EDITORIAL HIGHLIGHTS

18-11-2026

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GS 3: SCIENCE & TECHNOLOGY
THE HINDU PAGE: 07

Voyager 1, one light-day away from earth today, is a marvel of science

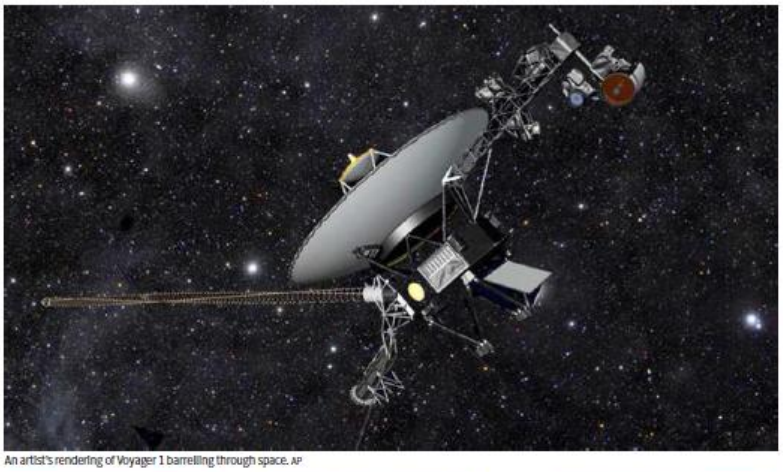
Measurements lying in the shadows of their successors can find new lives in the light of new theories. The Voyager 1 mission's longevity made that more apparent, allowing successive generations of researchers to find more uses for its data even as it continues to collect new information

Vasudevan Mukunth

Today, the Voyager 1 spacecraft will be one light-day away from the earth. This means a signal travelling at the speed of light will take one full day to go from the earth to Voyager 1, and signals from the spacecraft will similarly take one day to reach receivers on the earth.

This is a tremendous distance – almost 26 billion kilometres. Since February 17, 1998, Voyager 1 has been the farthest any space mission has been from us. And it keeps going at 61,000 km/hr. But even at such breathtaking speed, Voyager 1 is still barely out of the solar system. Each star's gravitational and magnetic fields extend out for billions of kilometres around them, bending the destinies of multiple worlds to their stellar will.

It is no surprise then that Voyager 1 has itself been defined by superlatives for providing a sense of the influence of our own sun: the first, the farthest, and indeed the oldest space mission still going.



An artist's rendering of Voyager 1 barrelling through space. AP

Pleasant surprise

When NASA launched Voyager 1, the Soviet Union was still a country, the Berlin Wall divided Germany, apartheid was law in South Africa, and neither the World Wide Web nor smartphones existed. Voyager 1 itself has changed during its mission: its operators switched off its cameras in 1990, replaced its ageing components with backups, and, by 2026, left only two of its ten science instruments online. Yet the superlatives have often obscured the important scientific contributions these instruments have themselves made.

For example, scientists were in for a pleasant surprise when they found that one of the instruments onboard Voyager 1 was actually tracking galactic cosmic rays even though it was not designed to. The ultraviolet spectrometer's purpose was to study ultraviolet light, released by grains of dust scattering sunlight in space and by the atmospheres of distant planets. The detector also registered noise from other sources, including from Voyager's nuclear power source, and scientists routinely subtracted it from the data to reveal the ultraviolet signals.

But in 2014, researchers reported in the journal *Astronomy & Astrophysics* that the background noise was actually created by cosmic rays – high-energy particles coming from beyond the solar system. They reanalysed this data collected between 1992 and 2013 and compared them to other instruments elsewhere that were tracking cosmic rays, and concluded the ultraviolet spectrometer onboard Voyager 1 was indeed sensitive to cosmic rays within a small energy range.

Little surprises

The team also sought independent evidence in this data to check whether Voyager 1 had reached or crossed the heliopause, the boundary of the region dominated by the solar wind, in 2012, although the implications went further.

For example, the spectrometer's unexpected readings raised questions about the part of space immediately inside the heliopause, where the solar wind seemed to flow more slowly. After more study, scientists proposed that the wind braked due to interactions between the subatomic particles it contained and the electrically neutral atoms from interstellar space. The proposal remains unconfirmed but nonetheless offered a new way to investigate the possibility that the heliopause may look different in different directions.

Voyager 1 has sprung many little surprises of similar nature that have often skipped the public eye. For another example, when Voyager 1 came close to Saturn, its instruments collected data scientists subsequently used to test one of Albert Einstein's predictions: that the frequency of electromagnetic radiation, such as light, changes when it passes through a gravitational field.

In a study published in *Physical Review Letters* in March 1990, researchers confirmed the prediction with 1% accuracy – a rare instance of an interplanetary mission contributing to fundamental physics. To be fair, the Voyager 1 result also depended on an assumption that radiation around Saturn did not interfere with the spacecraft's frequency reference.

Second, the NASA Gravity Probe A experiment had already confirmed Einstein's prediction in 1976, that too within a better accuracy of 0.02%. The finding based on Voyager 1 was nonetheless interesting because it was independent: based on wholly different instruments and from within a distinct planetary environment. Physicists seek such differences because there are alternative theories of gravity that, on paper, predict varying effects in varying conditions, and differences in the observed data could challenge theories that do not predict them.

Stepping stones

In the same visit to Saturn, scientists also used the radio signals Voyager 1 could emit to study the planet's rings. Specifically, as the spacecraft moved behind the rings, its signals bound for the earth travelled through the rings first. And by studying how the signals were scattered and weakened, scientists could piece together the distribution of materials in the rings.

Thus they discovered fine structures such as narrow gaps between the rings and wave-like undulations in their density, and determined that the particles making up the rings were at best 10-20 metres wide in certain regions.

Operators repeated the same technique with Saturn's moon Titan, which is the only moon in the solar system with a substantial atmosphere, and the only other planetary body to have liquids on its surface. When the Voyager 1 radio transmissions travelled through Titan's atmosphere, scientists were able to measure its temperature and pressure.

Both sets of findings were stepping stones for the landmark NASA Cassini mission, which studied the Saturnian system up close from 2004 to 2017. The data also informed plans for the mission's Huygens probe, which descended through Titan's atmosphere in 2005.

Measurements lying in the shadows of their successors can find new lives in the light of new theories. The Voyager 1 mission's longevity made that more apparent, allowing successive generations of researchers to find more uses for its data even as it continues to collect new information.

As it pulls farther away from the earth, its signals will grow dimmer and its instruments will eventually fall silent, but the scientific life of its observations will keep going.

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THE GIST

- Voyager 1's one unexpected discovery came when its ultraviolet spectrometer, designed to study UV light, was found to be unintentionally detecting galactic cosmic rays; scientists later realised the instrument was providing useful data on cosmic rays
- When the spacecraft came close to Saturn, its instruments collected data scientists subsequently used to test one of Albert Einstein's predictions; this result was notable for providing independent confirmation, albeit to a weaker degree than ideal, of a concept in fundamental physics
- Voyager 1's radio signals revealed detailed structures in Saturn's rings and helped measure the temperature and pressure of Titan's atmosphere; these findings laid the groundwork for the later Cassini-Huygens mission

GS 2: SOCIAL JUSTICE
THE HINDU PAGE: 08

Transgender rights, healthcare should not be compromised

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Parliament passed the Transgender Persons (Protection of Rights) Amendment Act, 2026 earlier this year. The new Act represents a significant shift from the Transgender Persons (Protection of Rights) Act, 2019. The 2026 amendment removes the principle of self-identification and demands a medical board's recommendation; a selection from prescribed categories; and certification by a District Magistrate. It fundamentally changes legal recognition for transgender persons from self-identification to medical assessment. While the 2026 Act does increase protection, it changes the philosophical foundation of transgender rights – from recognition based substantially on autonomy and self-identification towards recognition mediated by medical and administrative authorities.

Creating medico-legal hurdles

The definition of "transgender" as introduced in the Amendment Act is in contradiction to established international evidence and guidelines laid down in the World Health Organization ICD-11 and the World Professional Association for Transgender Health Standards of Care Version 8.

The new Act conflates two different issues: whether a person's gender identity is legally valid and a person's eligibility for social welfare benefits. It also makes a medical authority the gatekeeper of gender identity. The Supreme Court had held that gender identity is part of one's personal autonomy and dignity under Article 21, and had rejected the idea that gender identity should be dependent on medical intervention. This new definition resurrects the discredited psychiatric model in which a deeply felt internal and social identity becomes a matter for professional certification.

It raises the broader question of whether the law is protecting transgender persons or deciding which transgender identities are sufficiently medically recognisable to deserve protection. The new amendment defines 'transgender' very narrowly – it removes trans men, trans women and genderqueer persons from its statutory definition and introduces a restricted set of categories, which include certain socio-cultural identities and persons with specified variations in sex characteristics. For transgender persons excluded from this definition, it would create a mismatch between the gender incongruence experienced by the individual and that recognised administratively. It also excludes people who previously fell within the protection of the 2019 Act by medicalising some identities and culturally recognising some others (identities such as *kinner*, *hijra*, *aravani*, *jogta*, eunuch). It mandates medical certification of even such cultural categories. While the medical board can recognise biological characteristics (which may or may not co-occur with a transgender identity), how will it determine membership within a socio-cultural community? The new Act does not provide an effective appeal mechanism nor independent review.

> Clinical understanding of the care needs of a transgender person remains rudimentary in India. Doctors, nurses and hospital administrators need to be trained in basic transgender health

The *NALSA* judgment strongly articulated a rights and autonomy approach while the 2026 Act supports a paternalistic model with reduced autonomy. Should the state protect a marginalised group by introducing medico-legal hurdles or by maximising individual autonomy while providing strong protections against exploitation? The Act creates potential tensions with the constitutional reasoning of *NALSA*, risks excluding many gender-diverse people, and leaves important procedural questions about certification and appeal unresolved.

The consequences

The new Act has many negative public health consequences. The lack of an appeal process is particularly important as the certificate has implications for access to statutory rights and entitlements. It introduces multiple barriers to gender affirming care, documentation, employment, education, social-security schemes, insurance and mental health services. The ambiguity regarding the legality of gender-affirming and supportive care has resulted in uncertainty among care providers and has led some of them to delay, suspend, or withdraw services. This is likely to drive individuals toward unregulated and informal sources of care, including private, unqualified providers operating outside established medical systems. The shift towards the "grey market" for hormones and surgical interventions may increase the risk of self-medication, post-operative complications, infections, side-effects and morbidity. The bureaucratic requirements may lead to significant out-of-pocket expenditures and delays in accessing care. There is also emerging field-level evidence from helplines, community consultations, and hearing sessions indicating an increase in distress calls from transgender individuals, including reports of suicidal ideation, depression, sleep disturbance, and anxiety following the introduction of the amendment.

India has come a long way in recognising the rights of transgender persons. The 2014 *NALSA* judgment recognised transgender persons' right to identity and dignity, and the Government has since introduced laws, welfare schemes, identity certificates, shelter homes, insurance and healthcare initiatives for the community. And yet, transgender people and communities face massive discrimination in nearly all sectors. The National Human Rights Commission's (NHRC) 2026 advisory identifies continuing concerns involving education, healthcare, property and inheritance, employment, documentation, and policing and grievance redressal. The Act goes against the NHRC's recommendations particularly with respect to self-identification, independent grievance mechanisms and reducing documentation barriers.

Transgender healthcare

Many transgender persons hesitate to enter hospitals because of previous experiences, fear of being judged, lack of understanding among healthcare workers, concerns about privacy, cost, or dignified care. These become powerful barriers to seeking healthcare for people who have faced discrimination in environments that cater to cisgender people.

Some hospitals have dedicated transgender clinics that provide specialised care, counselling, hormone therapy, and gender-affirming services. Nevertheless, transgender persons can develop other illnesses such as diabetes or hypertension and may need the full range of care – primary, preventative, emergency, specialist, surgery, dental etc. They should not have to search for a "transgender-inclusive hospital" every time they fall sick. Transgender healthcare should become part of general healthcare.

Clinical understanding of the care needs of a transgender person remains rudimentary in India. Doctors, nurses, receptionists, security staff and hospital administrators need to be trained in basic transgender health. While the Madras High Court's *Sushma* (2021) verdict mandates such education, curriculum changes proposed by the National Medical Commission have failed to incorporate such training. Hospital forms and records should allow appropriate recording of a patient's preferred name and gender identity while retaining clinically relevant information. A mandate of the 2019 Act to designate a Complaints Officer in every establishment has not been complied with in most hospitals. There is an urgent need for inclusive mainstream healthcare, supported by specialised services when necessary.

The passage of the 2026 Act is contributing to a public health emergency. India should focus on the humanity of all people rather than divide them on the basis of bigotry and prejudice. One's humanity should be judged by the people we include rather than by those we exclude.

GS 3: SECURITY & DEFENCE
THE HINDU PAGE: 08

India needs a comprehensive doctrine on space security



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Space has transformed from a specialised domain of scientific exploration into an area which hosts essential infrastructure underpinning everyday life, economic activity and national security. Communications, navigation, weather forecasting, disaster management, agriculture, banking, logistics and critical infrastructure are increasingly dependent on satellites and space-enabled services. In India, space capabilities support the armed forces through communications, positioning, surveillance, timing and situational awareness. Space is therefore no longer a separate technological sector but an essential component of national resilience and strategic autonomy. As dependence expands, disruption can have consequences for markets, governance, security and society at large.

The character of threats in space is changing. Competition extends beyond the destruction of satellites to the disruption of the services they provide. Space systems can now be affected by jamming and spoofing that interfere with communications and navigation. Cyber interference can target satellite networks, ground stations and supporting infrastructure, while electronic warfare can degrade signals and reduce the reliability of space-enabled systems. Such methods can produce effects without physically damaging a spacecraft, making attribution and response more complex. The vulnerability lies not only in the satellite itself, but in the wider architecture connecting space assets to users on Earth. This shift from destruction to disruption has made space security a more complex challenge for states.

Changing threat landscape

This changing threat environment matters particularly for India, whose dependence on space-based services is expanding across military and civilian domains. The interconnected nature of these systems also means that disruption in one part of the space architecture can have consequences elsewhere on the ground. Therefore, resilience becomes essential.

As India's dependence on space grows, greater clarity is needed about how different forms of interference should be understood and assessed. What constitutes an attack on a space system? Is physical destruction of a satellite fundamentally different from jamming, spoofing or cyber interference that degrades or temporarily disables a system? How should responsibility be attributed when interference originates through complex networks or involves multiple actors? What if disruption is temporary but has significant effects on military operations, critical infrastructure or essential services? How should decision-makers distinguish accidental interference from deliberate attack? And, when attribution remains uncertain, how should a response be determined without inadvertently escalating a crisis?

India is not starting from a policy vacuum. The Indian Space Policy 2023 provides an overarching framework for space activities, while ISRO's Indian Space Situational Awareness Report for 2025 (ISSAR-2025) documents India's efforts in space situational awareness, collision avoidance and space-debris mitigation. The strategic question is how the existing policy framework and space situational awareness can better inform decision-making on hostile disruption, attribution and crisis response. India needs a clearer framework establishing thresholds, attribution standards and response principles for different forms of space disruption.

> India's objective should not be to turn outer space into another arena of conflict, but to ensure that disruption in space does not translate into vulnerability on Earth

Interconnected network

Space security cannot be treated solely as a military or government responsibility. An increasing part of the space ecosystem is operated and serviced by commercial entities. Private satellite operators and service providers support communications, navigation, and other activities underpinning civilian infrastructure and economic functions. Disruption affecting a commercial system can therefore have consequences for public services, businesses and national security. Security depends on the resilience of the wider ecosystem, not simply on protecting government-owned assets. Sustained government-industry coordination is important for information sharing, identifying vulnerabilities, responding to disruptions and maintaining essential services.

A comprehensive Indian space-security doctrine should begin with resilience: multiple systems, redundancy, and sufficient flexibility to sustain essential functions when individual components are disrupted. Equally important is space-domain awareness – the ability to understand activity around Indian assets, identify anomalies and strengthen the basis for attribution. A credible framework must also address reconstitution and recovery, ensuring that essential capabilities can be restored rapidly. This requires partnerships among government agencies, the armed forces, ISRO, commercial operators and other stakeholders. A space-security doctrine need not mean an unrestricted push towards weaponisation. Its purpose should be to ensure that India can deter, withstand, attribute and recover from disruption while preserving the peaceful use of outer space.

India's objective should not be to turn outer space into another arena of conflict, but to ensure that disruption in space does not translate into vulnerability on Earth. As space-enabled services become embedded in defence and economic activity, their continuity is inseparable from protecting national interests. The measure of space security should not be the accumulation of capabilities alone, but the capacity to preserve functions, withstand shocks and recover quickly.

GS 2: HEALTH & GOVERNANCE
THE HINDU PAGE: 09

Field staff inform health research



Parthesarathy Rajendran

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Ask a health worker in a humanitarian setting in South Asia what does not work in the setting, and they will have examples ready. They know where the patient referral system breaks down, which communities remain out of reach, and where protocols fail to account for ground realities.

Yet, these are rarely the people documenting the gaps or analysing why they persist. The research is done by professionals distant from the ground work, and the voices of field workers who know the gaps often do not make it to journals. As a result, the gaps persist in the next emergency. A field worker knows which question matters, while a researcher brings the systematic approach and methodological rigour needed to investigate it. Neither can do the other's job, nor should try. The task here is not to turn health workers into academics but develop knowledge applicable to different ground realities.

Humanitarian health workers spend days with people in communities that are struck by conflict, displaced from home, ground down by poverty and diseases. Standard models of care often do not work in such constrained settings. Hence, the workers improvise and find practical solutions. That experience is worth way more than we give credit for. They see barriers that never show up in routine data. They identify an approach that could work well beyond its place of origin.

Research should be carried out in a way where field staff are pushed to the margins when it comes to data collection. The people who run the operations should help shape the questions, have a say in how the study is designed and stay involved when the findings are interpreted and acted on. When that happens, their experience is no longer just an anecdote. It becomes evidence that can improve treatment, strengthen services and where data supports it, change policy.

Standard modes do not often work in humanitarian settings. Health workers at the ground level improvise and find practical solutions

In Gaza, between August 2024 and December 2025, a Médecins Sans Frontières (MSF) surgical field hospital treated around 5,550 trauma patients. A retrospective study looks at the injuries, the operations and how the patients fared. It addresses the shortage of systematic clinical data from a conflict setting where much of the available information has come from witness accounts. Although the findings are preliminary, the work has already produced practical tools, including standardised case definitions, reporting forms, and a data platform to support further analysis. These are important steps towards building a stronger evidence base from trauma care provided in conflict settings.

In Bihar, India, clinical studies led by MSF, alongside research conducted by the Drugs for Neglected Diseases initiative (DNDi) in Ethiopia, examined treatment for people living with HIV who were also affected by Visceral Leishmaniasis, commonly known as Kala-Azar. The studies found that combination therapy performed better than treatment with a single medicine. This body of evidence contributed to the World Health Organization's updated recommendations on treating HIV and Visceral Leishmaniasis for co-infection.

If we want more of this to happen, research should reach out to people running humanitarian operations. While research should maintain its rigour, there should be room for pragmatic study designs and real-world data and also backing practitioners so they can use both well.

Field workers also need mentorship, protected time, proper funding and the opportunity to work alongside experienced researchers. They require support to publish their findings, so that what is learned in one place can inform work in another.

Platforms such as 'MSF Scientific Days', initiated in London in 2004 and started as 'MSF Scientific Days South Asia' in New Delhi in 2015 which became MSF Scientific Days Asia in 2019, assist in collating these voices. Practitioners present their work, receive feedback, meet academic researchers and begin collaborations across projects and organisations. Such platforms can bring research within reach for frontline teams and encourage more of them to question and investigate what they see in work and build partnerships to find answers.

The knowledge to improve humanitarian healthcare is already being generated every day. Our responsibility is to develop partnerships to ensure it reaches practical applications, informs better decisions, and ultimately makes a difference in the lives of people who depend on the care we provide.

GS 2: SOCIAL JUSTICE (EDUCATION)
THE HINDU PAGE: 10

Making learning more inclusive for tribal students

Keralam's Community Study Centres help tribal students navigate a competitive education system

Amruth G. Kumar
Binesh Narayanan

Samoohya Patana Muri or Community Study Centres (CSC) is an initiative of the Keralam government started in 2018 to support the learning needs of children from tribal communities. In a tribal hamlet in Kasaragod district, CSC can be inventoried quite easily: a few computers, learning materials, a room open even after school hours, and light refreshments for ₹20 per student per day. What cannot be inventoried is: whether a tribal student who has failed an exam feels confident to walk in the next day and ask for help or are they pushed away?

Our education policies speak the fluent language of inventories. It counts enrolment, sq ft. of buildings, equipment, and pass percentages, among other things, and these are not trivial. But access alone does not ensure achievement without students' active participation in learning. Policies usually consider only access, not participation. A child can be enrolled in school and given basic learning resources, yet remain unable to use what is on offer. Persisting after failure and believing that school wants us to progress are not merely individual acts of will, but social acts.

Beyond infrastructure

Keralam's CSCs are an ideal site to test this argument. Run by the Scheduled Tribes Development Department, CSCs serve Scheduled Tribe and Scheduled Caste students from Classes V to XII with tutoring, learning materials, and refreshments. Every CSC employs an educated young person from the local community. There are currently 364 CSCs, as per the 'Economic Review' 2023, published by the Kerala Planning Board.

It is easy to understand this as a tuition-and-hardware scheme of the government. But this understanding misses its most powerful feature: the staff belong to the same community as the students, which formal schooling so often misses. Results of a study published in the Taylor and Francis QI Journal, *Diaspora, Indigenous, and Minority Education*, has insightful findings in this direction.

The study was conducted on 462 tribal school students in Kasaragod district. Findings show that students who viewed their CSC positively had stronger achievement motivation: they demonstrated better social skills, the capacity to express, read, and manage emotions in social situations as well. This means that the value of the CSC cannot be judged only by the number of tabletop computers, internet bandwidth, learning resources, and other facilities. The social skills these students develop through interactions with the facilitator and other peers also deserves serious attention.

Scheduled Tribe (ST) students gaining 'social skills' through CSC can be misunderstood. It does not imply that tribal children lack social skills and the CSC delivers it to them. The better reading is the reverse. Tribal students hail from communities that value cooperation and interdependence. On the other hand, schools reward competitive individualism. This appears to be a juxtaposed reality for the tribal students.

CSC plays a critical role in equipping the tribal students to navigate this demanding situation. The local facilitator at the CSC supports them in reaching the school and sustaining them at school. But this raises a more serious question: What role do schools play in helping these students adjust to school practices? A CSC that helps tribal students cope with a school that does not understand them is doing work the school should share. The more efficiently the CSC functions, the easier it becomes for the system to leave the school unchanged.

The path forward

At the national level, the lesson is not to copy Keralam's CSC equipped with computers and other resources. Some key points are proposed based on the evidence emerging from the study:

While evaluating such welfare schemes, the system must look beyond quantified outcomes. It should assess whether students freely seek help, feel comfortable at the CSC, progress to higher levels confidently (without liberal moderation and grace marks), and feel respected there, alongside learning outcomes. At the national level, such schemes should continuously observe the interests, attitudes and motivation that lead students to attendance, retention and higher achievements.

The facilitator appointed at such centres should be treated as an educator, not merely a custodian of equipment or a disciplinarian. They should be trained in adolescent development, learning strategies, academic and personal guidance, and counselling skills, and receive regular pay commensurate with their work.

Peer tutoring opportunities can be organised in CSCs, with senior students supporting younger ones and engaging them in mixed-age-group projects. None of this is an argument against computers, learning resources, and refreshments available for the students in CSC, and they must continue. The argument is against mistaking the inventoried items for real educational support for tribal students.

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GS 2: POLITY & JUDICIARY
INDIAN EXPRESS PAGE: 11



• LEGAL

Bilkis case: How convicts got bail after SC sent them back to jail in 2024

Sadaf Modak
Mumbai, November 17

THE SUPREME Court on Monday suspended the life sentence of two convicts in the Bilkis Bano case from the 2002 Gujarat riots and granted them bail. Bano, then aged 21 and five months pregnant, was gang-raped and seven of her family members, including her three-year-old daughter, were killed during the communal riots. This came over two years after the top court struck down the remission granted to the two, and nine others, by the Gujarat government, and directed them to surrender and return to jail.

What does the latest Supreme Court order say?

Bipinchand Kanaiyalal Joshi and Pradip Ramanlal Modhiya, lodged in a jail in Gujarat, filed a Special Leave to Appeal, challenging the Bombay High Court judgment passed on May 4, 2017, which confirmed their conviction and sentence given by the trial court in 2008. They told the Supreme Court that they had spent more than 17 years in jail. One of them said that he is severely disabled. The bench of Justice M M Sundresh and Justice Prasanna Varale said: "Certainly, there are issues to be decided in the appeal, both on fact and law."

The court suspended the sentence and granted bail to the two, directing a trial court to impose terms and conditions. It then directed that their appeals be listed for hearing "in due course" before the top court. In her response to the Supreme Court's bail to the two convicts, Bano said she could not believe that the court passed an order "without hearing her". She said she would fight the order. The law says a victim can be issued a notice and allowed to intervene and make submissions when hearing an appeal.

How were the 11 convicts released the first time?

In 2004, the Supreme Court transferred the gang-rape case from Gujarat to Mumbai over apprehensions of evidence tampering and the lack of a conducive situation for a fair trial. Four years on, a trial court in Mumbai convicted the 11 men of charges including murder, rape and rioting. The Bombay High Court upheld the punishment, as did the Supreme Court in 2017.

In 2022, one of the convicts again approached the top court seeking directions to the Gujarat government for premature release, citing a 1992 remission policy for convicts who had completed at least 14 years in jail. The court asked the Gujarat government to consider the application "within a period of two months", in line with the policy. Based on this, a government panel recommended their release and they were released from a Gujarat jail on August 15, 2022. They were felicitated upon their release by local leaders. Bano filed a plea against their release. In January 2024, a Supreme Court division bench said the Gujarat government did not have the jurisdiction to consider the remission applications.

This is because such an application can only be taken up by a government within whose territorial jurisdiction the applicant was convicted — in this case, Maharashtra — and not where the offence took place (that is, Gujarat). The court also said that the pleas for remission should have been considered as per a 2014 policy which has a bar for grant of remission to convicts of heinous crimes.

How is the earlier release different from this one?

In 2022, the 11 convicts were released on remission — which essentially means early release — with their life sentence considered complete. The justice system has provisions such as remission or reduction of a sentence, taking into account that convicts can reform themselves.

But the Supreme Court said in its 2024 order that this has to be balanced with the rights of the victim or her family. In prior rulings, the Supreme Court has expressed scepticism over the convict's claim to a second chance, particularly if the offence is a heinous one.

Unlike remission, the current release is on bail pending appeal. When the Supreme Court hears the appeal, it will go into detail on the merits of the case. The bench said that pending the appeal, the two men should be granted bail on grounds including the 17-year incarceration as part of their life sentence. The court also suspended their sentence, which means that their punishment is stayed till the final decision on the appeal. The other convicts can also file separate appeals seeking bail on similar grounds of parity. If the top court upholds the high court and trial court judgment, the two will have to return to jail.

GS 3: SCIENCE & TECH/ENVIRONMENT
INDIAN EXPRESS PAGE: 11

• ARTIFICIAL INTELLIGENCE

The growing backlash to data centres powering AI

The AI boom needs data centres and countries are racing to build them. The question among local communities: Who pays the cost, who gets the benefit



RISHIKA SINGH

TWO INTERLINKED events this month in the US indicate rising scepticism about the growth of data centres, facilities central to the artificial intelligence (AI) boom.

First came the midterm drubbing for the Republican Party, reflecting, among other factors, a rejection of data-centre expansion. A $2.5-trillion wipeout in tech and AI stocks was triggered amid expectations that Democrats would not be as pro-AI.

The disapproval is not just an American phenomenon. Closer home, Adani Enterprises and Google announced plans last October to develop India's largest AI data centre campus in Visakhapatnam, Andhra Pradesh, for $15 billion. Several pleas have been filed in courts, challenging the project on grounds including the environmental clearance process and land allocation.

VS Krishna, Coordination Committee Member at Human Rights Forum, a group challenging the project, told *The Indian Express* that the manner of approval was of "deep concern", with limited gains for the locals. Similar projects in locations ranging from Finland to Kenya have been opposed.

What is an AI data centre?

Accessing the internet is seamless. But the vast amount of information and data being exchanged still needs to be contained and managed at a physical location.

A data centre is a facility that houses the infrastructure needed to store, process and manage data, and provide the computing services that underpin much of the internet. It can include servers, computers, hard drives and cooling systems to manage the heat generated by electrical systems.

Shane Greenstein, professor of business administration at Harvard Business School, told *The Indian Express* that there are multiple types of data centres. "India already has many data centres within its borders... They serve as cloud providers for India's massive IT industry, offering computing, storage and related software services."

"Typically, they need to be nearby to deliver services without delays (what is termed "latency"). An Indian business could access such services in Europe or the US, but users would notice delays from the distance the electronic signals travel, or from congestion along the way," he said.

Data centres for training Large Language Models like ChatGPT initially did not need to be located nearby. However, the growing use of these models has increased demand for computing power. Newer-generation data centres typically use Nvidia's graphics processing units (GPUs), which can carry out complex calculations and support applications and programmes.

AI data centres thus tend to be larger and consume much more electricity. Adarsh Ranjan, research analyst at Carnegie India, said the scale has risen substantially. "Data centres are sometimes measured in terms of power, say a 10-megawatt data centre, referring to what it needs to run," he told *The Indian Express*. But now, he said, companies are treating bigger facilities as the baseline. The International Energy Agency says: "A typical AI-focused data centre consumes as much electricity as 100,000 households, but the largest ones under construction today will consume 20 times as much."

The other argument for expanding data centres concerns data sovereignty, Ranjan said. "The country in which the data centre is located will essentially determine the laws governing it — including how secure it is and who gets to access it. Imagine the data centre is located in a country that you don't have friendly ties with; that would lead to worries, especially if it's critical and sensitive data, like on health." Currently, the US leads globally, housing nearly half of all data centres.

Why are communities opposed?

Companies driving AI's growth have painted this pace as inevitable. An Adani-Google data centre media release says that its development "will create a powerful engine for economic growth in Visakhapatnam... and thereafter the entire nation by driving digital inclusivity and creating tens of thousands of jobs in technology, construction and clean energy." An associated energy project is planned not only to "support the data centre's operations but also enhance... India's electricity grid."

But for all their promised benefits, data centres have increasingly acquired a negative reputation, seen as guzzlers of water and electricity, with questionable benefits.

India's 2025-26 Economic Survey, for instance, stated that "Despite generating nearly 20 per cent of the world's data, India hosts only about 3 per cent of global data centres." It described the facilities as "double-edged swords". It quoted Mark P Mills, senior fellow at the Manhattan Institute, from a Congressional testimony: "In moonshot terms: the amount of energy used to launch a rocket is consumed every day by just one AI-infused datacenter."

Water is used in data centres primarily to remove the heat generated by servers and processors. Traditional cooling systems often use evaporative cooling, in which water is evaporated to dissipate heat. Newer approaches, including direct-to-chip cooling, circulate coolant through cold plates attached to processors. "People are generally wary of potable water being used, and how this could impact local community access to water," Ranjan said.

Data centres also require vast and reliable electricity supplies. While companies do procure renewable energy, electricity may also come from grids that rely heavily on fossil fuels. The additional load could ultimately be passed on to other consumers.

And there are cost and job issues (*see box*). VS Krishna of HRF said the green clearance process in Visakhapatnam was not based on informed public debate. An HRF press release flagged "serious consequences" of permitting the project in an area linked to a reservoir catchment and a wildlife sanctuary.

How are data centres regulated?

Ranjan said that globally, the conversation is focused on two areas. "Countries recognise the need to bring in investment and establish facilities to support their domestic ecosystem. The second part is to ensure that the environmental fallout does not impact local communities."

The Economic Survey suggests that since investment in AI infrastructure competes directly with other sources of demand, such as households and industries, a stronger case can be made for "smaller, task-specific (AI) models that can run on limited hardware and decentralised compute networks."

National data centre-specific policies have generally been lacking, although states have formulated their own, including in India and the US. "Uttar Pradesh, Maharashtra, Andhra Pradesh, Karnataka, and Telangana have their own policies, but these largely look at attracting investments," he said. In the absence of a national policy, states could engage in a kind of race to the bottom to offer the most cost-cutting alternatives to companies.

Experts say better resource utilisation is achievable, including with more green technology and energy-efficient methods. Ranjan said whether companies and governments move towards mandating them is more a question of political will.

But there is also a fundamental question at the heart of the opposition. Krishna said, "It has been billed as a gamechanger, but it's also indirect. It's a rudimentary example, but say, a hospital was being built instead. People will have direct use for it; it will result in lodging and food facilities coming up nearby, but that's not the case here."

Greenstein said data centres face an "inescapable issue": "The benefits go to users and businesses, who are distant and dispersed, while many of the costs are conspicuously local. That also creates opportunities for NIMBY (not in my backyard) opposition. Locals have no reason to care."

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Chart 1: **Data centre capacity in India**



Chart 2: **City-wise operational capacity (MW)**

Mumbai/Navi Mumbai	790
Chennai	305
Bengaluru	182
Hyderabad	152
Delhi-NCR	76
Others (Pune, Kolkata)	15

*Projected. MW refers to megawatts. Source: Ministry of Electronics and IT

Counting costs of building frontier AI

Part of the criticism of data centres stems from costs associated with frontier AI (the most advanced models), said Shane Greenstein, professor at Harvard Business School. The following are his estimates:

$2-$4 billion: The estimated cost of constructing the shell of a 150MW facility, a scale that marked the AI frontier last year. This includes land, connectivity, cooling, electricity, racks.

$3 billion or more: Filling the shell with servers and associated hardware. Frontier chips can drive expenses several times higher.

Billions more: Recurring bill for hardware replacement

$500 million annually: Operating cost, depending on location and weather.



"Such a build creates many jobs during construction, with thousands working on it for a year. After construction, the number of newly created jobs is modest, maybe just a bit more than 100 employees," GREENSTEIN TOLD THE INDIAN EXPRESS.

What is a data centre

A data centre houses the infra needed to store, process and manage data.

•

It provides the services that underpin much of the internet.

GS 2: INTERNATIONAL RELATIONS

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At Shenzhen, Putin seeks a table for three with Washington and Beijing



RAJA MANDALA

BY C RAJA MOHAN

WHY IS Vladimir Putin invested in bringing Donald Trump and Xi Jinping together in Shenzhen this week? Why is Russia, which promoted a "strategic triangle" between Moscow, Beijing and Delhi in the 1990s, now backing a potentially more consequential triangle involving Russia, China and America?

For the Indian strategic community convinced that Russia will forever remain an adversary of America, Moscow's enthusiasm for the trilateral summit deserves reflection. This, in turn, demands a better appreciation of Russian strategic traditions and Moscow's contemporary geopolitical compulsions. In Delhi's discourse, Russia has been reduced to a simple sum of bilateral considerations — oil, weapons, nuclear energy and propulsion, and past vetoes in India's favour at the UN Security Council. In Delhi, which takes Russia for granted as the "best friend forever", there is little political empathy for Moscow's structural challenges.

Why is Moscow, which helped create the Russia-India-China (RIC) forum, BRICS and the Shanghai Cooperation Organisation (SCO), now seeking a table for three with Washington and Beijing? The apparent contradiction erodes once we separate Russia's opposition to American primacy in Eurasia from its interest in accommodation with American power. Although Russian and Chinese think tanks reportedly discussed a trilateral summit for some time, the Russian initiative came to light at the SCO summit in September. Putin's top aide, Yuri Ushakov, told the press that the proposal had been discussed with Xi. Putin subsequently pursued it with Trump.

The simplest explanation for Putin's initiative is about restoring Moscow's standing as a great-power peer of America and China. Russia's economic weight cannot sustain that claim. But its nuclear arsenal, military capabilities, natural resources and geography give it strategic significance beyond its economic size. A G3 would translate these assets into political status. Russia would sit alongside the two leading powers and participate in the joint management of global challenges.

The second consideration is Ukraine. Although Moscow has long sought to push America out of Eurasia, it knows that a favourable settlement in Ukraine is difficult without Washington's support or acquiescence. Putin also sees opportunities in the growing differences between Trump and Europe on transatlantic security.

The third consideration is China. Beijing has helped Russia withstand Western sanctions and diplomatic isolation. But the partnership has become increasingly unequal. Russia has no interest in exchanging American domination for Chinese domination. A strategy of triangulation widens Moscow's options.

The fourth consideration is economic. Putin has floated cooperation with American companies in energy and the Arctic. His investment envoy, Kirill Dmitriev, has promoted commercial opportunities. Sanctions relief, investment and technology could ease Russia's economic constraints. These proposals appeal to Trump's transactional instincts. For Moscow, economic engagement with America would strengthen its freedom of manoeuvre.

> Russia has no interest in exchanging American domination for Chinese domination. A strategy of triangulation widens Moscow's options

These calculations are rooted in a deep historical tension within Russia's geopolitics. In Russia's national emblem, the double-headed eagle, one head looks west and the other east. Russia has long struggled to reconcile its European inheritance with its Eurasian geography and ambitions.

Peter the Great sought to Europeanise Russia as part of its modernisation. That inevitably produced a backlash from the so-called "Slavophiles", who opposed westernisation and demanded that Russia follow its own distinctive path.

In 1881, Fyodor Dostoevsky captured a powerful current in Slavophile thinking: "In Europe we are followers", he wrote, "whereas we shall go to Asia as masters". He also noted the paradox: "In Europe we are Asiatics, whereas in Asia we, too, are Europeans." Dostoevsky gave a remarkable expression to the impulse to compensate for marginalisation in Europe with imperial expansion in Asia.

The 1917 Bolshevik Revolution saw Moscow embrace the radical Western ideology of communism and become the fount of a new global political trend. But the capitalist backlash deepened Soviet Russia's separation from the West. Meanwhile, Russia's anti-communist émigré intellectuals who left the Soviet Union developed the idea of Eurasianism. Russia, they argued, was neither European nor Asian but a separate civilisation. The idea re-emerged after the Soviet collapse and gained political traction under Putin. Moscow's 2023 foreign policy concept describes Russia as a "unique country-civilisation" and a Eurasian power.

Yet the Russian eagle never stopped looking West. The Soviet Union allied with America and Britain against Nazi Germany in World War II. The détente of the 1970s with America combined rivalry with arms control and economic engagement. After the Cold War, Moscow sought integration into the Western-centred order.

Mikhail Gorbachev imagined a "common European home". Addressing the German Bundestag in September 2001, largely in German, Putin waxed lyrical about the possibilities of Europe becoming stronger by combining its capabilities with Russia's resources. He visualised a free trade pact, joint development of natural resources, and visa-free travel. Putin's early pursuit of a "harmonious economic community from Lisbon to Vladivostok" reflected the complementarities between Russian resources and European capital, technology and markets.

NATO's expansion and Western reluctance to address Moscow's security concerns saw the collapse of this vision. Putin's angry Munich speech in 2007 marked a turning point. The invasion of Ukraine and subsequent Western sanctions have since shattered much of Russia's economic relationship with Europe.

But resentment does not eliminate the strategic importance of the West in the Russian calculus. Delhi should take note, not offence. India's warm Cold War memories should not mask Russia's natural preoccupation with America, Europe and China. Nor should Delhi mistake the anti-Western rhetoric from Moscow for the pursuit of a permanent confrontation with Washington. A Russia with greater room for manoeuvre in Asia and at peace with Europe and America would serve Indian interests.

The writer is consulting editor on international affairs for The Indian Express. *He is also professor and director, Motwani Jadeja Institute of American Studies, O P Jindal Global University. His new book,* India Pivots to Europe: In Search of a Eurasian Balance, *is published this month*