button, the electrodes recorded a gradual increase in the strength of an electric signal, which he called the readiness potential. Think of it as the brain gearing up to act. This meant that if these same brain parts were stimulated with electric signals, one could manufacture in the individual an urge to move the hand or the foot.

Kornhuber's work, later confirmed by others, proved there was electrical activity in the brain before the individual performed a voluntary action. Subsequent research showed that certain brain circuits are activated before an individual is even aware of their intention to perform a voluntary movement.

In the new study, Noel & co. explored the question: when do we become aware of a decision we are about to make?

## Interesting patterns

In the first round with their setup, the researchers studied the full intentional chain. They recorded electrical activity in

## A surprise finding was a difference in timing of conscious recognition: the perception of movement and brain activity corresponding to this intent

the participant's M1 area caused by the intent to move his hand using functional MRI. They recorded any subsequent movement of that hand with NMES. Finally, they recorded the sound of the participant squeezing the ball in his hand. Thus, they had an objective way to measure each step of the intentional chain – a significant departure from previous studies in which researchers depended on participants' responses themselves.

When the researchers compared the objective measurements to the participant's subjective perceptions, some interesting patterns emerged. For example, when the team asked the participant to report the time at which he developed a conscious awareness of his intention, his answer suggested his perception preceded actual electrical activity recorded by the MRI. Similarly, when asked to report the time at which he perceived his hand began to move, the researcher found his perception preceded the signal recorded by NMES.

In the next round, the researchers used NMES to move the participant's hand, thus bypassing the subjective intent and therefore electrical activity in the brain. This time, the participant perceived that his hand moved at a time well after the measured electric signal. When the researchers blocked the hand movement signal from NMES, while keeping the intent and effect parts of the chain intact, the participant perceived his intention to occur much earlier – more so than the full intentional chain. In either case the difference was only in the order of milliseconds, but for the brain this is an eternity.

## The role of M1

The work of Patrick Haggard at University College London may help understand these results better. Haggard & Co. asked participants in a study to report the timing of an action (pressing a keyboard button, say) and the timing of an effect of their action (a colour changing on the computer monitor). The team's results

showed that participants perceived a shorter time interval between a voluntary action and its effect – called the intentional binding – than what was objectively recorded. In this context, Noel's team has discovered a new form of intentional binding: between intention and action.

Since the work of Kornhuber and Libet, as more scientists examined the time between an individual perceiving a voluntary decision and that decision turning into action, it has been becoming clearer that the timing of brain activity in relation to a voluntary decision depends on where in the brain one looks.

Through multiple attempts to understand the brain's goings-on in the moments leading up to a voluntary action, scientists have mapped the parts that light up with electrical activity as an individual consciously develops an urge to take some voluntary action as well as areas that light up with the conscious perception of having taken the action. In the new study, Noel *et al.* have added to this knowledge by revealing the role the M1 area plays with the start of a conscious decision to take some action and during the execution.

## Where are you looking?

In the last few decades, cognitive neuroscientists have found that a single voluntary decision for an individual involves multiple different slices in their brain. There's the slice of "what" decision to make, "when" to make it, "whether or not" to translate that decision to action. Activities in various parts of the brain correspond to different slices and the timing of brain activity in relation to a voluntary decision depends on which slice is examined. So if we look in the premotor or parietal cortical areas, we find them activated before a voluntary movement has occurred.

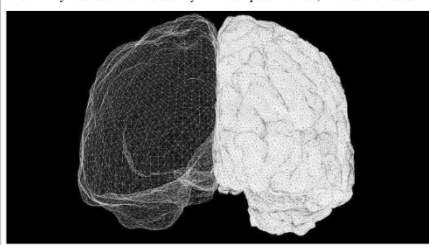
The new study shows that the M1 area integrates signals from premotor-parietal areas, which explains its activity in the moments leading up to the voluntary action.

The specific way the tests were set up made it possible for the researchers to separate M1 activity due to intention from its activity due to action. In a situation where a decision is converted to action, that of reaching for the remote in the example earlier, M1 activity relays that decision down to the spinal cord and to muscles of the arm.

The fact that the study was conducted with a single tetraplegic participant raises obvious questions about whether its findings can be generalised. In another recent study in *Nature Communications*, Noel collaborated with Italian scientist Tommaso Bertonni to examine the same question in 30 healthy participants.

They aimed to study the participants' brain activity using electrodes placed on their scalps (in contrast to electrodes implanted inside the M1 area of the brain). The results have supported the role of the M1 area of the brain in translating voluntary decisions to actions, adding further credence to the findings by Noel and team in their paper.

(Dr. Reeteka Sud is a neuroscientist by training and senior scientist at the Center for Brain and Mind, Department of Psychiatry, NIMHANS, Bengaluru. reeteka@gmail.com)



The desire for voluntary movement is reflected as electrical activity in specific parts of the brain.



# Modi likely to attend BRICS summit in Brazil next month; meet closely watched by U.S. govt.

## NEWS ANALYSIS

**Suhasini Haidar**  
NEW DELHI

Prime Minister Narendra Modi is expected to travel to Rio De Janeiro in July to attend the BRICS summit in Brazil, sources said here.

The gathering is being closely watched by the Donald Trump administration in the U.S. that sees BRICS as a counterweight to the G-7 group of developed nations. Russian President Vladimir Putin and Chinese President Xi Jinping are expected to attend, as well as the leaders of Saudi Arabia, the UAE, Iran, Egypt, and Indonesia.

Mr. Modi's attendance at the event comes soon after the four-day conflict with



PM Narendra Modi, Russian President Vladimir Putin and Chinese President Xi Jinping at the 2024 BRICS Summit in Russia. FILE PHOTO

Pakistan, and India's "new normal" on fighting terror. Any joint statement on cross-border terrorism by the largely economic grouping will be significant for India, officials said.

Any meeting with the Chinese President, whom Mr. Modi last met on the sidelines of the previous BRICS summit in Kazan, Russia in 2024, will also be

watched with interest, given China's support to Pakistan during Operation Sindoor, and plans to reset bilateral ties with the restart of the Kailash Mansarovar Yatra for Indian pilgrims to Tibet in June.

### Alternative currencies

In addition, BRICS discussions on the use of alternative or national currencies

for trade are likely to trigger reactions in the U.S., given warnings in the past few months by U.S. President Trump against any "de-dollarisation" plans by BRICS, and earlier this week by U.S. Commerce Secretary Howard Lutnick, who said India's participation in the grouping had ruffled feathers in Washington.

Mr. Lutnick said that apart from buying military hardware from Russia, India had "rubbed the U.S. the wrong way" by being a part of BRICS.

"[BRICS countries] are saying, 'Let's move to not support the dollar, and dollar hegemony...' That is not the way to win friends and influence people in America," he said.

The BRICS-11 now repre-

sents half the world's population and 39% of global GDP. The G-7, on the other hand – comprising Canada, France, Germany, Italy, Japan, the U.K., and the U.S., along with the EU – accounts for about 30% of the world's GDP.

### 'The Rio reset'

Washington-based think-tanks are billing the meeting of the BRICS grouping the "Rio Reset", suggesting it will pose a challenge to Western economies. According to the Brazil Presidency's concept note, the motto for this year's BRICS summit will be: "Strengthening Cooperation in the Global South for More Inclusive and Sustainable Governance". The note makes no mention of the use of alternate currencies.



# 'A conservative society is no excuse to deny security to LGBTQIA+ couples'

**Mohamed Imranullah S.**  
CHENNAI

Our society is still conservative, and not every parent is like Justice Leila Seth (former Chief Justice of the Himachal Pradesh High Court who openly supported her gay son), the Madras High Court has said adding that it should not be a reason for the police to deny security to LGBTQIA+ couples facing threats.

A Division Bench of Justices G.R. Swaminathan and V. Lakshminarayanan made the observation while allowing a *habeas corpus* petition filed by a 25-year-old woman from Tirupattur over the illegal detention of her partner by the latter's parents at their residence in Vellore district.

The judges allowed the detainee, who is also an adult, to go with the petitioner after she confirmed that her parents had confined her at their residence.

Justice Swaminathan also gave ₹1,000 from his personal funds towards the conveyance expenses of the same-sex couple.

The Division Bench also



The Madras High Court made the observation while allowing a plea by a woman over the illegal detention of her partner. FILE PHOTO

expressed reservations over the use of the expression 'queer' to describe persons whose gender identity or sexual orientation were outside societal norms. It said that there was nothing strange or odd about such inclinations and, therefore, the expression was not appropriate.

## Discomforting usage

"We feel certain discomfort in employing the expression 'queer.' Any standard dictionary defines this word as meaning 'strange or odd.' To a homosexual individual, his/her/their sexual orientation must be perfectly natural and normal... Why

then should they be called queer?" the judges wondered.

Meanwhile, censuring the police for having forced the detainee to go with her parents when a complaint was lodged with them, the Court held that the officials, the jurisdictional police in particular, would be duty-bound to respond to complaints of threats or harassment received from members of the LGBTQIA+ community.

"We also restrain the detainee's natal family members from interfering with her personal liberty. We issue a writ of continuing mandamus to the jurisdictional police to provide

adequate protection to the detainee as well as the petitioner, as and when required," the judges ordered.

Expressing their inability to convince the parents of the detainee to accept the relationship between their daughter and the petitioner, the Division Bench said, "But the law is very clear. All individuals possess the right to universal enjoyment of human rights."

Authoring the verdict, Justice Swaminathan also wrote, "Marriage is not the sole mode to found a family. The concept of 'chosen family' is now well settled and acknowledged in LGBTQIA+ jurisprudence. The petitioner and the detainee can very well constitute a family."

## Welfare efforts

The Division Bench also referred to efforts taken by Justice N. Anand Venkatesh of the Madras High Court to improve the conditions of the LGBTQIA+ community.

It said that the judge had approved a deed of familial association to recognise the civil union entered into by LGBTQIA+ partners.



# Govt. to bring new national policy on senior citizens

Population projections estimate 20% of the country will be senior citizens by 2047; discussions focus on how the draft policy should 'reflect demographic realities' as India heads into the future

**Abhinav Lakshman**  
NEW DELHI

**A** new national policy on senior citizens is in the draft stages with the Union Ministry of Social Justice and Empowerment, government officials said, adding that some details of it were discussed on Wednesday at a meeting of the National Council for Senior Citizens, chaired by Social Justice Minister Virendra Kumar.

The Ministry said discussions focused on how the draft policy should "reflect the demographic realities" of India as it heads into the future.

A statement from the Ministry said population projections estimated that 20% of the country would be senior citizens by 2047.

According to the 2011 Census, senior citizens accounted for 8.23% of the nation's population at the time.

According to the govern-



According to the government's projections, senior citizens will account for 12.16% of the country's population in 2026. GETTY IMAGES

ment's projections, they will account for about 12.16% of the country's population in 2026. The government on Wednesday said the forthcoming Census reference period for a headcount would be March 2027.

A government official told *The Hindu*, "The policy is in a draft stage now. Suggestions have already come in from relevant stakeholders and some of these suggestions were put forth at the meeting on Wednesday."

They added that one of the suggestions was to consider that India will have a higher proportion of senior citizens by 2047.

This was the fourth meeting of the National Council for Senior Citizens, the government said in its statement.

## Digital inclusion

At the meeting, the council also deliberated on "digital inclusion" of senior citizens, the government said. It further discussed institutionalising NGOs and se-

nior citizen associations in policy formulation, implementation, and feedback mechanisms.

Deliberations also went into establishing a grievance redress mechanism to address elder abuse and neglect; implementing minimum standards for "old age homes" and senior care institutions; and "promoting community engagement and intergenerational bonding".

The council also undertook a detailed review of the progress under the Rashtriya Vayoshri Yojana (RVY) and Integrated Programme for Senior Citizens (IPSR), Senior Citizen Portal in terms of enhancing quality and post-distribution follow-up of assisted living devices, the statement added.

The government said that under the Rashtriya Vayoshri Yojana, more than five lakh senior citizens had been given "free assisted living devices".





# Expedition to study ecological impact of Kochi shipwreck

**The Hindu Bureau**

KOCHI

Fishery Oceanographic Research Vessel (FORV) *Sagar Sampada*, operated by the Central Marine Fisheries Research Institute here, will carry out an expedition to investigate the potential ecological and biogeochemical impacts caused by the Liberian-flagged *MSC ELSA 3* that sank off the Kochi coast on May 24.

A team of scientists at the CMFRI will collect samples from 16 research stations spaced 10 nautical miles apart, providing a zonal coverage of the region



**Cast away:** A container from the sunken ship that washed ashore at Tharayilkadavu in Alappuzha. SURESH ALLEPPEY

surrounding the shipwreck sunken vessel.

During the 10-day voyage, scientists will monitor the biodiversity, biogeochemical parameters, regional hydrography, as well as ocean currents us-

ing advanced instruments. Sediment sample will be collected to assess the impact on seabed communities. High-end acoustic systems and big eye camera will help identify the changes in marine life.



# Next Census to conclude by March 2027: govt.

The Census after an unprecedented 16-year gap will be the country's first digital Census

This Census will also be the first in Independent India to include an enumeration of castes as well

The dates of the two phases will be 'published in the official gazette tentatively on June 16

**Vijaita Singh**  
NEW DELHI

India will count its population by March 1, 2027, in a Census to be held after an unprecedented 16-year gap, the Union Ministry of Home Affairs announced on Wednesday. This will be the country's first digital Census, and the first in Independent India to include an enumeration of castes as well.

The Census will be conducted in two phases by February 28, 2027 and the data will have a reference date of 12 a.m. on March 1, 2027. For the Union Territory of Ladakh and the non-synchronous snow-bound areas of the Union Territory of Jammu and Kashmir and the States of Himachal Pradesh and Uttarakhand, the reference date for the population

count will be 12 a.m. on October 1, 2026. However, the government has not yet notified the date of commencement of the exercise. The notification of the Centre's intention to conduct the Census, and the dates of the two phases will be "published in the official gazette tentatively on June 16 as per provisions of section 3 of the Census Act 1948," according to the press release.

The Constitution mandates that the first Census after 2026 can be used as the basis to redraw Lok Sabha constituencies which are currently drawn on the basis of 1971 Census data.

## Two-phase process

The next general election is expected to be held in 2029.

The last Census was

## To be counted

India will be counting its people after a gap of 16 years in the first digital Census which will also include caste enumeration



**Crucial numbers:** An enumerator at a household in Hyderabad during the 2011 Census. FILE PHOTO

held in 2011 and the subsequent exercise scheduled to take place in 2021 was delayed indefinitely, initially due to the COVID-19 pandemic. On April 30, the Union Cabinet had decided to include caste enumeration as part of the next Census exercise.

**October 1, 2026:** Reference date for Union Territory of Ladakh and the non-synchronous snow-bound areas of the U.T. of Jammu and Kashmir and States of Himachal Pradesh and Uttarakhand

**March 1, 2027:** Reference date set for remaining parts of the country

Around **24 lakh** enumeration blocks (EB) finalised for the 2011 Census are likely to be used for the 2027 Census. Each EB usually comprises 150-180 houses or 650-800 people

India's Census is conducted under the provisions of the Census Act, 1948 and the Census Rules, 1990, and will be completed in two phases: first, the house listing and housing schedule; and then, the population enumeration. Both phases usually span a

## No reason for another delay of 23 months: Cong.

**NEW DELHI**  
Hours after the Union government announced the schedule for the Census exercise, the Congress on Wednesday said there was no reason to delay the exercise for another 23 months and slammed the Narendra Modi-led government for not meeting "deadlines". » **PAGE 5**

period of 11 months from April 1 to February 28 the following year. This time around, caste will be enumerated in the second phase.

The 24 lakh enumeration blocks that were finalised for the planned 2021 census are likely to be used

for the 2027 exercise. Around 30 lakh enumerators, including a sizeable number of government school teachers, will be trained afresh on the mobile application that has been readied for the exercise.

## NPR updation

"A significant addition to the training manual would be the enumeration of caste. Another drop box to record the castes is likely to be added next to the Scheduled Caste (SC) and Scheduled Tribe (ST) tables, the only two categories counted so far," a senior government official said.

There was no announcement on updating the National Population Register (NPR), which already has a database of 119 crore residents.

The population register

was to be updated during the first phase of the planned 2021 census.

Citizens may also get an opportunity to "self-enumerate" as the Office of the Registrar General of India, which conducts the census, had developed a self-enumeration portal in English for the planned 2021 census. This option, however, will only be available to those households that have updated the NPR online.

According to the Citizenship Rules 2003, the NPR is the first step towards compilation of a National Register of Indian Citizens (NRIC/NRC).

The census will impact the next delimitation of Lok Sabha and State Assembly seats and the proposed 33% reservation for women in Parliament and Assemblies.

