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PCS Special:	21 July
21J7	Four Indians killed near Ukrainian port of Odessa यूक्रेन के ओडेसा बंदरगाह के निकट चार भारतीयों की मृत्यु
21J7	Press and play प्रेस और खेल
21J7	Khalil al-Hayya, Hamas' negotiator in Gaza talks, named group chief गाज़ा वार्ता में हमास के वार्ताकार खलील अल-हय्या बने संगठन के प्रमुख
21J7	Chess legend Judit Polgar declines post of Hungary President शतरंज की दिग्गज जुडित पोलगार ने हंगरी के राष्ट्रपति पद का प्रस्ताव ठुकराया

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Four Indians killed near Ukrainian port of Odessa

PCS
Kallol Bhattacherjee
NEW DELHI

Four Indian citizens were killed and one was critically injured in an attack on a merchant vessel near the Ukrainian port of Odessa on Sunday.

India condemned the incident and called such attacks impeding freedom of navigation "deplorable".

The Ministry of External Affairs on Monday reiterated India's opposition to attacks on merchant vessels as such incidents violate the freedom of navigation.

The Acting Foreign Minister of Ukraine, Andrii Sybiha, has blamed Russia for the attack and said five crew members of the ship remain missing.

"On the evening of 19 July 2026, vessel *MV Golden Leo* was attacked while departing the port of Odessa. At the time of the incident, there were 17 crew members on board, including five Indians. As per information available, four Indian nationals have tragically lost their lives, while one is hospitalised in a critical condition," said the Ministry in its statement.

Caught in a war: Smoke rising from civilian cargo ship *Golden Leo* in the Black Sea, following an alleged Russian missile strike on Sunday. AFP

"India condemns such attacks and reiterates that targeting commercial shipping and endangering innocent civilian crew members, or otherwise impeding freedom of navigation and commerce is deplorable and should be avoided," said the MEA in its statement.

The incident comes amid the death of several Indian seafarers in the continuing attacks by the U.S. and Iran on commercial vessels in the Gulf.

The Ukraine's Acting Foreign Minister said the attack was not an isolated incident. "Russia has now struck a civilian vessel navigating Ukraine's maritime corridor. The crew included citizens of Syria and India. A Ukrainian maritime pilot was killed," said Mr. Sybiha. He said Russia attacked another merchant vessel with the flag of Antigua and Barbuda in the Black Sea on Saturday.

Mr. Sybiha said Ukraine had informed the International Maritime Organization and Ukraine's international partners "about Russia's latest attacks on civilian shipping, as well as the states whose citizens were killed or injured."

Maritime Trade News has reported that *Golden Leo* was carrying a crew of 17 Syrian and Indian nationals and that at least 10 sailors were killed in the attack. The Russian authorities are yet to comment on the incident.

21J7. Four Indians killed near Ukrainian port of Odessa
यूक्रेन के ओडेसा बंदरगाह के निकट चार भारतीयों की मृत्यु

- **Four Indian citizens** were killed and one was critically injured in an attack on a **merchant vessel** near the **Ukrainian port of Odessa** on **Sunday**.
  रविवार को **यूक्रेन के ओडेसा बंदरगाह** के निकट एक **व्यापारी जहाज़** पर हुए हमले में **चार भारतीय नागरिकों** की मृत्यु हो गई तथा एक अन्य गंभीर रूप से घायल हो गया।
- "On the evening of **19 July 2026**, vessel **MV Golden Leo** was attacked while departing the port of **Odessa**.
  19 जुलाई 2026 की शाम **एमवी गोल्डन लियो (MV Golden Leo)** पर **ओडेसा बंदरगाह** से रवाना होते समय हमला किया गया।
- "**India** condemns such attacks and reiterates that targeting **commercial shipping** and endangering innocent **civilian crew members**, or otherwise impeding **freedom of navigation** and **commerce**, is **deplorable** and should be avoided," said the **MEA** in its statement.
  विदेश मंत्रालय ने अपने बयान में कहा कि **भारत** ऐसे हमलों की निंदा करता है तथा दोहराता है कि **वाणिज्यिक जहाज़ों** को निशाना बनाना, निर्दोष **नागरिक चालक दल के सदस्यों** के जीवन को खतरे में डालना अथवा **नौवहन की स्वतंत्रता** और **व्यापार** में बाधा उत्पन्न करना **निंदनीय** है और इससे बचा जाना चाहिए।
- He said **Russia** attacked another **merchant vessel** flying the **flag of Antigua and Barbuda** in the **Black Sea** on **Saturday**.
  उन्होंने बताया कि **शनिवार** को **रूस** ने **काला सागर (Black Sea)** में **एंटीगुआ और बारबुडा** के **ध्वज** वाले एक अन्य **व्यापारी जहाज़** पर भी हमला किया।

PCS

Press and play

Spain smothered the opposition with possession and positional football

Spain's second World Cup title, achieved after a narrow extra-time victory over Argentina in the final, was a triumph of the collective. The Luis de la Fuente-coached outfit conceded just one goal in eight matches, was unmatched in the centre of the pitch with playmaker and Golden Ball winner Rodri completing a record 790 passes, and exhibited diffused excellence up front by having seven different players score its 14 goals. So much so that even the individual brilliance of the teenaged Lamine Yamal was astutely subsumed within the whole. In fact, de la Fuente and Rodri had combined to deliver the 2024 European Championship too, with the latter adjudged the world's best later that year. A second Ballon d'Or for the 30-year-old midfield metronome appears a certainty. The win also cemented Spain's position as the pre-eminent footballing force of the first quarter of this century. Starting 2008, the country has won two of the five World Cups and three of the five Euros. Spain is the reigning women's World Champion, and the assembly line of coaches it produces and players it exports make the nation a true powerhouse. Interestingly, after its maiden World Cup win in 2010, Spain had not gone past the round of 16 at three subsequent editions. The success in North America is thus a full-circle moment.

Another high point for the tournament was Lionel Messi's enduring genius. Argentina's quality in the final was dire and the behaviour of its players petulant, but that should not detract from the 39-year-old's excellence in bringing his country to the cusp of defending its crown. Kylian Mbappe's experience was bitter-sweet; he won the Golden Boot (10 goals) and became the all-time top-scorer in World Cups (22) but remained a mute spectator as Spain subjugated his star-studded France in the semifinal. Jude Bellingham inspired England to third place, the best performance for the nation since winning in 1966. But the summer sojourn laid bare the team's continued lack of cutting edge after back-to-back runner-up finishes at Euro 2020 and 2024. The World Cup will also be etched in memory for a plethora of missteps, which governing body FIFA unfortunately condoned. By arbitrarily invoking immigration rules, and trying to interfere politically in on-field matters, the co-host U.S. pushed the envelope in undesirable ways. Commercially driven hydration breaks and the half-time show in the final were tedious and disruptive. Football should be allowed to flow freely, on and off the turf.

21J7. Press and play
प्रेस और खेल

- Spain's **second World Cup title**, achieved after a narrow **extra-time victory** over **Argentina** in the **final**, was a triumph of the **collective**.

फाइनल में **अर्जेंटीना** पर **अतिरिक्त समय** में मिली मामूली जीत के साथ हासिल किया गया **स्पेन का दूसरा विश्व कप खिताब**, सामूहिक प्रयास की विजय था।

- The **Luis de la Fuente**-coached outfit conceded just **one goal** in **eight matches**, was unmatched in the centre of the pitch with playmaker and **Golden Ball** winner **Rodri** completing a record **790 passes**, and exhibited diffused excellence up front by having **seven different players** score its **14 goals**.

लुइस डी ला फुएंते के प्रशिक्षित दल ने **आठ मैचों** में केवल **एक गोल** खाया, जबकि मिडफ़ील्ड में **गोल्डन बॉल** विजेता **रोद्री** ने रिकॉर्ड **790 पास** पूरे कर अद्वितीय प्रदर्शन किया, और आक्रमण पंक्ति में **सात अलग-अलग खिलाड़ियों** द्वारा कुल **14 गोल** कर सामूहिक उत्कृष्टता का प्रदर्शन किया।

- So much so that even the individual brilliance of the teenaged **Lamine Yamal** was astutely subsumed within the whole.

यहाँ तक कि किशोर खिलाड़ी **लामिन यामाल** की व्यक्तिगत प्रतिभा भी टीम के सामूहिक प्रदर्शन में सहज रूप से समाहित हो गई।

- Starting **2008**, the country has won **two of the five World Cups** and **three of the five Euros**.

2008 से अब तक इस देश ने **पाँच विश्व कपों में से दो** तथा **पाँच यूरो चैम्पियनशिपों में से तीन** अपने नाम किए हैं।

- Interestingly, after its maiden **World Cup** win in **2010**, Spain had not gone past the **round of 16** at three subsequent editions.

रोचक रूप से, **2010** में अपना पहला **विश्व कप** जीतने के बाद स्पेन अगले तीन संस्करणों में **अंतिम-16 चरण** से आगे नहीं बढ़ पाया था।

- **Kylian Mbappe's** experience was bittersweet; he won the **Golden Boot (10 goals)** and became the **all-time top-scorer in World Cups (22)** but remained a mute spectator as **Spain** subjugated his star-studded **France** in the **semi-final**.

किलियन एम्बाप्पे का अनुभव मिश्रित रहा; उन्होंने **गोल्डन बूट (10 गोल)** जीता और **विश्व कप इतिहास के सर्वाधिक गोल करने वाले खिलाड़ी (22 गोल)** बने, किंतु **सेमीफ़ाइनल** में **स्पेन** द्वारा उनकी सितारों से सजी **फ्रांस** टीम को पराजित करते समय वे असहाय दर्शक बने रहे।

Award	Purpose	Winner (2026)
☐ **Golden Ball**	Best player of the tournament	Rodri (Spain) (FIFA)
☐ **Golden Boot**	Top goalscorer of the tournament	Kylian Mbappé (France) – 10 goals (FIFA)
☐ **Golden Glove**	Best goalkeeper	Unai Simón (Spain) (FIFA)

Award	Purpose	Winner (2026)
Best Young Player Award	Best player under 21 years of age	Pau Cubarsí (Spain) (FIFA)
FIFA Fair Play Trophy	Team with the best disciplinary record and fair play	**Spain** (FIFA)

Khalil al-Hayya, Hamas' negotiator in Gaza talks, named group chief

AFP (FILE PHOTO)

Palestinian group Hamas said on Monday that it had elected Khalil al-Hayya, the group's negotiator in indirect truce talks with Israel, as the head of its political bureau. Hamas's armed wing, the Ezzedine Al-Qassam Brigades, also declared their "full support". Mr. Hayya succeeds Yahya al-Sinwar who was killed by Israel in 2024. AFP

21J7. Khalil al-Hayya, Hamas' negotiator in Gaza talks, named group chief
गाज़ा वार्ता में हमास के वार्ताकार खलील अल-हय्या बने संगठन के प्रमुख

- **Palestinian** group **Hamas** said on **Monday** that it had elected **Khalil al-Hayya**, the group's negotiator in indirect **truce talks** with **Israel**, as the head of its **Political Bureau**.

फ़िलिस्तीनी संगठन **हमास** ने **सोमवार** को घोषणा की कि उसने **इज़राइल** के साथ अप्रत्यक्ष **युद्धविराम वार्ता** में अपने प्रमुख वार्ताकार **खलील अल-हय्या** को संगठन के **राजनीतिक ब्यूरो** का प्रमुख निर्वाचित किया है।

- **Hamas's** armed wing, the **Ezzedine Al-Qassam Brigades**, also declared its **"full support."**

हमास के सशस्त्र संगठन **इज़्ज़ेद्दीन अल-क़स्साम ब्रिगेड्स** ने भी उन्हें अपना **"पूर्ण समर्थन"** देने की घोषणा की।

- **Mr. Hayya** succeeds **Yahya al-Sinwar**, who was killed by **Israel** in **2024**.

श्री खलील अल-हय्या ने **याह्या अल-सिनवार** का स्थान लिया है, जिनकी **2024** में **इज़राइल** द्वारा हत्या कर दी गई थी।

Chess legend Judit Polgar declines post of Hungary President

Agence France-Presse
BUDAPEST

Chess legend Judit Polgar on Monday turned down Hungarian Prime Minister Peter Magyar's offer to join his push to break with the Viktor Orban era as the country's President.

The pro-European conservative had nominated Ms. Polgar, widely considered the greatest woman to have taken to the chequered board, as a figure from outside politics to help carry out his promise of "regime change" from Mr. Orban's hardline 16-year tenure.

"I do not feel I have the strength to take on the historic responsibility of uniting a divided nation, and so I am unable to accept the invitation," Ms. Polgar posted on social media.

"I will do everything in my power to support a new, independent, and respected President of the Republic in achieving these goals," she added.

President Tamas Sulyok was removed by a constitutional amendment last week.

21J7. Chess legend Judit Polgar declines post of Hungary President
शतरंज की दिग्गज जुडित पोलगार ने हंगरी के राष्ट्रपति पद का प्रस्ताव ठुकराया

- **Chess** legend **Judit Polgar** on **Monday** turned down **Hungarian Prime Minister Peter Magyar's** offer to join his effort to end the **Viktor Orbán** era as the country's **President**.

शतरंज की महान खिलाड़ी **जुडित पोलगार** ने **सोमवार** को **हंगरी के प्रधानमंत्री पीटर माज्यार** द्वारा देश की **राष्ट्रपति** बनने का प्रस्ताव अस्वीकार कर दिया। यह प्रस्ताव **विक्टर ओर्बान** के लंबे शासनकाल के बाद नए राजनीतिक दौर की शुरुआत के उद्देश्य से दिया गया था।

TOPICS COVERED	
21J7	Adult unmarried daughter can seek money for education from father: HC वयस्क अविवाहित पुत्री शिक्षा के लिए पिता से आर्थिक सहायता मांग सकती है: उच्च न्यायालय

Adult unmarried daughter can seek money for education from father: HC

GS I: Society: Women Issue

The Hindu Bureau
BENGALURU

Observing that an adult unmarried daughter is entitled to invoke Section 20(d) of the Protection of Women from Domestic Violence Act, 2005, to seek monetary relief from her father for pursuing post-graduation amid her parents' strained relationship, the Karnataka High Court upheld a trial court order directing a man to pay ₹16 lakh towards the annual fee for his daughter's PG medical course.

"The obligations of parents to provide basic amenities, healthcare and education cannot be said to be extinguished upon a child attaining majority. It is the custom and practice everywhere in the world that parents are morally obligated to provide basic amenities, including healthcare and education," the High Court observed.

The father was directed to pay ₹16 lakh towards his daughter's PG medical course fees.

Two orders

Justice H.P. Sandesh passed the order while dismissing a revision petition filed by a 53-year-old man from Mangaluru. He had challenged the orders issued by two trial courts – one directing him to pay ₹16 lakh towards his daughter's fee and another upholding the first order.

The High Court noted that the girl's father and mother were living together when she was pursuing her MBBS course and that it was the father who had paid her fees then. The court said all three now live in the same building, with the mother and daughter on one floor and the father on another owing to the strained relationship between the couple.

The High Court also observed that the father had the financial capacity to meet his daughter's educational expenses.

Citing the Supreme Court's recent judgment, Justice Sandesh said that it had held that a daughter has an "indefeasible, legally enforceable and legitimate right to secure educational expenses from her parents", and parents in conflict could be compelled to provide necessary funds for higher education of the daughter within their financial limit.

21J7. Adult unmarried daughter can seek money for education from father: HC
वयस्क अविवाहित पुत्री शिक्षा के लिए पिता से आर्थिक सहायता मांग सकती है: उच्च न्यायालय

- Observing that an **adult unmarried daughter** is entitled to invoke **Section 20(d)** of the **Protection of Women from Domestic Violence Act, 2005**, to seek **monetary relief** from her **father** for pursuing **post-graduation** amid her parents' strained relationship, the **Karnataka High Court** upheld a **trial court** order directing a man to pay **₹16 lakh** towards the annual fee for his daughter's **PG medical course**.
  यह टिप्पणी करते हुए कि एक **वयस्क अविवाहित पुत्री** अपने माता-पिता के तनावपूर्ण वैवाहिक संबंधों के बीच **स्नातकोत्तर (पोस्ट-ग्रेजुएशन)** की पढ़ाई के लिए अपने **पिता** से **आर्थिक सहायता** प्राप्त करने हेतु **घरेलू हिंसा से महिलाओं का संरक्षण अधिनियम, 2005** की **धारा 20(d)** का सहारा ले सकती है, **कर्नाटक उच्च न्यायालय** ने **निचली अदालत** के उस आदेश को बरकरार रखा, जिसमें पिता को अपनी पुत्री के **स्नातकोत्तर चिकित्सा पाठ्यक्रम** की वार्षिक फीस के रूप में **₹16 लाख** का भुगतान करने का निर्देश दिया गया था।
- "The obligations of **parents** to provide basic amenities, **healthcare** and **education** cannot be said to be extinguished upon a child attaining **majority**.
  उच्च न्यायालय ने कहा, **"माता-पिता** का अपने बच्चों को मूलभूत सुविधाएँ, **स्वास्थ्य सेवा** और **शिक्षा** उपलब्ध कराने का दायित्व केवल बच्चे के **वयस्क** हो जाने से समाप्त नहीं माना जा सकता।

- It is the custom and practice everywhere in the world that **parents** are morally obligated to provide basic amenities, including **healthcare** and **education**," the **High Court** observed.
दुनिया भर में यह सामाजिक परंपरा और व्यवहार है कि **माता-पिता** अपने बच्चों को **स्वास्थ्य सेवा** और **शिक्षा** सहित आवश्यक मूलभूत सुविधाएँ उपलब्ध कराने के नैतिक रूप से उत्तरदायी होते हैं।"

GS Paper 1: Geography	21 July 2026
TOPICS COVERED	
21J7	China, Philippines trade barbs in South China Sea encounter दक्षिण चीन सागर में चीन और फ़िलीपींस के बीच आरोप-प्रत्यारोप
21J7	Ugandans and Tanzanians find fragile refuge in Kenya as repression soars बढ़ते दमन के बीच युगांडा और तंज़ानिया के लोग केन्या में अस्थायी शरण तलाश रहे हैं

China, Philippines trade barbs in South China Sea encounter

GS I Geography

Associated Press
MANILA

The Philippine military on Monday accused China's coast guard of allegedly injuring a Filipino sailor during an incident in the disputed Second Thomas Shoal in the South China Sea.

The military said Chinese coast guard personnel aboard a motorboat repeatedly struck the sailor on the head with a wooden baton, injuring him and damaging his smaller vessel.

China's coast guard responded by claiming that two rubber boats belonging to a Filipino vessel had rammed the Chinese patrol boat. "During the incident, Philippine personnel attacked Chinese law enforcement personnel using oars and long sticks," the Chinese coast guard said in a statement on social media.

The row was just the latest altercation between Chinese and Philippines personnel in disputed waters in the South China Sea, which Beijing claims virtually in its entirety.

21J7. China, Philippines trade barbs in South China Sea encounter
दक्षिण चीन सागर में चीन और फ़िलीपींस के बीच आरोप-प्रत्यारोप

- The **Philippine military** on **Monday** accused **China's Coast Guard** of allegedly injuring a **Filipino sailor** during an incident near the disputed **Second Thomas Shoal** in the **South China Sea**.

फ़िलीपींस की सेना ने **सोमवार** को आरोप लगाया कि **चीन के तटरक्षक बल (China Coast Guard)** ने **दक्षिण चीन सागर** के विवादित **सेकंड थॉमस शोल** के निकट हुई एक घटना में एक **फ़िलीपीन नाविक** को घायल कर दिया।

Feature	South China Sea	East China Sea
Major disputed islands	Spratly, Paracel, Scarborough Shoal, Second Thomas Shoal, Reed Bank	Senkaku (Diaoyu/Diaoyutai) Islands
Number of claimant countries	Six (China, Taiwan, Vietnam, Philippines, Malaysia, Brunei)	Three (Japan, China, Taiwan)
Main issue	Multiple overlapping territorial and maritime claims	Sovereignty over one island group
Strategic importance	Shipping lanes, fisheries, hydrocarbons, military bases	Fisheries, hydrocarbons, strategic naval location
Key legal issue	China's Nine-Dash Line rejected by the 2016 UNCLOS tribunal	Sovereignty dispute remains unresolved

GS Paper II: Polity	21 July 2026
TOPICS COVERED	
21J7	Reclaiming footpaths, taking cities back from cars फुटपाथों को पुनः प्राप्त करना, शहरों को कारों के प्रभुत्व से वापस लेना

Reclaiming footpaths, taking cities back from cars

GS II: Polity

Chandrakant Lahariya

Practising specialist in 'preventive and cardiometabolic medicine' with nearly 18 years of work experience with the World Health Organization and the United Nations system

Few sights are more ordinary in an Indian city than a pedestrian being pushed off a footpath and onto the road. A mother, holding a school bag in one hand and a child in the other, walks around a parked car. An elderly man tests a broken footpath before stepping down onto the road. A wheelchair user gives up before the journey has even begun. A vendor, debris, an open drain, a two-wheeler, and a signboard together form what is still, with bureaucratic optimism, called a pavement. The citizen is then forced to walk on a road designed as though only vehicles possess rights.

Upholding walkability

In June 2026, the Supreme Court of India gave constitutional language to this daily indignity, in *Maniyar Iliyaz @ Shaik Riyaz vs P. Ayyappan* (2026). It held that walking on demarcated footpaths is a fundamental constitutional right, protected under Article 19(1)(d) and Article 21 of the Constitution. It observed that pedestrians have a right to safe footpaths and footways, and directed States and Union Territories to frame policies and guidelines for their provision and maintenance. This is not a minor municipal instruction. It is a public health intervention, a road safety measure, and a democratic test of whether Indian cities are built for people or merely for machines.

The timing could not be more urgent. India is becoming less active precisely when it needs movement the most. Health risk factors and diseases such as diabetes, hypertension, fatty liver disease, and obesity are rising rapidly, as reported by every newly available population health dataset.

Walking and increased physical activity are among the low- and no-cost interventions that can halt and reverse this rise in metabolic diseases. Yet, the World Health Organization (WHO)'s India Physical Activity Profile 2024 estimates that 49.4% of Indian adults do not meet the recommended levels of physical activity; among women, the figure is 57.2%. Among children and adolescents aged 11 to 17 years, it is 74%. WHO recommends at least 150 minutes of moderate-intensity physical activity each week for adults. For most citizens, this does not mean gym memberships or elite fitness routines. It means having the ability to walk safely to a bus stop, school, market, clinic, metro station, or park.

These are not failures of willpower alone; rather, they are exacerbated by the built environment. A city that makes walking difficult quietly prescribes sedentary living. Footpaths, therefore, are not decorative strips of cement added after roads have been designed. They are preventive medicine laid in stone. A usable pavement allows children to walk to school, office-goers to use public transport, older adults to remain mobile, and women to move safely. Walking improves blood pressure, insulin sensitivity, weight control, mood, sleep, and joint function. It is the simplest health habit available to the largest number of citizens. Yet, we in India have made it difficult and dangerous. Many Indians would prefer to use cars and scooters less if cities offered safe, continuous, shaded footpaths.

Safe, accessible footpaths are a test of governance, revealing whether India's cities truly serve their people

The road safety argument is equally compelling. The Union Ministry of Road Transport and Highways (Transport Research Wing) 'Road Accidents in India 2024' report found that two-wheeler riders and pedestrians together accounted for nearly 67% of road fatalities, with 1.28 lakh deaths among these vulnerable groups. The National Crime Records Bureau's 2024 data place the number at more than 1.1 lakh and the share at at least 60%. The exact totals differ across official sources, but the message is unambiguous: pedestrians and two-wheeler riders remain India's most vulnerable road users. Every time a footpath disappears, the road becomes a contest between flesh and metal.

Orderly shared streets

The solution cannot be episodic anti-encroachment drives, in which a few carts and cars are removed before the same disorder returns the following week. Nor can it be a punitive war on street vendors, who are workers with legal protections and legitimate economic claims. The answer lies in planned allocation: footpaths for walking, vending zones for vendors, parking spaces for vehicles, utility corridors for public infrastructure, and meaningful penalties for violations. A humane city organises the street so that livelihoods and mobility can coexist without endangering lives.

Citizens, too, have a role, though not the only one. First, walk deliberately: begin with 10 to 15 minutes after two major meals, or build towards 30 minutes at a fixed time each day. Second, convert short errands into walking errands; distances under one kilometre should not automatically require a scooter or car. Third, combine walking with public transport by using the metro, bus, or shared mobility for part of the commute. Fourth, make walking social: families, resident welfare associations, and workplaces can create walking groups and car-free morning routines. Fifth, reclaim walking as a health check. If breathlessness, knee pain, fear of falling, or unsafe streets prevent walking, treat that as a signal to seek medical advice, improve strength, or demand civic correction. Most importantly, the recent Supreme Court decision has given citizens and resident welfare associations an opportunity to demand their right to walk on encroachment-free footpaths.

Yet, citizens cannot easily walk their way out of poor urban planning. Civic bodies and governments must act with seriousness. Every road project should include continuous, shaded, well-lit, and barrier-free footpaths, along with safe crossings. Footpaths must be wide enough for two people or a wheelchair, with ramps and clear passageways near bus stops. Encroachment control should be continuous, transparent, and fair. Parking on footpaths must invite stringent action, with penalties that change behaviour. Street design should prioritise schools, hospitals, bus stops, markets, and metro stations, where pedestrian volumes are high. Tree cover, benches, public toilets, and lighting are not embellishments; they determine whether women, children, persons with disabilities, and older people can walk.

Policy action

India also needs a national active-mobility mission linking urban development, transport, health, and education. Cities and urban planning should be assessed not by the length of flyovers built, but by the number of safe walking kilometres created. Municipal commissioners should publish ward-level footpath maps and annual audits of encroachment-free footpaths. School zones should have traffic calming measures and protected crossings. Employers should encourage active commuting. Doctors should prescribe walking advice to nudge behaviour, but governments must provide the pavements on which those prescriptions can be followed.

The Supreme Court has moved the footpath from the margins of municipal housekeeping to the centre of constitutional rights. The next task is to move it from judgment to habit, budget, design, and enforcement. A country battling diabetes, hypertension, obesity, stress, and road deaths cannot treat walking as an afterthought. India does not merely need more roads; it needs more rights of way for ordinary citizens. The footpath is where public health, dignity, and democracy meet. We need to take our cities back from cars. We need to rebuild our cities for people. The proportion of encroachment-free footpaths should become a barometer of whether elected governments value citizens' fundamental rights in every ward and on every major road.

21J7. Reclaiming footpaths, taking cities back from cars
फुटपाथों को पुनः प्राप्त करना, शहरों को कारों के प्रभुत्व से वापस लेना

- A **vendor**, **debris**, an **open drain**, a **two-wheeler**, and a **signboard** together form what is still, with bureaucratic optimism, called a **pavement**.
  एक **फेरीवाला**, **मलबा**, **खुली नाली**, एक **दोपहिया वाहन**, तथा एक **साइनबोर्ड** मिलकर उस स्थान का निर्माण करते हैं, जिसे प्रशासनिक आशावाद के साथ अब भी **फुटपाथ** कहा जाता है।

- In **June 2026**, the **Supreme Court of India** gave constitutional language to this daily indignity, in **Maniyar Iliyaz @ Shaik Riyaz vs P. Ayyappan (2026)**.
  जून 2026 में **भारत के सर्वोच्च न्यायालय** ने **Maniyar Iliyaz @ Shaik Riyaz बनाम P. Ayyappan (2026)** मामले में इस दैनिक अपमान को संवैधानिक मान्यता प्रदान की।
- It held that walking on demarcated **footpaths** is a **fundamental constitutional right**, protected under **Article 19(1)(d)** and **Article 21** of the **Constitution**.
  न्यायालय ने कहा कि निर्धारित **फुटपाथों** पर चलना एक **मौलिक संवैधानिक अधिकार** है, जिसे **संविधान** के **अनुच्छेद 19(1)(d)** तथा **अनुच्छेद 21** के अंतर्गत संरक्षण प्राप्त है।

- It observed that **pedestrians** have a right to safe **footpaths** and **footways**, and directed **States** and **Union Territories** to frame policies and guidelines for their provision and maintenance.
  न्यायालय ने यह भी कहा कि **पैदल यात्रियों** को सुरक्षित **फुटपाथों** एवं **पैदल मार्गों** का अधिकार है तथा **राज्यों** एवं **केंद्रशासित प्रदेशों** को इनके निर्माण और रखरखाव के लिए नीतियाँ एवं दिशानिर्देश तैयार करने का निर्देश दिया।
- It is a **public health intervention**, a **road safety measure**, and a democratic test of whether **Indian cities** are built for **people** or merely for **machines**.
  यह एक **सार्वजनिक स्वास्थ्य हस्तक्षेप**, एक **सड़क सुरक्षा उपाय**, तथा इस बात की लोकतांत्रिक परीक्षा है कि **भारतीय शहर लोगों** के लिए बनाए गए हैं या केवल **वाहनों** के लिए।
- Health risk factors and diseases such as **diabetes**, **hypertension**, **fatty liver disease**, and **obesity** are rising rapidly, as reported by every newly available **population health dataset**.
  नवीनतम **जनस्वास्थ्य आँकड़ों** के अनुसार **मधुमेह**, **उच्च रक्तचाप**, **फैटी लिवर रोग**, तथा **मोटापा** जैसे स्वास्थ्य जोखिम और रोग तीव्र गति से बढ़ रहे हैं।
- **Walking** and increased **physical activity** are among the low- and no-cost interventions that can halt and reverse this rise in **metabolic diseases**.
  पैदल चलना तथा **शारीरिक गतिविधि** बढ़ाना कम या बिना लागत वाले ऐसे उपाय हैं, जो **चयापचय संबंधी रोगों** की बढ़ती प्रवृत्ति को रोकने तथा उलटने में सहायक हो सकते हैं।
- Yet, the **World Health Organization (WHO)**'s **India Physical Activity Profile 2024** estimates that **49.4%** of **Indian adults** do not meet the recommended levels of **physical activity**; among **women**, the figure is **57.2%**.
  फिर भी, **विश्व स्वास्थ्य संगठन (WHO)** की **India Physical Activity Profile 2024** के अनुसार **49.4%** **भारतीय वयस्क** अनुशंसित स्तर की **शारीरिक गतिविधि** नहीं करते; **महिलाओं** में यह आँकड़ा **57.2%** है।
- The **Union Ministry of Road Transport and Highways (Transport Research Wing) 'Road Accidents in India 2024'** report found that **two-wheeler riders** and **pedestrians** together accounted for nearly **67%** of **road fatalities**, with **1.28 lakh deaths** among these vulnerable groups.
  सड़क परिवहन एवं राजमार्ग मंत्रालय (परिवहन अनुसंधान प्रकोष्ठ) की **'Road Accidents in India 2024'** रिपोर्ट के अनुसार **दोपहिया वाहन चालकों** और **पैदल यात्रियों** की संयुक्त हिस्सेदारी **सड़क दुर्घटना मृत्यु** के लगभग **67%** मामलों में थी, जिनमें इन संवेदनशील वर्गों के **1.28 लाख लोगों** की मृत्यु हुई।

GS Paper II: Governance	21 July 2026
TOPICS COVERED	
21J7	APAAR: SC to direct CBSE to comply with HC order APAAR: सुप्रीम कोर्ट, CBSE को उच्च न्यायालय के आदेश का पालन करने का निर्देश देगा

APAAR: SC to direct CBSE to comply with HC order

GS II: Governance

Krishnadas Rajagopal
NEW DELHI

The Supreme Court agreed to clarify on Monday that the Central Board of Secondary Education's implementation of the Automated Permanent Academic Account Registry (APAAR) across India must be voluntary as per an Orissa High Court judgment of last year, which had directed a clear "opt-out/refusal option" in the consent form.

A three-judge Bench headed by Chief Justice of India Surya Kant told petitioner-parents led by Abhishek Baxi, represented by senior advocate Indira Jaising and Paras Nath Singh, in open court that it would pass an order requiring the CBSE to comply with an Orissa High Court judgment of December 12, 2025. The High Court judgment in *Rohit Anand Das versus State Of Odisha* had directed the APAAR consent form to "include an opt out/refusal of consent option".

"We will pass an order to the CBSE to give effect to the judgment on a pan-India basis," the Chief Justice said.

21J7. APAAR: SC to direct CBSE to comply with HC order
APAAR: सुप्रीम कोर्ट, CBSE को उच्च न्यायालय के आदेश का पालन करने का निर्देश देगा

- The **Supreme Court** agreed to clarify on Monday that the **Central Board of Secondary Education (CBSE)**'s implementation of the **Automated Permanent Academic Account Registry (APAAR)** across **India** must be **voluntary** as per an **Orissa High Court** judgment of last year, which had directed a clear **"opt-out/refusal option"** in the **consent form**.

सुप्रीम कोर्ट ने सोमवार को यह स्पष्ट करने पर सहमति व्यक्त की कि **केंद्रीय माध्यमिक शिक्षा बोर्ड (CBSE)** द्वारा पूरे **भारत** में **ऑटोमेटेड परमानेंट एकेडमिक अकाउंट रजिस्ट्री (APAAR)** का कार्यान्वयन **स्वैच्छिक** होना चाहिए, जैसा कि पिछले वर्ष **उड़ीसा उच्च न्यायालय** ने अपने निर्णय में कहा था। उच्च न्यायालय ने **सहमति प्रपत्र (Consent Form)** में स्पष्ट **"ऑप्ट-आउट/सहमति से इनकार (Opt-out/Refusal Option)"** का विकल्प शामिल करने का निर्देश दिया था।

Automated Permanent Academic Account Registry (APAAR)

- **APAAR (Automated Permanent Academic Account Registry)** is a **12-digit lifelong digital academic identity** for every student in India under the **"One Nation, One Student ID"** initiative of the **Ministry of Education**.
- It is aligned with the **National Education Policy (NEP) 2020** and the **National Credit and Qualifications Framework (NCrF)**.

Objectives

- Digitally store academic records in one place.
- Enable **seamless transfer** between schools, colleges, and universities.
- Simplify **credit recognition and transfer**.
- Reduce paperwork and improve verification of academic credentials.

- Integrated with **DigiLocker** for secure digital access.
- Linked with the **Academic Bank of Credits (ABC)** to facilitate credit accumulation and transfer in higher education.

Registration Process

1. Student details are verified by the **school/institution**.
2. **Parental consent** is required for minors.
3. Identity is authenticated.
4. The APAAR ID is generated and made available through **DigiLocker**.

Canada-India defence collaboration for a secure future

GS II: IR

Canada is seeing an historic shift for our country – one that opens new opportunities for relations between Canada and India. Speaking at CANSEC 2026, Canada's leading defence, security and emerging technology event, on May 27, 2026, Prime Minister Mark Carney said: "The very nature of war is rapidly evolving, driven by the proliferation of drones, autonomous systems, and weapons in orbit. Conflicts could emerge closer to our borders than before, and new weapons are reducing the distance that separates us from them. The world has changed, and Canada must change with it. That is why, six weeks after forming the government, we announced our ambitious plan to rebuild, rearm, and reinvest in the Canadian Armed Forces."

This is at a time when the world is changing, and Canada-India defence collaboration can translate into a strategy for a secure future.

The good news is that we are already walking on this path. In 2025, Mr. Carney announced that Canada is on track to spend 5% of its GDP on defence by 2035. In March, we already surpassed 2% of the GDP, placing Canada among one of the 10 largest economies in the world.

As Mr. Carney said during his speech in January 2026 at the World Economic Forum's Annual Meeting in Davos, there has been a rupture in the world order. Or as Prime Minister Narendra Modi has said, we are living through a decade of crisis.

Bilateral defence engagement

In this changing world, defence cooperation between Canada and India has become crucial and we have already taken steps to bolster it.

Most recently, we accredited Defence Advisers in both Ottawa and Delhi. Mr. Carney and Mr. Modi agreed to establish a Defence Dialogue to prioritise cooperation on shared interests and align capacities. Canadian and Indian navies participated in the Rim of the Pacific exercises and Talisman Sabre exercises. In June this year, a delegation from India's National Defence College visited Canada. This will allow Indian officers to have direct exchanges with military colleges and bases in Canada.

Chris Cooter
High Commissioner for Canada to India

Shared interests drive Canada and India toward a stronger strategic defence partnership

We have established a national Defence Investment Agency to streamline military procurement. We have also launched a defence Industrial Strategy to diversify supply chains so Canada does not rely on just one country. That is why we are calling on natural partners such as India to participate in co-development, subsystem manufacturing, and sustainment. We are investing in innovation, including through a half billion-dollar investment in next generation aerospace technologies, including a drone innovation hub.

Strategic technology cooperation

Canada's strengths in advanced technologies can complement India's scale, manufacturing capacity, and expanding industrial base. Canada is one of only a few countries with a full-spectrum aerospace sector, while India's domestic aviation industry is the third largest domestic market in the world. Canada is a research and development powerhouse, while India is focused on advancing innovation capacity and high-end manufacturing.

Canada and India are part of a small group of countries with advanced space capabilities. The importance of civilian space cooperation was highlighted in the joint statement between our two Prime Ministers. Canada's strengths in advanced components for satellite technology and space robotics can complement India's strengths in low-cost platforms. Canada's RADARSAT constellation system can have application in meeting India's aim of advancing its naval capacity in the region. Critical minerals are the building block of defence technologies – another area where Canada and India can expand their partnership. Amid the crisis in West Asia, national security and economic security are inextricably linked. Here, a critical partnership between Canada and India can take shape.

Canada has vast geological reserves of 31 critical minerals from cobalt to helium. Canada holds the tenth largest reserves of rare earth elements; the third largest recoverable resources of uranium; and 5% of the world's tungsten reserves. Additionally, Canada is the second largest producer and exporter of uranium globally, with 24% of global production in 2024. Canada has embarked on a strategy to diversify its trusted partners. For India, there is a need for reliable partners such as Canada to reach its own economic and national security goals. The Canada-India memorandum of understanding on Critical Minerals Value Chain, signed during Mr. Carney's visit to India in February-March 2026, laid the groundwork for the integration of stable, resilient supply chains between the two countries.

Building on shared legacy

As we look forward, it is worth recalling our shared history and common sacrifice. Recently, I visited the Kirkee War Cemetery in Pune where members of the Royal Canadian Air Force killed during the Second World War were laid to rest. As I walked through the memorial site, I was reminded that our countries have stood shoulder to shoulder in the past, not just on the battlefield but for common causes and for the shared security of our countries. Let us continue that long-standing tradition as we reshape the defence cooperation between our two countries.

21J7. Canada-India defence collaboration for a secure future
सुरक्षित भविष्य के लिए कनाडा-भारत रक्षा सहयोग

- Speaking at **CANSEC 2026**, **Canada**'s leading **defence**, **security**, and **emerging technology** event, on **May 27, 2026**, **Prime Minister Mark Carney** said: "The very nature of **war** is rapidly evolving, driven by the proliferation of **drones**, **autonomous systems**, and **weapons in orbit**.
  27 मई 2026 को **CANSEC 2026**, जो **कनाडा** का प्रमुख **रक्षा**, **सुरक्षा**, एवं **उभरती प्रौद्योगिकी** सम्मेलन है, में संबोधित करते हुए **प्रधानमंत्री मार्क कार्नी** ने कहा, "**युद्ध** की प्रकृति तीव्र गति से बदल रही है, जिसका कारण **ड्रोन**, **स्वायत्त प्रणालियों**, तथा **अंतरिक्ष में तैनात हथियारों** का तीव्र प्रसार है।"
- **Canadian** and **Indian navies** participated in the **Rim of the Pacific** exercises and **Talisman Sabre** exercises.
  कनाडाई और **भारतीय नौसेनाओं** ने **रिम ऑफ द पैसिफिक (Rim of the Pacific)** तथा **टैलिसमैन सेबर (Talisman Sabre)** सैन्य अभ्यासों में भाग लिया।
- We have also launched a **Defence Industrial Strategy** to diversify **supply chains** so **Canada** does not rely on just one country.
  हमने **आपूर्ति शृंखलाओं** में विविधता लाने के लिए **रक्षा औद्योगिक रणनीति (Defence Industrial Strategy)** भी प्रारंभ की है, ताकि **कनाडा** केवल एक ही देश पर निर्भर न रहे।
- We are investing in **innovation**, including through a **half billion-dollar investment** in **next generation aerospace technologies**, including a **drone innovation hub**.
  हम **नवाचार** में निवेश कर रहे हैं, जिसमें **अगली पीढ़ी की एयरोस्पेस प्रौद्योगिकियों** के लिए **आधा अरब डॉलर का निवेश** तथा एक **ड्रोन नवाचार केंद्र (Drone Innovation Hub)** की स्थापना भी शामिल है।

Strategic technology cooperation
रणनीतिक प्रौद्योगिकी सहयोग

- **Canada** is one of only a few countries with a **full-spectrum aerospace sector**, while **India's** domestic aviation industry is the **third largest domestic market** in the world.
  कनाडा उन कुछ देशों में से एक है, जिनके पास **पूर्ण-विकसित एयरोस्पेस क्षेत्र** है, जबकि **भारत** का घरेलू विमानन उद्योग विश्व का **तीसरा सबसे बड़ा घरेलू बाज़ार** है।
- **Canada** is a **research and development** powerhouse, while **India** is focused on advancing **innovation capacity** and **high-end manufacturing**.
  कनाडा अनुसंधान एवं विकास के क्षेत्र में अग्रणी राष्ट्र है, जबकि **भारत नवाचार क्षमता** तथा **उच्च-स्तरीय विनिर्माण** को आगे बढ़ाने पर केंद्रित है।
- **Canada's RADARSAT constellation system** can have application in meeting **India's** aim of advancing its **naval capacity** in the region.
  कनाडा की RADARSAT उपग्रह प्रणाली क्षेत्र में **भारत** की **नौसैनिक क्षमता** को सुदृढ़ करने के उद्देश्य की पूर्ति में उपयोगी हो सकती है।
- **Critical minerals** are the building block of **defence technologies** — another area where **Canada** and **India** can expand their partnership.
  महत्त्वपूर्ण खनिज (Critical Minerals) रक्षा प्रौद्योगिकियों का आधार हैं—यह एक ऐसा क्षेत्र है जहाँ **कनाडा** और **भारत** अपनी साझेदारी का विस्तार कर सकते हैं।
- **Canada** has vast geological reserves of **31 critical minerals** from **cobalt** to **helium**.
  कनाडा के पास **कोबाल्ट** से लेकर **हीलियम** तक **31 महत्त्वपूर्ण खनिजों** के विशाल भूवैज्ञानिक भंडार हैं।
- **Canada** holds the **tenth largest reserves** of **rare earth elements**; the **third largest recoverable resources** of **uranium**; and **5%** of the world's **tungsten reserves**.
  कनाडा के पास **दुर्लभ मृदा तत्वों** का **दसवाँ सबसे बड़ा भंडार**, **यूरेनियम** के **तीसरे सबसे बड़े पुनर्प्राप्त करने योग्य संसाधन**, तथा विश्व के **टंगस्टन भंडार** का **5%** हिस्सा है।
- Additionally, **Canada** is the **second largest producer and exporter of uranium** globally, with **24% of global production** in **2024**.
  इसके अतिरिक्त, **2024** में **वैश्विक उत्पादन का 24%** योगदान देकर **कनाडा** विश्व का **यूरेनियम का दूसरा सबसे बड़ा उत्पादक और निर्यातक** रहा।
- The **Canada-India Memorandum of Understanding on Critical Minerals Value Chain**, signed during **Mr. Carney's** visit to **India** in **February-March 2026**, laid the groundwork for the integration of stable, resilient **supply chains** between the two countries.
  फरवरी–मार्च 2026 में **श्री कार्नी** की **भारत** यात्रा के दौरान हस्ताक्षरित **कनाडा-भारत महत्त्वपूर्ण खनिज मूल्य शृंखला पर समझौता ज्ञापन** ने दोनों देशों के बीच स्थिर और सुदृढ़ **आपूर्ति शृंखलाओं** के एकीकरण की आधारशिला रखी।

GS Paper III: Economy	21 July 2026
TOPICS COVERED	
21J7	Why inflation is rising in India भारत में मुद्रास्फीति क्यों बढ़ रही है
21J7	India joins WTO's agreement on fisheries subsidies भारत WTO के मत्स्य पालन सब्सिडी समझौते में शामिल हुआ

Why inflation is rising in India

India's recent inflation surge has been mainly driven by higher fuel costs and food price pressures rather than excess demand; food inflation stems largely from supply shocks such as poor monsoons, while rising oil prices have pushed up production costs and manufactured goods inflation

GS III: Economy

ECONOMIC NOTES

Rohit Azad
Indranil Chowdhury

Inflation, except during the COVID-19 pandemic, has remained relatively low in India for over a decade. But it is back with a bang. Wholesale Price Index (WPI) inflation is hovering close to 10% in June **(Chart 1a)**. After remaining low – negative, or close to 0 – until December last year, the climb started with a sharp jump since March this year.

Even those with only a fleeting connection to economics believe that prices rise when demand outpaces supply (overheating), and vice versa. But is that really the case?

Before we go into the causes, let us look at what contributed to this rise in WPI inflation in the first place. The WPI is a weighted average of three sub-categories of commodities: primary articles (food, minerals, etc.), fuel and power and manufactured products. **Chart 1b** shows the contribution of each to total WPI inflation. The latter two – the orange and the red bars – have contributed to this dramatic jump in recent months. Fuel and power prices require little explanation as they are determined by oil prices purchased from abroad and are essentially imported prices. However, primary commodity and manufactured product prices need to be understood.

Structural differences in pricing

The Polish economist Michal Kalecki argued that while primary commodity prices are demand-determined, industrial prices are cost-determined. In other words, inflation of industrial commodities is not determined by a demand and supply mismatch. Come to think of it, this is commonsensical if you leave aside the quintessential demand-supply curves out of your head. After all, prices of cars, cycles, or toothbrushes do not fluctuate with a change in their demand. If more cars are demanded, more are produced and supplied to the customer instead of increasing the price. Prices of tomatoes or mangoes, on the other hand, vary quite significantly with a mismatch between demand and supply.

Viewed this way, the demand and supply curves need to be reconstructed **(Graph 1)**. For primary commodities (panel (a)), supply is virtually fixed, represented by a vertical curve on the quantity axis, whereas demand follows the usual downward sloping curve. A decline in supply (shifting of the supply curve in panel (a) to the left) will increase its prices. In the case of food, for example, a bad monsoon will affect production adversely, thereby decreasing supply and increasing its prices. A good monsoon, on the other hand, will bring the prices down. Inflation here is demand-pull.

For the manufactured commodities (panel (b)), the supply curve is flat, which means a rise or a fall in demand (shifting of the demand curve) will bring about an equivalent supply of such commodities with no change in their prices. Again, the reason is simple. Most such commodities, except in cases of supply constraints, are produced in factories that run below capacity, so an increase in their demand simply increases their production. Demand here, quite opposite to the earlier case, has no role to play in determining their prices. Prices are determined instead by the cost of production. The supply curve is nothing but a profit markup over the cost (the vertical difference between supply and cost is the profit markup). A rise in the costs would push the cost curve up, and, unless the capitalists want to absorb this rise in cost through a lower markup, this would get passed on as higher prices in the market. Inflation here is purely cost-push.

Decoding India's inflation

A look at the main drivers of India's recent inflation and the forces shaping prices across the economy

Chart 1a: Wholesale Price Index (WPI): YoY inflation (%)

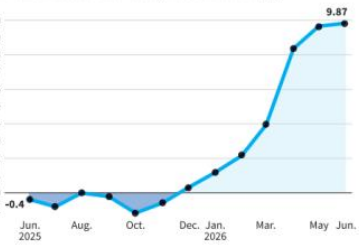
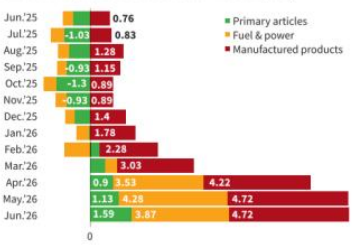
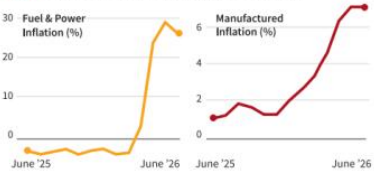


Chart 1b: Weighted contribution to WPI inflation (in %)



Source: Authors' calculations; Office of the Economic Adviser, DPIIT, Ministry of Commerce & Industry, Government of India (WPI, base 2022–23)

Chart 2: Fuel and power and manufactured inflation (%)



Source: Authors' calculations; Office of the Economic Adviser, DPIIT, Ministry of Commerce & Industry, Government of India (WPI, base 2022–23)

Graph 1: Structural differences in pricing

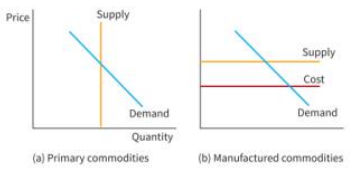
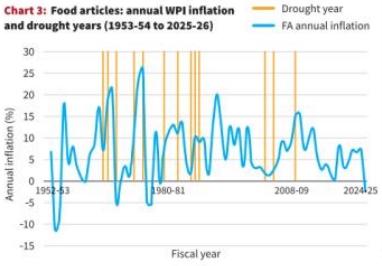


Chart 3: Food articles: annual WPI inflation and drought years (1953-54 to 2025-26)



What happened in the Indian case?

Having seen this difference, let us apply this idea to the inflationary problem currently facing India. If manufactured prices are cost-determined, what do their costs depend on? While wage cost is an important component of total costs, it is usually not the factor that pushes prices up because Indian workers do not really have space to bargain for higher wages. In other words, Indian workers are mostly price-takers; they make do with what they get. It is the material costs instead, which create the inflationary impulse.

One of the most important materials used in the production of any industrial commodity is oil. If we plot the movement of fuel and power against the manufactured prices **(Chart 2)**, we can see almost a one-to-one correspondence between the two. A rise in fuel and power prices raised the manufactured inflation as well.

Food prices, too, have risen. One likely reason is the adverse impact of an inadequate monsoon, as a result of the El Niño effect, on agricultural production this year. **Chart 3** plots data on food price inflation with years in which the country experienced droughts. In every instance, drought conditions were accompanied by a significant rise in food inflation, much in line with the Kaleckian structuralist idea. To be sure, there have been instances in which food price inflation has taken place even in the absence of such supply shocks. These could perhaps be the years of high demand. Suffice to say that a drought is a sufficient, even if not a necessary, condition for food prices to soar.

What is to be done?

Given these structural differences, can something be done to control inflation? Let us start with the food prices. We believe food prices need to be decoupled from the vagaries of nature to the extent possible. That India solely depends on the rain gods to feed its population is in itself quite unscientific and an anachronism in the modern era of technology. The country must invest heavily in agriculture, particularly in irrigation infrastructure, which is not entirely dependent on the monsoon.

As for manufactured goods, controlling fuel and power costs, when crude oil prices are rising, may be difficult, but there are still ways that they can be controlled. Instead of the ill-thought-out inflation targeting framework, the government should apply a countercyclical indirect tax policy to keep fuel and power prices in check. If the government can reduce the customs and excise duties when crude prices soar, the cost at the pump can be controlled. In fact, this is exactly what the government did a few months ago, which is why pump prices were held constant despite soaring crude prices in the international markets. Unfortunately, the government has withdrawn this measure, which is one of the primary reasons WPI inflation has risen sharply.

(The authors are a part of the DevMac (Development Macroeconomics) network, which seeks pluralism in Economics)

THE GIST

- Manufactured goods prices are determined largely by production costs, while primary commodity prices respond more to changes in demand and supply.
- Higher global crude oil prices have raised fuel costs, which in turn have pushed up inflation in manufactured goods.
- Food inflation has been exacerbated by an inadequate monsoon, underscoring the need for greater investment in irrigation and measures to cushion fuel price shocks.

21J7. Why inflation is rising in India
भारत में मुद्रास्फीति क्यों बढ़ रही है

- Even those with only a fleeting connection to **economics** believe that **prices** rise when **demand** outpaces **supply** (**overheating**), and vice versa.

अर्थशास्त्र की सामान्य जानकारी रखने वाले लोग भी यह मानते हैं कि जब **मांग**, **आपूर्ति** से अधिक हो जाती है (**अतिउत्साह/Overheating**), तब **कीमतें** बढ़ती हैं और इसके विपरीत स्थिति में घटती हैं।

- The **WPI** is a weighted average of three sub-categories of commodities: **primary articles** (**food**, **minerals**, etc.), **fuel and power**, and **manufactured products**.
  WPI वस्तुओं की तीन उप-श्रेणियों—**प्राथमिक वस्तुएँ** (**खाद्य पदार्थ**, **खनिज** आदि), **ईंधन एवं ऊर्जा**, तथा **विनिर्मित उत्पादों**—का भारित औसत है।
- **Fuel and power** prices require little explanation as they are determined by **oil prices** purchased from abroad and are essentially **imported prices**.
  ईंधन एवं ऊर्जा की कीमतों को अलग से समझाने की आवश्यकता नहीं है, क्योंकि वे विदेशों से खरीदे जाने वाले **तेल के मूल्यों** पर आधारित होती हैं और मूलतः **आयातित कीमतें** होती हैं।

- The **Polish economist Michal Kalecki** argued that while **primary commodity prices** are **demand-determined**, **industrial prices** are **cost-determined**.
  पोलैंड के अर्थशास्त्री मिशाल कालेकी का तर्क था कि जहाँ **प्राथमिक वस्तुओं की कीमतें मांग-निर्धारित** होती हैं, वहीं **औद्योगिक वस्तुओं की कीमतें लागत-निर्धारित** होती हैं।
- In other words, **inflation** of **industrial commodities** is not determined by a **demand** and **supply** mismatch.
  अर्थात् **औद्योगिक वस्तुओं** की **मुद्रास्फीति** का निर्धारण **मांग** और **आपूर्ति** के असंतुलन से नहीं होता।
- For **primary commodities** (panel (a)), **supply** is virtually fixed, represented by a vertical curve on the quantity axis, whereas **demand** follows the usual downward sloping curve.
  प्राथमिक वस्तुओं (पैनल (a)) के मामले में **आपूर्ति** लगभग स्थिर होती है, जिसे मात्रा-अक्ष पर एक ऊर्ध्वाधर वक्र द्वारा दर्शाया जाता है, जबकि **मांग** सामान्य रूप से नीचे की ओर ढलान वाले वक्र का अनुसरण करती है।
- A decline in **supply** (shifting of the supply curve in panel (a) to the left) will increase its **prices**.
  आपूर्ति में कमी (अर्थात् पैनल (a) में आपूर्ति वक्र का बाईं ओर खिसकना) **कीमतों** में वृद्धि करेगी।
- In the case of **food**, for example, a bad **monsoon** will affect production adversely, thereby decreasing **supply** and increasing its **prices**.
  उदाहरण के लिए **खाद्य पदार्थों** के मामले में कमजोर **मानसून** उत्पादन को प्रभावित करेगा, जिससे **आपूर्ति** घटेगी और **कीमतें** बढ़ेंगी।
- A good **monsoon**, on the other hand, will bring the **prices** down.
  इसके विपरीत, अच्छा **मानसून कीमतों** को कम करेगा।
- **Inflation** here is **demand-pull**.
  इस स्थिति में **मुद्रास्फीति मांग-प्रेरित (Demand-Pull)** होती है।
- For the **manufactured commodities** (panel (b)), the **supply curve** is flat, which means a rise or a fall in **demand** (shifting of the demand curve) will bring about an equivalent **supply** of such commodities with no change in their **prices**.
  विनिर्मित वस्तुओं (पैनल (b)) के मामले में **आपूर्ति वक्र** समतल होता है, जिसका अर्थ है कि **मांग** में वृद्धि या कमी होने पर उसी अनुपात में **आपूर्ति** बढ़ या घट जाती है, जबकि **कीमतों** में कोई परिवर्तन नहीं होता।
- Again, the reason is simple.
  इसके पीछे का कारण भी सरल है।
- Most such commodities, except in cases of **supply constraints**, are produced in **factories** that run below **capacity**, so an increase in their **demand** simply increases their **production**.
  ऐसी अधिकांश वस्तुएँ, **आपूर्ति संबंधी बाधाओं** को छोड़कर, उन **कारखानों** में निर्मित होती हैं जो अपनी पूर्ण **क्षमता** से कम पर कार्य करते हैं। इसलिए उनकी **मांग** बढ़ने पर केवल **उत्पादन** बढ़ जाता है।
- **Prices** are determined instead by the **cost of production**.
  यहाँ **कीमतों** का निर्धारण **उत्पादन लागत** द्वारा होता है।
- The **supply curve** is nothing but a **profit markup** over the **cost** (the vertical difference between supply and cost is the **profit markup**).

आपूर्ति वक्र वास्तव में **लागत** पर जोड़े गए **लाभ मार्जिन (Profit Markup)** का प्रतिनिधित्व करता है (आपूर्ति और लागत के बीच का ऊर्ध्वाधर अंतर ही **लाभ मार्जिन** होता है)।

- A rise in the **costs** would push the **cost curve** up, and, unless the **capitalists** want to absorb this rise in cost through a lower **markup**, this would get passed on as higher **prices** in the market.
  यदि **लागत** बढ़ती है, तो **लागत वक्र** ऊपर की ओर खिसक जाएगा। जब तक **पूँजीपति** कम **लाभ मार्जिन** स्वीकार करके इस अतिरिक्त लागत को स्वयं वहन न करें, तब तक यह वृद्धि बाज़ार में अधिक **कीमतों** के रूप में उपभोक्ताओं पर स्थानांतरित हो जाएगी।
- **Inflation** here is purely **cost-push**.
  इस स्थिति में **मुद्रास्फीति** पूर्णतः **लागत-प्रेरित (Cost-Push)** होती है।

What happened in the Indian case?
भारतीय परिप्रेक्ष्य में क्या हुआ?

- If **manufactured prices** are **cost-determined**, what do their costs depend on?
  यदि **विनिर्मित वस्तुओं की कीमतें लागत-निर्धारित** हैं, तो उनकी लागत किन कारकों पर निर्भर करती है?
- While **wage cost** is an important component of total costs, it is usually not the factor that pushes prices up because **Indian workers** do not really have space to bargain for higher wages.
  यद्यपि **मजदूरी लागत** कुल लागत का एक महत्त्वपूर्ण घटक है, फिर भी सामान्यतः यही कीमतों में वृद्धि का प्रमुख कारण नहीं होती, क्योंकि **भारतीय श्रमिकों** के पास अधिक वेतन के लिए प्रभावी सौदेबाज़ी की पर्याप्त गुंजाइश नहीं होती।
- It is the **material costs** instead, which create the **inflationary impulse**.
  इसके विपरीत, **कच्चे माल की लागत** ही **मुद्रास्फीति की प्रवृत्ति** को उत्पन्न करती है।
- One of the most important materials used in the production of any industrial commodity is **oil**.
  किसी भी औद्योगिक वस्तु के उत्पादन में प्रयुक्त सबसे महत्त्वपूर्ण कच्चे माल में से एक **तेल** है।
- If we plot the movement of **fuel and power** against the **manufactured prices (Chart 2)**, we can see almost a **one-to-one correspondence** between the two.
  यदि हम **ईंधन एवं ऊर्जा** की कीमतों की तुलना **विनिर्मित वस्तुओं की कीमतों (चार्ट 2)** से करें, तो दोनों के बीच लगभग **प्रत्यक्ष समानता** दिखाई देती है।
- A rise in **fuel and power prices** raised the **manufactured inflation** as well.
  ईंधन एवं ऊर्जा की कीमतों में वृद्धि ने **विनिर्माण क्षेत्र की मुद्रास्फीति** को भी बढ़ा दिया।
- In every instance, **drought conditions** were accompanied by a significant rise in **food inflation**, much in line with the **Kaleckian structuralist** idea.
  प्रत्येक अवसर पर **सूखे की परिस्थितियों** के साथ **खाद्य मुद्रास्फीति** में उल्लेखनीय वृद्धि देखी गई, जो **कालेकीयन संरचनावादी** दृष्टिकोण के अनुरूप है।
- We believe **food prices** need to be **decoupled** from the vagaries of **nature** to the extent possible.
  हमारा मानना है कि **खाद्य कीमतों** को जहाँ तक संभव हो, **प्राकृतिक परिस्थितियों** की अनिश्चितताओं से **अलग** किया जाना चाहिए।
- That **India** solely depends on the **rain gods** to feed its population is in itself quite **unscientific** and an **anachronism** in the modern era of technology.
  यह तथ्य कि **भारत** अपनी जनसंख्या का भरण-पोषण करने के लिए पूरी तरह **मानसून** पर निर्भर है, आधुनिक प्रौद्योगिकी के युग में स्वयं में **अवैज्ञानिक** तथा **कालबाह्य** है।
- The country must invest heavily in **agriculture**, particularly in **irrigation infrastructure**, which is not entirely dependent on the **monsoon**.
  देश को **कृषि** में, विशेष रूप से **सिंचाई अवसंरचना** में, बड़े पैमाने पर निवेश करना चाहिए, जो पूरी तरह **मानसून** पर निर्भर न हो।

- Instead of the ill-thought-out **inflation targeting framework**, the government should apply a **countercyclical indirect tax policy** to keep **fuel and power prices** in check.
  अपर्याप्त रूप से विचारित **मुद्रास्फीति लक्ष्यीकरण ढाँचे** के स्थान पर सरकार को **प्रति-चक्रात्मक अप्रत्यक्ष कर नीति** अपनानी चाहिए, ताकि **ईंधन एवं ऊर्जा की कीमतों** को नियंत्रित रखा जा सके।
- If the government can reduce the **customs** and **excise duties** when **crude prices** soar, the **cost at the pump** can be controlled.
  यदि **कच्चे तेल की कीमतों** में वृद्धि होने पर सरकार **सीमा शुल्क** और **उत्पाद शुल्क** में कमी करे, तो **पेट्रोल पंप पर उपभोक्ता मूल्य** को नियंत्रित किया जा सकता है।

GS III: Economy

India joins WTO's agreement on fisheries subsidies

India on Monday announced it had joined the WTO's agreement on fisheries subsidies, which prohibits government support to illegal fishing activities and over-exploitation of stocks. The agreement focuses on subsidies related to marine wild capture fishing and fishing-related activities at sea. It was adopted by consensus at the 12th WTO Ministerial Conference in Geneva in 2022 and the first multilateral WTO agreement with an environmental sustainability objective. PTI

21J7. India joins WTO's agreement on fisheries subsidies

भारत WTO के मत्स्य पालन सब्सिडी समझौते में शामिल हुआ

- **India** on **Monday** announced that it had joined the **World Trade Organization (WTO)** agreement on **fisheries subsidies**, which prohibits **government support** to **illegal fishing activities** and the **over-exploitation of fish stocks**.
  भारत ने **सोमवार** को घोषणा की कि वह **विश्व व्यापार संगठन (WTO)** के **मत्स्य पालन सब्सिडी समझौते** में शामिल हो गया है, जो **अवैध मत्स्य पालन गतिविधियों** तथा **मत्स्य संसाधनों के अत्यधिक दोहन** के लिए **सरकारी सहायता** पर प्रतिबंध लगाता है।
- The agreement focuses on **subsidies** related to **marine wild capture fishing** and **fishing-related activities at sea**.
  यह समझौता **समुद्री जंगली मत्स्य पकड़ने (Marine Wild Capture Fishing)** तथा **समुद्र में मत्स्य पालन से संबंधित गतिविधियों** के लिए दी जाने वाली **सब्सिडी** पर केंद्रित है।
- It was adopted by **consensus** at the **12th WTO Ministerial Conference** in **Geneva** in **2022** and is the **first multilateral WTO agreement** with an **environmental sustainability** objective.
  इसे **2022** में **जिनेवा** में आयोजित **WTO के 12वें मंत्रिस्तरीय सम्मेलन** में **सर्वसम्मति** से अपनाया गया था तथा यह **पर्यावरणीय स्थिरता** के उद्देश्य वाला **WTO का पहला बहुपक्षीय समझौता** है।

GS Paper III: Science and Technology	21 July 2026
TOPICS COVERED	
21J7	Bengaluru to host India-U.S. space group meet in August बेंगलुरु अगस्त में भारत-अमेरिका अंतरिक्ष समूह की बैठक की मेज़बानी करेगा
21J7	India approves first dengue vaccine for persons aged 4–60 भारत ने 4 से 60 वर्ष आयु वर्ग के लिए पहली डेंगू वैक्सीन को मंजूरी दी
21J7	Quiz
21J7	How magnetic levitation lifts and propels high-speed maglev trains चुंबकीय उत्तोलन उच्च गति वाली मैग्लेव ट्रेनों को कैसे ऊपर उठाता और आगे बढ़ाता है
21J7	IndiGo to order 1,000 engines from CFM International इंडिगो CFM इंटरनेशनल से 1,000 इंजन खरीदेगी
21J7	Natco Pharma gets U.S. FDA nod for generic cancer drug नैटको फार्मा को जेनेरिक कैंसर दवा के लिए अमेरिकी FDA की मंजूरी

Bengaluru to host India-U.S. space group meet in August

GS III: S&T

BENGALURU

The next meeting of India-U.S. Civil Space Joint Working Group (CSJWG) will be held in Bengaluru in August.

Eric Atkins, Public Diplomacy Officer, U.S. Consulate General, said on Monday that the CSJWG experts from the U.S. and India would hold bilateral talks at the meetings.

"The very next collaboration on the calendar is the next meeting of the CSJWG, which is being held here in Bengaluru. A bilateral meeting of experts from the U.S. and India will be held in the first week of August," he said.

Experts from the two countries will hold bilateral talks, says U.S. Public Diplomacy Officer

The CSJWG was established in 2005 and over the years, officials from the Indian Space Research Organisation (ISRO) and experts from other Indian government agencies have held discussions with the NASA and the U.S. government agencies.

The two countries have had a strong bilateral cooperation in space and collaborated on various space programmes, including the NASA-ISRO Synthetic Aperture Radar (NISAR) mission which was launched in 2025.

Meanwhile, Swati Mohan, space scientist and project manager for AstroNav at NASA Jet Propulsion Laboratory who is on a visit to Bengaluru, during an interaction with media, highlighted the achievements of the Mars 2020 Perseverance Rover.

"The Perseverace Rover has had a phenomenal run, its prime mission was designed for about three Earth years which it has exceeded... Its primary objective is to collect samples that could hold the science of past life on Mars, and it has done that successfully," Dr. Mohan said.

21J7. Bengaluru to host India-U.S. space group meet in August
बेंगलुरु अगस्त में भारत-अमेरिका अंतरिक्ष समूह की बैठक की मेज़बानी करेगा

- The next meeting of the **India-U.S. Civil Space Joint Working Group (CSJWG)** will be held in **Bengaluru** in **August**.

भारत-अमेरिका सिविल स्पेस संयुक्त कार्य समूह (ICSJWG) की अगली बैठक **अगस्त** में **बेंगलुरु** में आयोजित की जाएगी।

- The **CSJWG** was established in **2005** and over the years, officials from the **Indian Space Research Organisation (ISRO)** and experts from other **Indian government agencies** have held discussions with **NASA** and **U.S. government agencies**.

CSJWG की स्थापना **2005** में हुई थी और तब से **भारतीय अंतरिक्ष अनुसंधान संगठन (ISRO)** के अधिकारियों तथा अन्य **भारतीय सरकारी एजेंसियों** के विशेषज्ञों ने **नासा (NASA)** और **अमेरिकी सरकारी एजेंसियों** के साथ नियमित चर्चा की है।

- The two countries have had a strong **bilateral cooperation** in **space** and collaborated on various **space programmes**, including the **NASA-ISRO Synthetic Aperture Radar (NISAR)** mission which was launched in **2025**.

दोनों देशों के बीच **अंतरिक्ष क्षेत्र** में मजबूत **द्विपक्षीय सहयोग** रहा है और उन्होंने अनेक **अंतरिक्ष कार्यक्रमों** पर मिलकर कार्य किया है, जिनमें **नासा-इसरो सिंथेटिक एपर्चर रडार (NISAR)** मिशन भी शामिल है, जिसे **2025** में प्रक्षेपित किया गया था।

- Meanwhile, **Swati Mohan**, **space scientist** and **Project Manager for AstroNav** at **NASA Jet Propulsion Laboratory**, who is on a visit to **Bengaluru**, highlighted the achievements of the **Mars 2020 Perseverance Rover** during an interaction with the media.

इस बीच, **नासा जेट प्रोपल्शन लेबोरेटरी** में **एस्ट्रोनैव (AstroNav) परियोजना प्रबंधक** एवं **अंतरिक्ष वैज्ञानिक स्वाति मोहन**, जो **बेंगलुरु** के दौरे पर हैं, ने मीडिया से बातचीत के दौरान **मार्स 2020 पर्सिवियरेंस रोवर** की उपलब्धियों पर प्रकाश डाला।

- "The **Perseverance Rover** has had a phenomenal run, its **prime mission** was designed for about **three Earth years**, which it has exceeded..."

डॉ. मोहन ने कहा, "**पर्सिवियरेंस रोवर** ने असाधारण प्रदर्शन किया है। इसका **प्राथमिक मिशन** लगभग **तीन पृथ्वी वर्षों** के लिए निर्धारित किया गया था, जिसे यह पहले ही पार कर चुका है..."

- "Its primary objective is to collect samples that could hold the science of **past life on Mars**, and it has done that successfully," **Dr. Mohan** said.

डॉ. मोहन ने कहा, "इसका मुख्य उद्देश्य ऐसे नमूने एकत्र करना है, जिनसे **मंगल ग्रह पर अतीत में जीवन** के वैज्ञानिक प्रमाण मिल सकते हैं, और इस उद्देश्य को इसने सफलतापूर्वक पूरा किया है।"

India approves first dengue vaccine for persons aged 4-60

GS III: S&T

The Hindu Bureau
CHENNAI

The Drug Controller General of India (DCGI) has granted market authorisation to Takeda Biopharmaceuticals India's QDENGA (TAK-003), making it the first dengue vaccine to be approved in the country, according to a press release from the company.

The vaccine has been approved for the prevention of dengue in individuals aged four to 60. QDENGA is a live-attenuated tetravalent vaccine designed to provide protection against all four dengue virus serotypes and is administered as a two-dose regimen, with doses given three months apart.

According to the company, the vaccine can be administered irrespective of whether an individual has had a previous dengue infection, and does not require pre-vaccination screening.

The approval comes as dengue continues to pose a significant public health challenge in India, where reported cases have increased nearly 11-fold over the past two decades. India accounts for nearly one-third of the global dengue burden, although modelling studies suggest the actual number of infections is substantially higher than reported.


India accounts for one-third of the global dengue burden.

Clinical trials

The approval is based on Takeda's global clinical development programme comprising 19 Phase I, II and III clinical trials involving over 28,000 participants in dengue-endemic and non-endemic regions.

The company's pivotal Phase III trial enrolled more than 20,000 participants across eight dengue-endemic countries.

According to Takeda, the vaccine demonstrated an efficacy of 80.2% against virologically confirmed dengue 12 months after the second dose, and 90.4% efficacy against dengue-related hospitalisation at 18 months.

The approval in India was also supported by a Phase III clinical trial conducted among participants aged 4 to 60 years. The company said the study found the vaccine to be safe, well tolerated and immunogenic in children, adolescents and adults.

Takeda said QDENGA has been approved in 43 countries across Asia, Latin America and Europe, with more than 32 million doses distributed through public and private immunisation programmes.

21J7. India approves first dengue vaccine for persons aged 4–60
भारत ने 4 से 60 वर्ष आयु वर्ग के लिए पहली डेंगू वैक्सीन को मंजूरी दी

- The **Drug Controller General of India (DCGI)** has granted **market authorisation** to **Takeda Biopharmaceuticals India's QDENGA (TAK-003)**, making it the **first dengue vaccine** to be approved in the country, according to a **press release** from the company.
भारतीय औषधि महानियंत्रक (DCGI) ने **टाकेडा बायोफार्मास्यूटिकल्स इंडिया** की **QDENGA (TAK-003)** को **बाज़ार में उपयोग की अनुमति (Market Authorisation)** प्रदान कर दी है। कंपनी की **प्रेस विज्ञप्ति** के अनुसार, यह **भारत में स्वीकृत पहली डेंगू वैक्सीन** बन गई है।
- The **vaccine** has been approved for the prevention of **dengue** in individuals aged **4 to 60 years**.
इस **वैक्सीन** को **4 से 60 वर्ष** आयु के व्यक्तियों में **डेंगू** की रोकथाम के लिए मंजूरी दी गई है।
- **QDENGA** is a **live-attenuated tetravalent vaccine** designed to provide protection against all **four dengue virus serotypes** and is administered as a **two-dose regimen**, with doses given **three months apart**.
QDENGA एक **जीवित-क्षीणित चतुर्संयोजी (Live-Attenuated Tetravalent) वैक्सीन** है, जिसे **डेंगू वायरस के सभी चार सीरोटाइप** से सुरक्षा प्रदान करने के लिए विकसित किया गया है। इसे **दो खुराकों** के रूप में दिया जाता है, जिनके बीच **तीन महीने** का अंतर होता है।
- According to the company, the **vaccine** can be administered irrespective of whether an individual has had a previous **dengue infection**, and does not require **pre-vaccination screening**.
कंपनी के अनुसार, यह **वैक्सीन** इस बात की परवाह किए बिना दी जा सकती है कि व्यक्ति को पहले **डेंगू संक्रमण** हुआ है या नहीं, तथा इसके लिए **टीकाकरण-पूर्व जाँच (Pre-vaccination Screening)** की आवश्यकता नहीं होती।
- **India** accounts for nearly **one-third** of the global **dengue burden**, although **modelling studies** suggest the actual number of infections is substantially higher than reported.
भारत विश्व के कुल **डेंगू भार** का लगभग **एक-तिहाई** हिस्सा वहन करता है, यद्यपि **मॉडलिंग अध्ययनों** से संकेत मिलता है कि वास्तविक संक्रमणों की संख्या दर्ज मामलों की तुलना में कहीं अधिक है।
- **Takeda** said **QDENGA** has been approved in **43 countries** across **Asia**, **Latin America** and **Europe**, with more than **32 million doses** distributed through **public** and **private immunisation programmes**.
टाकेडा ने बताया कि **QDENGA** को **एशिया**, **लैटिन अमेरिका** और **यूरोप** के **43 देशों** में मंजूरी मिल चुकी है तथा **सार्वजनिक** और **निजी टीकाकरण कार्यक्रमों** के माध्यम से इसकी **3.2 करोड़ (32 मिलियन) से अधिक खुराकें** वितरित की जा चुकी हैं।

QUESTION 5

Z difluoride is incredibly hard to study and highly radioactive. Yet it's special because it demonstrates that even Z, a noble gas scientists once thought to be chemically inert, can form chemical compounds — albeit with fluorine and its unmatched reactivity. Z difluoride has no commercial applications because, again, Z is so radioactive. Name Z.

Answers to July 7 quiz:

1. Process that combines nitrogen, oxygen to form ammonia – **Ans: Haber process**
2. Tech that works by maintaining a group of more excited atoms – **Ans: Laser**
3. Acid in blood that participates in regulating blood pH – **Ans: Carbonic acid**
4. Equilibrium that holds a star together against nuclear fusion, etc. – **Ans: Hydrostatic**
5. Process that turns inert nitrogen into a bioavailable form – **Ans: Fixation**

Visual: Calvin cycle

First contact: K.N. Viswanathan | Tamal Biswas | Prem Nath Tiwari | Anmol Agrawal | Faisal Khan

21J7. Quiz

Radon (Rn)

- **Z** is **Radon (Rn)**, the only naturally occurring **radioactive noble gas** that is known to form the compound **radon difluoride (RnF_2)**.
- Noble gases were once considered completely **chemically inert** because they possess a **fully filled valence shell**.
- However, later discoveries showed that heavier noble gases such as **xenon, krypton, and radon** can react with highly electronegative **fluorine** under suitable conditions.
- **Radon difluoride (RnF_2)** is extremely difficult to study because **radon is highly radioactive**. The most stable isotope, **Radon-222**, has a half-life of only about **3.82 days**, causing the compound to decompose rapidly.
- Because of its intense radioactivity, **RnF_2 has no commercial or industrial applications** and is investigated only in specialised nuclear chemistry laboratories.

1. Haber Process

- The **Haber Process** is the industrial method used to manufacture **ammonia (NH_3)** from **nitrogen (N_2)** and **hydrogen (H_2)**.
- The reaction is:
  $N_2 + 3H_2 \rightleftharpoons 2NH_3$
- It is carried out at about **400–500°C**, **150–300 atmospheres pressure**, using a finely divided **iron catalyst** with promoters such as **K_2O** and **Al_2O_3**.
- Developed by **Fritz Haber** and industrialised by **Carl Bosch**, the process revolutionised agriculture by enabling large-scale production of **nitrogen fertilisers**.

2. Laser

- **LASER** stands for **Light Amplification by Stimulated Emission of Radiation**.
- A laser works by creating a **population inversion**, where more atoms remain in an excited state than in the ground state.
- Stimulated emission causes identical photons to be emitted, producing a beam that is **coherent, monochromatic, highly directional, and intense**.
- Lasers are widely used in **medicine (eye surgery)**, **optical fibre communication**, **barcode scanners**, **industrial cutting and welding**, **scientific research**, and **defence**.
- The first working laser was developed by **Theodore H. Maiman** in **1960** using a synthetic ruby crystal.

3. Carbonic Acid

- **Carbonic acid (H_2CO_3)** is formed when **carbon dioxide (CO_2)** dissolves in water inside the body.
- It plays a central role in maintaining the **acid-base balance (blood pH)** through the **bicarbonate buffer system**.
- The equilibrium is:
  $CO_2 + H_2O \rightleftharpoons H_2CO_3 \rightleftharpoons H^+ + HCO_3^-$
- This reversible reaction allows the body to regulate blood pH close to **7.35–7.45**.
- The enzyme **carbonic anhydrase**, present in red blood cells, greatly accelerates this reaction.

- Proper regulation of carbonic acid is essential for normal respiration and metabolic functioning.

4. Hydrostatic Equilibrium

- **Hydrostatic equilibrium** is the condition in which the inward pull of **gravity** is exactly balanced by the outward pressure produced by **hot gases** generated through **nuclear fusion** inside a star.
- This balance allows stars such as the **Sun** to maintain a stable size and shape for billions of years.
- If gravity dominates, the star contracts; if internal pressure dominates, it expands.
- Hydrostatic equilibrium governs every stage of **stellar evolution**, from the main-sequence phase to red giants and eventually white dwarfs, neutron stars, or black holes depending on stellar mass.

5. Nitrogen Fixation

- **Nitrogen fixation** is the process by which atmospheric **nitrogen gas (N_2)** is converted into biologically usable compounds such as **ammonia (NH_3)** or **ammonium (NH_4^+)**.
- Biological nitrogen fixation is mainly carried out by bacteria such as **Rhizobium**, **Azotobacter**, and **cyanobacteria** using the enzyme **nitrogenase**.
- Nitrogen can also be fixed naturally by **lightning** and industrially through the **Haber Process**.
- Nitrogen fixation is an essential step in the **nitrogen cycle**, supporting plant growth, crop productivity, ecosystem functioning, and global food security.

Visual: Calvin Cycle

- The **Calvin Cycle**, also known as the **Calvin–Benson Cycle**, is the **light-independent stage of photosynthesis**.
- It occurs in the **stroma of chloroplasts**, where **carbon dioxide (CO_2)** is converted into carbohydrates using **ATP** and **NADPH** produced during the light reactions.
- The enzyme **RuBisCO** catalyses the fixation of CO_2 to **ribulose-1,5-bisphosphate (RuBP)**.
- The cycle consists of **three stages**: **carbon fixation**, **reduction**, and **regeneration of RuBP**.
- The Calvin Cycle forms the biochemical basis for food production in plants and ultimately sustains nearly all life on Earth.

How magnetic levitation lifts and propels high-speed maglev trains

Maglev trains use powerful magnetic fields to move above the track without wheels, eliminating rolling friction, enabling speeds of over 400 km/hr; however, the technology requires dedicated guideways with precision engineering, making construction and operation expensive

GS III: S&T

Vasudevan Mukunth

'Maglev' is a portmanteau of 'magnetic levitation'. Instead of running on wheels, maglev technology uses strong magnetic fields to lift the train and move it forward. Since the train floats above the track, there is no rolling friction during normal operations, nor are operations affected by inclement weather, like rain or snow. The result: the train can move at extremely high speed, topping 400 km/hr, while also giving passengers a smooth ride.

How is a train lifted?

Nature has four fundamental forces: the two nuclear forces, the electromagnetic force, and gravity. Of them, gravity is the weakest by far – around 1039 times weaker than the electromagnetic force. This is why a small magnet can stay stuck to your fridge despite having the entire gravitational force of the earth pulling it down. The same idea applies to lifting a train weighing somewhere from 150 to 500 tonnes.

Engineers get the train to float above the tracks using electromagnetic suspension (EMS). The train has two 'arms' that wrap around the guideway over which it runs. Strong electromagnets on these arms point magnetic fields up towards the protruding parts of the guideway. Say you are lifting a bag with your hand. Your fingers wrap around the bag's strap. The train's arms do something like this – they wrap only just halfway, and from the bottom part, i.e., where the tip of your finger would be, exert a magnetic field into the underside of the strap. When these electromagnets are turned on, they exert a magnetic field that attracts them towards the guideway, i.e., your fingers would be attracted towards the strap. As a result, the train is pushed upwards. The train is fit with sensors that help it float around 10 mm above the guideway at all times.

In a closely related technology called electrodynamic suspension (EDS), there are superconducting magnets on the train that are cooled to a very low temperature. When the train moves, the magnets that move with it induce an electric current in coils built into the sides of the tracks. (The phenomenon is called electromagnetic induction.) The result is a repulsive force that pushes the train up. Since the magnets have to move to induce the current, the train often needs to be travelling at around 100 km/hr before the effect can kick in, and until then it uses wheels. The train also hovers higher above the track, at around 100 mm.

But in exchange for requiring wheels, EDS can support higher speeds. EMS systems operate at around or under 500 km/hr whereas the SCMAGLEV EDS system in Japan achieved 603 km/hr during testing in 2015.

How does the train move forward?

The walls of the guideway are lined with coils that carry an alternating current (AC). This current creates a magnetic field that constantly shifts its poles (north to south) along the track. The magnets on the train are attracted to the 'opposite' pole ahead and repelled by the 'like' pole behind. As a result, the train is simultaneously pulled forward from the front and pushed forward from the back. And to make the train go faster, engineers just need to increase the frequency of the AC.

Similarly, the current is used to switch the direction of the magnetic field to slow the train or altogether stop it. This process may also use regenerative braking to divert the energy 'saved' by braking to the electric grid.

If a fast-moving maglev train starts to drift, there are magnets on the sides that repel/attract accordingly to ensure it stays centered. For emergencies or when the magnetic braking fails, the system is also fit with friction brakes. They come in two forms, although there are other technologies as well. One: the maglev train is also fit with 'regular' auxiliary wheels, and these wheels have a braking system akin to those in other trains and cars. Two: braking pads between the guideway and the train apply friction to further slow it down.

What are the downsides of maglev?

The maglev system including the guideway cannot reuse existing guideways and stations vis-à-vis non-maglev trains. It needs its own. And this infrastructure is very expensive as the guideway needs to have magnets and coils with precision engineering.

The Shanghai Maglev, which was completed in 2004, cost ₹580 crore to ₹720 crore per kilometre (adjusted for inflation). This is excluding the cost of preparing the local terrain first – and operational costs like maintenance. Ergo, there needs to be very high and consistent passenger demand. Otherwise, the economics won't work out.

On the engineering front, while there is no rolling friction, a train moving very fast – especially over 300 km/hr – experiences aerodynamic resistance due to the flow of air around the train's body. This is why maglev trains have aerodynamic designs (which can add to the cost), including a front portion that resembles a bird's beak.

Is maglev technology used elsewhere?

Maglev is essential about using magnetic fields to support or move objects – a use-case that arises in many enterprises. High-speed turbines and compressors suspend their rotating shafts in a magnetic field instead of conventional bearings, minimising mechanical contact and allowing the blades to turn faster. Similarly, modern aircraft carriers use the linear motor technology that pushes maglev trains forward to accelerate aircraft on the vessels' runways.

Factory automation systems also use it to achieve the rapid, precise motion crucial in semiconductor manufacturing, food and medicine packaging, CNC machining, inspection cameras involving lasers or X-rays, and DNA sequencing, among others.

Scientists have also used magnetic fields to levitate biological samples, liquid droplets, molten metals, and even small animals for experiments. Following a suggestion by his wife, the British physicists Andre Geim and Michael Berry used a magnetic field to levitate a frog in 1997. This was possible because a form of magnetism called diamagnetism gives all materials a very weak magnetic field. The duo had to work out the strength of the field required to 'cancel out' the gravitational force exerted on the frog by the earth. Thus, they were able to get the frog to float using a 10-tesla magnet.

For this work the duo won an Ig Nobel Prize in 2000. Today, Geim remains the only scientist to have won both an Ig Nobel Prize and a Nobel Prize. Berry is also a noted physicist, known for his work on semi-classical physics.

21J7. How magnetic levitation lifts and propels high-speed maglev trains
चुंबकीय उत्तोलन उच्च गति वाली मैग्लेव ट्रेनों को कैसे ऊपर उठाता और आगे बढ़ाता है

- **'Maglev'** is a portmanteau of **'magnetic levitation'**.
  'मैग्लेव (Maglev)' शब्द **'मैग्नेटिक लेविटेशन (चुंबकीय उत्तोलन)'** का संक्षिप्त रूप है।
- Instead of running on **wheels**, **maglev technology** uses strong **magnetic fields** to lift the **train** and move it forward.
  पहियों पर चलने के बजाय **मैग्लेव प्रौद्योगिकी ट्रेन** को ऊपर उठाने और आगे बढ़ाने के लिए शक्तिशाली **चुंबकीय क्षेत्रों** का उपयोग करती है।
- Since the **train** floats above the **track**, there is no **rolling friction** during normal operations, nor are operations affected by inclement **weather**, like **rain** or **snow**.
  चूँकि **ट्रेन पटरी** के ऊपर तैरती रहती है, इसलिए सामान्य संचालन के दौरान **रोलिंग घर्षण** नहीं होता और **वर्षा** या **हिमपात** जैसी प्रतिकूल **मौसम** परिस्थितियों का भी संचालन पर प्रभाव नहीं पड़ता।
- The result: the **train** can move at extremely high speed, topping **400 km/hr**, while also giving passengers a smooth ride.
  परिणामस्वरूप, **ट्रेन 400 किमी/घंटा** से अधिक की अत्यधिक गति से चल सकती है तथा यात्रियों को अत्यंत सहज यात्रा का अनुभव प्रदान करती है।

How is a train lifted?
ट्रेन को ऊपर कैसे उठाया जाता है?

- **Nature** has four **fundamental forces**: the two **nuclear forces**, the **electromagnetic force**, and **gravity**.
  प्रकृति में चार **मौलिक बल** होते हैं—दो **नाभिकीय बल**, **विद्युत-चुंबकीय बल**, तथा **गुरुत्वाकर्षण बल**।
- Of them, **gravity** is the weakest by far — around **10^{39}** times weaker than the **electromagnetic force**.
  इनमें **गुरुत्वाकर्षण बल** सबसे कमजोर है, जो **विद्युत-चुंबकीय बल** की तुलना में लगभग **10^{39}** गुना कम शक्तिशाली है।
- This is why a small **magnet** can stay stuck to your **fridge** despite having the entire gravitational force of the **Earth** pulling it down.
  इसी कारण एक छोटा **चुंबक** **पृथ्वी** के सम्पूर्ण गुरुत्वाकर्षण बल के बावजूद **फ्रिज** से चिपका रहता है।
- The same idea applies to lifting a **train** weighing somewhere from **150 to 500 tonnes**.
  यही सिद्धांत **150 से 500 टन** भार वाली **ट्रेन** को ऊपर उठाने में भी लागू होता है।
- **Engineers** get the **train** to float above the tracks using **electromagnetic suspension (EMS)**.
  अभियंता **इलेक्ट्रोमैग्नेटिक सस्पेंशन (EMS)** का उपयोग करके **ट्रेन** को पटरी के ऊपर तैरने योग्य बनाते हैं।
- The **train** has two **'arms'** that wrap around the **guideway** over which it runs.
  ट्रेन में दो **'भुजाएँ'** होती हैं, जो उस **गाइडवे** को दोनों ओर से आंशिक रूप से घेरती हैं, जिस पर वह चलती है।
- Strong **electromagnets** on these **arms** point **magnetic fields** up towards the protruding parts of the **guideway**.
  इन **भुजाओं** पर लगे शक्तिशाली **विद्युत-चुंबक** अपने **चुंबकीय क्षेत्र** को **गाइडवे** के उभरे हुए भागों की ओर निर्देशित करते हैं।
- Say you are lifting a **bag** with your **hand**.
  मान लीजिए कि आप अपने **हाथ** से एक **बैग** उठा रहे हैं।
- Your **fingers** wrap around the **bag's strap**.
  आपकी **उँगलियाँ** **बैग की पट्टी** को पकड़ लेती हैं।
- The **train's arms** do something like this — they wrap only just halfway, and from the bottom part, i.e., where the tip of your **finger** would be, exert a **magnetic field** into the underside of the **strap**.
  ट्रेन **की भुजाएँ** भी इसी प्रकार कार्य करती हैं—वे **गाइडवे** को केवल आंशिक रूप से घेरती हैं और निचले भाग से, अर्थात जहाँ आपकी **उँगली** का सिरा होता, वहाँ से **चुंबकीय क्षेत्र** उत्पन्न कर **गाइडवे** के निचले हिस्से पर प्रभाव डालती हैं।
- When these **electromagnets** are turned on, they exert a **magnetic field** that attracts them towards the **guideway**, i.e., your **fingers** would be attracted towards the **strap**.
  जब ये **विद्युत-चुंबक** सक्रिय किए जाते हैं, तो वे ऐसा **चुंबकीय क्षेत्र** उत्पन्न करते हैं जो उन्हें **गाइडवे** की ओर आकर्षित करता है, ठीक उसी प्रकार जैसे आपकी **उँगलियाँ** **बैग की पट्टी** की ओर आकर्षित होती हैं।
- As a result, the **train** is pushed upwards.
  इसके परिणामस्वरूप **ट्रेन** ऊपर की ओर उठ जाती है।
- The **train** is fitted with **sensors** that help it float around **10 mm** above the **guideway** at all times.
  ट्रेन में **सेंसर** लगे होते हैं, जो उसे हर समय **गाइडवे** से लगभग **10 मिमी** ऊपर तैरते रहने में सहायता करते हैं।
- In a closely related technology called **electrodynamic suspension (EDS)**, there are **superconducting magnets** on the **train** that are cooled to a very low **temperature**.
  इलेक्ट्रोडायनेमिक सस्पेंशन (EDS) नामक संबंधित प्रौद्योगिकी में **ट्रेन** पर **सुपरकंडक्टिंग चुंबक** लगाए जाते हैं, जिन्हें अत्यंत निम्न **तापमान** तक ठंडा किया जाता है।
- When the **train** moves, the **magnets** that move with it induce an **electric current** in **coils** built into the sides of the **tracks**.
  जब **ट्रेन** चलती है, तो उसके साथ गतिमान **चुंबक**, **पटरी** के किनारों में लगी **कॉइलों** में **विद्युत धारा** उत्पन्न करते हैं।
- (The phenomenon is called **electromagnetic induction**.)
  (इस प्रक्रिया को **विद्युत-चुंबकीय प्रेरण (Electromagnetic Induction)** कहा जाता है।)

- The result is a **repulsive force** that pushes the **train** up.
  इसके परिणामस्वरूप एक **प्रतिकर्षण बल** उत्पन्न होता है, जो **ट्रेन** को ऊपर उठाता है।
- Since the **magnets** have to move to induce the **current**, the **train** often needs to be travelling at around **100 km/hr** before the effect can kick in, and until then it uses **wheels**.
  चूँकि **विद्युत धारा** उत्पन्न करने के लिए **चुंबकों** का गतिमान होना आवश्यक है, इसलिए इस प्रभाव के सक्रिय होने से पहले **ट्रेन** को लगभग **100 किमी/घंटा** की गति प्राप्त करनी होती है और तब तक वह **पहियों** का उपयोग करती है।
- The **train** also hovers higher above the **track**, at around **100 mm**.
  इस प्रणाली में **ट्रेन पटरी** से लगभग **100 मिमी** ऊपर तैरती है।
- But in exchange for requiring **wheels**, **EDS** can support higher **speeds**.
  यद्यपि **EDS** प्रणाली में प्रारंभिक चरण में **पहियों** की आवश्यकता होती है, फिर भी यह अधिक **गति** प्राप्त करने में सक्षम होती है।
- **EMS systems** operate at around or under **500 km/hr** whereas the **SCMAGLEV EDS system** in **Japan** achieved **603 km/hr** during testing in **2015**.
  EMS प्रणालियाँ लगभग **500 किमी/घंटा** या उससे कम गति पर संचालित होती हैं, जबकि **जापान** की **SCMAGLEV EDS प्रणाली** ने **2015** के परीक्षणों के दौरान **603 किमी/घंटा** की गति प्राप्त की थी।

How does the train move forward?
ट्रेन आगे कैसे बढ़ती है?

- The walls of the **guideway** are lined with **coils** that carry an **alternating current (AC)**.
  गाइडवे की दीवारों पर **कुंडलियाँ (Coils)** लगी होती हैं, जिनमें **प्रत्यावर्ती धारा (Alternating Current-AC)** प्रवाहित होती है।
- This current creates a **magnetic field** that constantly shifts its poles (**north** to **south**) along the track.
  यह धारा एक **चुंबकीय क्षेत्र** उत्पन्न करती है, जो पटरियों के साथ लगातार अपने ध्रुवों (**उत्तर** से **दक्षिण**) को बदलता रहता है।
- The **magnets** on the train are attracted to the **opposite pole** ahead and repelled by the **like pole** behind.
  ट्रेन पर लगे **चुंबक** आगे स्थित **विपरीत ध्रुव** की ओर आकर्षित होते हैं तथा पीछे स्थित **समान ध्रुव** द्वारा प्रतिकर्षित होते हैं।
- As a result, the train is simultaneously pulled forward from the front and pushed forward from the back.
  फलस्वरूप, ट्रेन एक ही समय में आगे की ओर खींची भी जाती है और पीछे से धकेली भी जाती है।
- And to make the train go faster, engineers just need to increase the **frequency** of the **AC**.
  ट्रेन की गति बढ़ाने के लिए अभियंताओं को केवल **प्रत्यावर्ती धारा (AC)** की **आवृत्ति (Frequency)** बढ़ानी होती है।
- Similarly, the current is used to switch the direction of the **magnetic field** to slow the train or altogether stop it.
  इसी प्रकार, ट्रेन की गति कम करने अथवा उसे पूरी तरह रोकने के लिए **चुंबकीय क्षेत्र** की दिशा बदलने हेतु भी विद्युत धारा का उपयोग किया जाता है।
- This process may also use **regenerative braking** to divert the energy 'saved' by braking to the **electric grid**.
  इस प्रक्रिया में **पुनर्योजी ब्रेकिंग (Regenerative Braking)** का भी उपयोग किया जा सकता है, जिससे ब्रेक लगाने पर बचाई गई ऊर्जा को **विद्युत ग्रिड** में वापस भेजा जाता है।
- If a fast-moving **maglev train** starts to drift, there are magnets on the sides that repel/attract accordingly to ensure it stays centered.

यदि तीव्र गति से चल रही **मैग्लेव ट्रेन** अपने मार्ग से हटने लगे, तो उसके दोनों ओर लगे चुंबक आवश्यकता अनुसार आकर्षित या प्रतिकर्षित होकर उसे केंद्र में बनाए रखते हैं।

- For emergencies or when the **magnetic braking** fails, the system is also fitted with **friction brakes**.
  आपातकालीन परिस्थितियों में अथवा **चुंबकीय ब्रेकिंग** विफल होने पर इस प्रणाली में **घर्षण ब्रेक** भी लगाए जाते हैं।
- They come in two forms, although there are other technologies as well.
  यद्यपि अन्य तकनीकें भी उपलब्ध हैं, फिर भी ये मुख्यतः दो प्रकार के होते हैं।
- One: the **maglev train** is also fitted with 'regular' **auxiliary wheels**, and these wheels have a braking system akin to those in other trains and cars.
  पहला, **मैग्लेव ट्रेन** में सामान्य **सहायक पहिए** भी लगाए जाते हैं, जिनमें अन्य ट्रेनों और कारों के समान ब्रेकिंग प्रणाली होती है।
- Two: **braking pads** between the **guideway** and the train apply friction to further slow it down.
  दूसरा, **गाइडवे** और ट्रेन के बीच स्थित **ब्रेकिंग पैड** घर्षण उत्पन्न करके ट्रेन की गति को और कम करते हैं।

What are the downsides of maglev?
मैग्लेव प्रणाली की सीमाएँ क्या हैं?

- The **maglev system**, including the **guideway**, cannot reuse existing guideways and stations vis-à-vis non-maglev trains.
  मैग्लेव प्रणाली, जिसमें **गाइडवे** भी शामिल है, सामान्य ट्रेनों के लिए बने वर्तमान मार्गों और स्टेशनों का पुनः उपयोग नहीं कर सकती।
- It needs its own.
  इसके लिए पृथक अवसंरचना की आवश्यकता होती है।
- And this infrastructure is very expensive as the **guideway** needs to have **magnets** and **coils** with **precision engineering**.
  यह अवसंरचना अत्यंत महँगी होती है, क्योंकि **गाइडवे** में **चुंबकों**, **कुंडलियों**, तथा **उच्च-सटीक अभियांत्रिकी** की आवश्यकता होती है।
- The **Shanghai Maglev**, which was completed in **2004**, cost **₹580 crore to ₹720 crore per kilometre** (adjusted for inflation).
  शंघाई मैग्लेव, जो **2004** में पूर्ण हुई, की लागत (मुद्रास्फीति समायोजन के बाद) लगभग **₹580 करोड़ से ₹720 करोड़ प्रति किलोमीटर** रही।
- On the engineering front, while there is no **rolling friction**, a train moving very fast — especially over **300 km/hr** — experiences **aerodynamic resistance** due to the flow of air around the train's body.
  अभियांत्रिकी की दृष्टि से, यद्यपि इसमें **रोलिंग घर्षण** नहीं होता, फिर भी **300 किमी/घंटा** से अधिक गति से चलने वाली ट्रेन को उसके चारों ओर बहने वाली वायु के कारण **वायुगतिकीय प्रतिरोध** का सामना करना पड़ता है।
- This is why **maglev trains** have **aerodynamic designs**, including a front portion that resembles a **bird's beak**.
  इसी कारण **मैग्लेव ट्रेनों** का **वायुगतिकीय डिज़ाइन** बनाया जाता है, जिसमें अग्रभाग प्रायः **पक्षी की चोंच** जैसा दिखाई देता है।

Is maglev technology used elsewhere?
क्या मैग्लेव प्रौद्योगिकी का उपयोग अन्य क्षेत्रों में भी होता है?

- High-speed **turbines** and **compressors** suspend their rotating shafts in a **magnetic field** instead of conventional bearings, minimising **mechanical contact** and allowing the blades to

turn faster.
उच्च गति वाले **टर्बाइन** और **कम्प्रेसर** अपने घूमने वाले शाफ्ट को पारंपरिक बियरिंग्स के स्थान पर **चुंबकीय क्षेत्र** में निलंबित रखते हैं, जिससे **यांत्रिक संपर्क** न्यूनतम हो जाता है और ब्लेड अधिक तीव्र गति से घूम सकते हैं।

- **Factory automation systems** also use it to achieve the rapid, precise motion crucial in **semiconductor manufacturing**, **food and medicine packaging**, **CNC machining**, **inspection cameras** involving **lasers** or **X-rays**, and **DNA sequencing**, among others.
कारखाना स्वचालन प्रणालियाँ भी इसका उपयोग **सेमीकंडक्टर निर्माण**, **खाद्य एवं औषधि पैकेजिंग**, **सीएनसी मशीनिंग**, **लेज़र** अथवा **एक्स-रे** आधारित **निरीक्षण कैमरों**, तथा **डीएनए अनुक्रमण** जैसी प्रक्रियाओं में तीव्र एवं सटीक गति प्राप्त करने के लिए करती हैं।
- Scientists have also used **magnetic fields** to levitate **biological samples**, **liquid droplets**, **molten metals**, and even **small animals** for experiments.
वैज्ञानिकों ने **चुंबकीय क्षेत्रों** का उपयोग **जैविक नमूनों**, **द्रव बूंदों**, **पिघली हुई धातुओं**, तथा यहाँ तक कि **छोटे जानवरों** को भी प्रयोगों के लिए हवा में तैराने हेतु किया है।
- Following a suggestion by his wife, the British physicists **Andre Geim** and **Michael Berry** used a **magnetic field** to levitate a **frog** in **1997**.
अपनी पत्नी के सुझाव पर ब्रिटिश भौतिकविद् **आंद्रे गीम** और **माइकल बेरी** ने **1997** में एक **चुंबकीय क्षेत्र** का उपयोग करके एक **मेंढक** को हवा में तैराया।
- This was possible because a form of magnetism called **diamagnetism** gives all materials a very weak **magnetic field**.
यह संभव हुआ क्योंकि **प्रतिचुंबकत्व (Diamagnetism)** नामक चुंबकत्व का एक रूप सभी पदार्थों को अत्यंत कमजोर **चुंबकीय क्षेत्र** प्रदान करता है।
- The duo had to work out the strength of the **field** required to 'cancel out' the **gravitational force** exerted on the frog by the **Earth**.
दोनों वैज्ञानिकों को उस **चुंबकीय क्षेत्र** की आवश्यक तीव्रता निर्धारित करनी पड़ी, जो **पृथ्वी** द्वारा मेंढक पर लगाए गए **गुरुत्वाकर्षण बल** को निष्प्रभावी कर सके।
- Thus, they were able to get the **frog** to float using a **10-tesla magnet**.
इस प्रकार वे **10 टेस्ला के चुंबक** की सहायता से **मेंढक** को हवा में तैराने में सफल हुए।
- For this work the duo won an **Ig Nobel Prize** in **2000**.
इस कार्य के लिए दोनों वैज्ञानिकों को **2000** में **इग नोबेल पुरस्कार** प्रदान किया गया।
- Today, **Geim** remains the only scientist to have won both an **Ig Nobel Prize** and a **Nobel Prize**.
आज **आंद्रे गीम** ऐसे एकमात्र वैज्ञानिक हैं, जिन्होंने **इग नोबेल पुरस्कार** और **नोबेल पुरस्कार** दोनों प्राप्त किए हैं।
- **Berry** is also a noted physicist, known for his work on **semi-classical physics**.
माइकल बेरी भी एक प्रसिद्ध भौतिकविद् हैं, जिन्हें **अर्ध-शास्त्रीय भौतिकी (Semi-classical Physics)** में उनके योगदान के लिए जाना जाता है।

Radioactive Decay

- Carbon-14, used in archaeological dating, is radioactive.
- Inside a Carbon-14 nucleus:
- One **neutron changes into a proton**.
- An **electron** and another tiny particle called an **antineutrino** are emitted.
- Carbon-14 becomes Nitrogen-14.
- This entire process happens because of the **weak nuclear force**.
- Think of it as:

Weak force = Nature's particle-conversion mechanism.

- The train floats because of magnetic levitation, but it moves forward because a travelling electromagnetic field acts like a giant invisible motor that continuously pulls and pushes it along the track.

Every material on Earth responds to a magnetic field in some way.

Scientists classify materials into three broad categories:

- **Ferromagnetic** (strongly attracted): Iron, cobalt, nickel.
- **Paramagnetic** (weakly attracted): Aluminium, platinum.
- **Diamagnetic** (weakly repelled): Water, wood, plastic, copper, gold, plants, and living organisms.

Surprisingly, **almost every living thing—including humans—is diamagnetic** because our bodies are made mostly of **water (about 60–70%)**, and water is diamagnetic.

Diamagnetism

- Diamagnetism is a property by which a material develops a **very weak magnetic field in the opposite direction** when placed in an external magnetic field.
- A diamagnetic material behaves as if it creates a tiny magnet whose poles oppose the external magnet.
- Normally, this repulsion is **extremely weak**, so we never notice it.

Then how did scientists make a frog float?

- In **1997**, British physicists **Andre Geim** and **Michael Berry** used an **extremely powerful superconducting magnet**.
- The magnetic field produced was about **16 tesla**, which is **hundreds of thousands of times stronger than Earth's magnetic field** (Earth's field is about **50 microtesla**).
- Since a frog's body is mostly water, it is diamagnetic.
- The powerful magnetic field created a repulsive force strong enough to **balance the frog's weight**.
- When the **upward magnetic force became equal to the downward gravitational force**, the frog floated in mid-air.
- The frog was **not attracted** by the magnet. Instead, it was **repelled upward** because of diamagnetism.

Why is this useful?

Scientists use magnetic levitation to study materials **without physical contact**, avoiding contamination or damage.

It has been used to levitate:

- **Biological samples**, allowing delicate tissues to be examined without touching containers.
- **Liquid droplets**, helping researchers understand fluid behaviour.
- **Molten metals**, preventing reactions with containers during manufacturing.
- **Small animals**, to study how living organisms respond to weightless conditions similar to

those in space.

The **Ig Nobel Prize** is a humorous award given for unusual research that first makes people **laugh** and then makes them **think**. Despite its comic presentation, the research is usually genuine and published scientifically.

Main Difference

Basis	Nobel Prize	Ig Nobel Prize
Purpose	Honours highly important contributions	Honours unusual, imaginative or amusing research
Nature	Serious and prestigious	Humorous but intellectually meaningful
Organised by	Nobel institutions in Sweden and Norway	*Annals of Improbable Research*
First awarded	1901	1991
Prize value	Includes medal, diploma and substantial money	Usually symbolic or humorous
Example	Discovery of a major scientific principle	Research on why bananas are slippery

Can someone win both?

Yes. **Andre Geim** is famous for winning both awards:

- **Ig Nobel Prize, 2000:** For using a powerful magnetic field to levitate a frog.
- **Nobel Prize in Physics, 2010:** Shared with Konstantin Novoselov for groundbreaking experiments involving **graphene**.

GS III: S&T

IndiGo to order 1,000 engines from CFM International

IndiGo on Monday announced the signing of a Memorandum of Understanding (MoU) with CFM International to order more than 1,000 LEAP-1A engines for the 510 Airbus A320neo family aircraft it has on order. The deal marks the largest single order ever placed for LEAP engines and sets a new record for CFM International. The MoU also covers CFM International's support for setting up IndiGo's upcoming engine maintenance, repair and overhaul (MRO) facility.

21J7. IndiGo to order 1,000 engines from CFM International

इंडिगो CFM इंटरनेशनल से 1,000 इंजन खरीदेगी

- **IndiGo** on **Monday** announced the signing of a **Memorandum of Understanding (MoU)** with **CFM International** to order more than **1,000 LEAP-1A engines** for the **510 Airbus A320neo family aircraft** it has on order.

इंडिगो ने **सोमवार** को **CFM इंटरनेशनल** के साथ एक **समझौता ज्ञापन (MoU)** पर हस्ताक्षर करने की घोषणा की, जिसके तहत वह अपने ऑर्डर किए गए **510 एयरबस A320neo परिवार के विमानों** के लिए **1,000 से अधिक LEAP-1A इंजन** खरीदेगी।

- The deal marks the **largest single order** ever placed for **LEAP engines** and sets a new record for **CFM International**.

यह समझौता **LEAP इंजनों** के लिए अब तक का **सबसे बड़ा एकल ऑर्डर** है और **CFM इंटरनेशनल** के लिए एक नया रिकॉर्ड स्थापित करता है।

- The **MoU** also covers **CFM International's** support for setting up **IndiGo's** upcoming **Engine Maintenance, Repair and Overhaul (MRO) facility**.
  इस **समझौता ज्ञापन** में **इंडिगो** की प्रस्तावित **इंजन रखरखाव, मरम्मत एवं ओवरहॉल (MRO) सुविधा** की स्थापना के लिए **CFM इंटरनेशनल** द्वारा तकनीकी सहयोग प्रदान करने का भी प्रावधान है।

Natco Pharma gets U.S. FDA nod for generic cancer drug

GS III: S&T

HYDERABAD

Natco shares touched over 4% intra-day before ending less than 1% higher at ₹950.55 each

Natco Pharma's shares were in the spotlight on Monday after it received tentative approval from the U.S. FDA for Olaparib, 100 mg, and 150 mg, which are bioequivalent to AstraZeneca Pharmaceuticals' referenced drug Lynparza used in the treatment of certain types of cancer.

The shares of the generic drugmaker touched more than 4% intra-day before ending the day less than 1% higher at ₹950.55 each. Natco Pharma said it would be manufacturing Olaparib tablets while its partner Alembic Pharmaceuticals would be distributing the product in the U.S. Olaparib tablets had estimated sales of around $1.4 billion in the U.S. for 12 months ending March 2026 as per industry sales data. The Para IV litigation, a statutory mechanism to resolve drug patent disputes, is on-going, it said.

21J7. Natco Pharma gets U.S. FDA nod for generic cancer drug

नैटको फार्मा को जेनेरिक कैंसर दवा के लिए अमेरिकी FDA की मंजूरी

- **Natco Pharma's** shares were in the spotlight on **Monday** after it received **tentative approval** from the **U.S. Food and Drug Administration (U.S. FDA)** for **Olaparib 100 mg** and **150 mg** tablets, which are **bioequivalent** to **AstraZeneca Pharmaceuticals'** reference drug **Lynparza**, used in the treatment of certain types of **cancer**.
  नैटको फार्मा के शेयर **सोमवार** को चर्चा में रहे, जब उसे **अमेरिकी खाद्य एवं औषधि प्रशासन (U.S. FDA)** से **Olaparib 100 mg** और **150 mg** टैबलेट के लिए **अस्थायी मंजूरी (Tentative Approval)** मिली। यह दवा **एस्ट्राजेनेका फार्मास्यूटिकल्स** की संदर्भ दवा **Lynparza** के **जैव-समतुल्य (Bioequivalent)** है, जिसका उपयोग कुछ प्रकार के **कैंसर** के उपचार में किया जाता है।
- **Natco Pharma** said it would manufacture **Olaparib tablets**, while its partner **Alembic Pharmaceuticals** would distribute the product in the **United States**.
  नैटको फार्मा ने बताया कि वह **Olaparib टैबलेट** का निर्माण करेगी, जबकि उसकी साझेदार **एलेम्बिक फार्मास्यूटिकल्स** इस उत्पाद का **संयुक्त राज्य अमेरिका** में वितरण करेगी।
- The **Para IV litigation**, a **statutory mechanism** to resolve **drug patent disputes**, is ongoing, the company said.
  कंपनी ने बताया कि **दवा पेटेंट विवादों** के समाधान के लिए निर्धारित **वैधानिक प्रक्रिया (Para IV Litigation)** अभी भी जारी है।

GS Paper III: Environment	21 July 2026
TOPICS COVERED	
21J7	India's green transition is missing long-duration energy storage भारत के हरित संक्रमण में दीर्घ-अवधि ऊर्जा भंडारण का अभाव है
21J7	Security meets ecology as BSF mulls fence in Sundarbans सुंदरबन में बाड़ लगाने पर बीएसएफ के विचार के साथ सुरक्षा और पारिस्थितिकी का संगम
21J7	Number of polluted river stretches in India in 2025 भारत में 2025 में प्रदूषित नदी खंडों की संख्या

India's green transition is missing long-duration energy storage

Longer-term energy storage is needed to ensure that the grid remains reliable during prolonged periods of low solar and wind generation; the longer the time over which a technology discharges energy, the better its economics; at the same time, storing more energy is also expensive

Environment

Aedna Kurian
Ammu Susanna Jacob

A pumped hydroelectric storage power plant in Tasmania. The plant stores electricity by pumping water uphill when power is abundant. Later, the water flows downhill through turbines, generating electricity during periods of high demand. GETTY IMAGES

On May 21, India recorded its highest peak demand of 270.8 gigawatt (GW) during the day, an increase of approximately 90 GW from the same window in 2019. While power generators often meet India's summer peak, the demand again increases at night, especially due to the use of air conditioners. This underscores the need for longer-term energy storage to ensure the grid remains reliable during prolonged periods of low solar and wind generation.

India's current energy storage roadmap only offers a partial solution. The 2026 Long-Term National Resource Adequacy Plan envisages 80 GW of battery energy storage and 94 GW of pumped hydroelectric energy storage (PHES) by FY2035-36. This translates to average discharge durations of roughly 4 and 6 hours, respectively.

This could be enough to address short-term fluctuations but may not suffice during adverse weather conditions, such as heatwaves.

In this context, long-duration energy storage (LDES) technologies, which are capable of delivering power for days rather than hours, could turn out to be the missing pillar of India's green energy transition.

Diverse landscape

LDES refers to technologies that store energy and discharge it as power or thermal energy over extended periods, from 8 hours to days, weeks, or seasons. By storing energy when renewable generation is abundant and supplying it during periods of peak demand or low generation, LDES can provide the reliability and flexibility to support a renewable-heavy grid.

Further, unlike short-duration energy storage systems, which discharge energy for less than 8 hours and smooth intra-day demand fluctuations, LDES provides the endurance needed to balance supply and demand for prolonged periods, ease grid congestion, and provide grid resilience and stability.

Several LDES technologies are available today, each at different stages of development and commercial readiness, including PHES, compressed-air energy storage (CAES), thermal storage, hydrogen-based storage, and flow batteries.

Of these, PHES remains the benchmark because of its mature infrastructure and a high energy efficiency of 70-80%. CAES has a similar level of market readiness but a slightly lower efficiency of 40-70%. Thermal storage stands out for its long discharge duration – around 200 hours – and an energy efficiency of 55-90%. However, researchers are still developing it.

Costs of long-term storage

Although chemical energy storage, such as with hydrogen, has even higher discharge durations of up to 1,000 hours, it is not efficient. Vanadium flow batteries – an example of electrochemical energy storage – are commercially ready, come in different sizes, and have an efficiency of 80-85% across durations of 10-24 hours.

Scientists are also working on more cutting-edge solutions like iron-air batteries. In all, the LDES landscape is diverse and worth looking forward to.

The longer the time over which a technology discharges energy, the better its economics. At the same time, storing more energy also costs more. So for discharge durations beyond six hours, short-duration energy storage systems are unlikely to prove cost-effective.

The LDES Council is an international body that brings together industry leaders, technology developers, investors, policymakers, and other stakeholders to accelerate the innovation and commercialisation of LDES technologies. It has projected a significant decrease in LDES costs by 2030, making it an economically feasible storage solution.

According to a study by Pacific Northwest National Laboratory, a research body under the U.S. Department of Energy, PHES and CAES are the most cost-effective and commercially viable technologies at present, at $0.12/kWh and $0.10/kWh, respectively.

However, both technologies need specific site conditions. PHES requires two water reservoirs at different heights so that water can be pumped to the upper reservoir when surplus electricity is available and released downhill to generate power when needed. Thus, the site must have enough land for the reservoirs, an optimal height difference for the water to flow down with force, and of course water.

Likewise, CAES needs large underground spaces, such as salt caverns or depleted gas fields, that can safely hold high-pressure air without major leaks.

Where such sites are not available, other LDES options, such as hydrogen, thermal storage or vanadium flow batteries – which depend less on specific land, water, and subterranean conditions, may be more suitable.

India's position on LDES

The California Public Utilities Commission, California's primary utility regulator responsible for overseeing electricity, natural gas, telecommunications, and other public utility services, has set an LDES procurement target of 2 GW. It has said this capacity will be deployed between 2031 and 2037.

Long-duration energy storage (LDES) technologies, which are capable of delivering power for days rather than hours, could turn out to be the missing pillar of India's green energy transition

Similarly, to unlock investments and accelerate deployment, the U.K. has launched a financial framework for LDES that provides a safety net for investors. Among other measures, it will ensure LDES projects have a minimum revenue, even in poor market conditions.

Per a 2026 report by the Central Electricity Authority, India's PHES potential is about 267 GW. The report also said India plans to install PHES projects with an aggregate capacity of 100.8 GW by 2035-2036. Of this, 11.6 GW is currently under construction.

In early 2025, India also launched a 160-MWh carbon dioxide battery storage system at the National Thermal Power Corporation (NTPC) in Kudgi, Karnataka. It works by cycling carbon dioxide between liquid and gas phases and has an operational life exceeding 25 years. This was followed by inaugurating the country's first MWh-scale vanadium redox flow battery system – a 3-MWh facility installation at NTPC in Greater Noida.

Proposed roadmap

While the Long-Term National Resource Adequacy Plan acknowledges the role of energy storage in maintaining power grid reliability, it does not specifically recognise the need for LDES.

To address this gap, LDES should be incorporated into the Ministry of Power's National Framework for Promoting Energy Storage Systems, accompanied by guidelines on its deployment and integration into grid operations.

Similarly, while the National Electricity Plan outlines projected capacities for battery ESS and PHES, it does not provide technology-specific assessments or deployment pathways for LDES.

Given the growing importance of LDES in a renewable-rich power system, future planning exercises should include estimates of LDES requirements and identify technologies best suited to India's extreme weather and geographical conditions.

Faster environmental and land clearances, transmission alignment, and clear regulatory classification are also important to unlock investments.

The incentive structure, including subsidies and viability-gap funding, must be technology-agnostic and incentivise co-location opportunities with data centres. As the market matures, the focus must shift to long-term revenue contracts, tariff structures, and procurement frameworks.

Intense efforts should be made to build awareness among all stakeholders of the available LDES solutions, and their grid use cases should be presented. As part of this effort, dispatch centres should be directed to post staff for skill enhancement and training to support optimal dispatch, multi-day charge-discharge decisions, state-of-charge management across seasons, and coordination across storage assets with proper guidelines and protocols for LDES.

Without planning to include LDES, however, India's clean energy future could be forced to rest on favourable weather and market conditions.

Aedna Kurian is an analyst and Ammu Susanna Jacob is a senior research scientist in the Energy Storage group, at the Center for Study of Science, Technology and Policy (CSTEP), a research-based think-tank.

21J7. India's green transition is missing long-duration energy storage
भारत के हरित संक्रमण में दीर्घ-अवधि ऊर्जा भंडारण का अभाव है

- India recorded its **highest peak demand** of **270.8 gigawatt (GW)** during the day on **May 21**, an increase of approximately **90 GW** from the same window in **2019**.
  21 मई को भारत ने दिन के दौरान **270.8 गीगावाट (GW)** की अपनी **सर्वाधिक शिखर विद्युत मांग** दर्ज की, जो **2019** की समान अवधि की तुलना में लगभग **90 GW** अधिक थी।

- The **2026 Long-Term National Resource Adequacy Plan** envisages **80 GW** of **battery energy storage** and **94 GW** of **pumped hydroelectric energy storage (PHES)** by **FY2035-36**.
  2026 दीर्घकालिक राष्ट्रीय संसाधन पर्याप्तता योजना में **वित्त वर्ष 2035-36** तक **80 GW बैटरी ऊर्जा भंडारण** तथा **94 GW पम्प्ड हाइड्रोइलेक्ट्रिक ऊर्जा भंडारण (PHES)** की परिकल्पना की गई है।
- In this context, **long-duration energy storage (LDES)** technologies, which are capable of delivering power for **days** rather than **hours**, could turn out to be the missing pillar of India's **green energy transition**.
  इस संदर्भ में, **दीर्घ-अवधि ऊर्जा भंडारण (LDES)** प्रौद्योगिकियाँ, जो **घंटों** के बजाय **दिनों** तक ऊर्जा उपलब्ध करा सकती हैं, भारत के **हरित ऊर्जा संक्रमण** का अभावग्रस्त आधारस्तंभ सिद्ध हो सकती हैं।

Diverse landscape
विविध परिदृश्य

- **LDES** refers to technologies that store **energy** and discharge it as **power** or **thermal energy** over extended periods, from **8 hours** to **days, weeks, or seasons**.
  LDES उन प्रौद्योगिकियों को संदर्भित करता है जो **ऊर्जा** का भंडारण करती हैं तथा उसे **विद्युत** अथवा **तापीय ऊर्जा** के रूप में **8 घंटे** से लेकर **दिनों, सप्ताहों अथवा ऋतुओं** तक की विस्तारित अवधि में उपलब्ध कराती हैं।
- By storing **energy** when **renewable generation** is abundant and supplying it during periods of **peak demand** or low generation, **LDES** can provide the **reliability** and **flexibility** to support a **renewable-heavy grid**.
  जब **नवीकरणीय ऊर्जा उत्पादन** प्रचुर मात्रा में होता है, तब **ऊर्जा** का भंडारण करके तथा **शिखर मांग** अथवा कम उत्पादन की अवधि में उसकी आपूर्ति करके **LDES**, **नवीकरणीय ऊर्जा-प्रधान ग्रिड** को आवश्यक **विश्वसनीयता** और **लचीलापन** प्रदान कर सकता है।
- Further, unlike **short-duration energy storage systems**, which discharge energy for less than **8 hours** and smooth **intra-day demand fluctuations**, **LDES** provides the endurance needed to balance **supply and demand** for prolonged periods, ease **grid congestion**, and provide **grid resilience** and **stability**.
  इसके अतिरिक्त, **अल्प-अवधि ऊर्जा भंडारण प्रणालियों** के विपरीत, जो **8 घंटे** से कम समय तक ऊर्जा प्रदान करती हैं तथा **दिन के भीतर मांग में होने वाले उतार-चढ़ाव** को संतुलित करती हैं, **LDES** लंबी अवधि तक **आपूर्ति और मांग** के संतुलन, **ग्रिड भीड़भाड़** को कम करने तथा **ग्रिड की प्रत्यास्थता** और **स्थिरता** सुनिश्चित करने के लिए आवश्यक क्षमता प्रदान करता है।
- Several **LDES technologies** are available today, each at different stages of **development** and **commercial readiness**, including **PHES**, **compressed-air energy storage (CAES)**, **thermal storage**, **hydrogen-based storage**, and **flow batteries**.
  वर्तमान में अनेक **LDES प्रौद्योगिकियाँ** उपलब्ध हैं, जो **विकास** तथा **वाणिज्यिक तत्परता** के विभिन्न चरणों में हैं। इनमें **PHES**, **संपीडित-वायु ऊर्जा भंडारण (CAES)**, **तापीय भंडारण**, **हाइड्रोजन-आधारित भंडारण**, तथा **फ्लो बैटरियाँ** शामिल हैं।
- Of these, **PHES** remains the benchmark because of its **mature infrastructure** and a high **energy efficiency** of **70-80%**.
  इनमें **PHES** अपने **परिपक्व अवसंरचना** तथा **70-80%** की उच्च **ऊर्जा दक्षता** के कारण मानक प्रौद्योगिकी बना हुआ है।
- **CAES** has a similar level of **market readiness** but a slightly lower **efficiency** of **40-70%**.
  CAES की **बाज़ार तत्परता** लगभग समान है, किंतु इसकी **दक्षता** अपेक्षाकृत कम, अर्थात **40-70%** है।
- **Thermal storage** stands out for its long **discharge duration** — around **200 hours** — and an **energy efficiency** of **55-90%**.
  तापीय भंडारण अपनी लंबी **डिस्चार्ज अवधि** — लगभग **200 घंटे** — तथा **55-90%** की **ऊर्जा दक्षता** के कारण विशेष रूप से उल्लेखनीय है।

- However, researchers are still developing it.
  हालाँकि, **शोधकर्ता** अभी भी इस प्रौद्योगिकी के विकास पर कार्य कर रहे हैं।

Costs of long-term storage
दीर्घकालिक भंडारण की लागत

- Although **chemical energy storage**, such as with **hydrogen**, has even higher discharge durations of up to **1,000 hours**, it is not efficient.
  यद्यपि **रासायनिक ऊर्जा भंडारण**, जैसे **हाइड्रोजन** के माध्यम से, **1,000 घंटे** तक की अधिक निर्वहन अवधि प्रदान करता है, फिर भी यह **दक्ष** नहीं है।
- **Vanadium flow batteries** — an example of **electrochemical energy storage** — are commercially ready, come in different sizes, and have an **efficiency of 80-85%** across durations of **10-24 hours**.
  वैनेडियम फ्लो बैटरियाँ — **विद्युत-रासायनिक ऊर्जा भंडारण** का एक उदाहरण — व्यावसायिक उपयोग के लिए तैयार हैं, विभिन्न आकारों में उपलब्ध हैं, और **10-24 घंटे** की अवधि में **80-85% दक्षता** प्रदान करती हैं।
- Scientists are also working on more cutting-edge solutions like **iron-air batteries**.
  वैज्ञानिक **आयरन-एयर बैटरियों** जैसे अधिक उन्नत समाधानों पर भी कार्य कर रहे हैं।
- In all, the **LDES** landscape is diverse and worth looking forward to.
  समग्र रूप से, **LDES** का परिदृश्य विविधतापूर्ण है और भविष्य के लिए आशाजनक है।
- The longer the time over which a technology discharges energy, the better its economics.
  किसी प्रौद्योगिकी द्वारा ऊर्जा के निर्वहन की अवधि जितनी अधिक होती है, उसकी **आर्थिक व्यवहार्यता** उतनी ही बेहतर होती है।
- At the same time, storing more energy also costs more.
  साथ ही, अधिक ऊर्जा का भंडारण करने में अधिक लागत भी आती है।
- So for discharge durations beyond **six hours**, **short-duration energy storage systems** are unlikely to prove cost-effective.
  अतः **छह घंटे** से अधिक की निर्वहन अवधि के लिए **अल्पकालिक ऊर्जा भंडारण प्रणालियाँ** लागत की दृष्टि से प्रभावी सिद्ध होने की संभावना कम होती है।
- The **LDES Council** is an international body that brings together industry leaders, technology developers, investors, policymakers, and other stakeholders to accelerate the innovation and commercialisation of **LDES technologies**.
  एलडीईएस परिषद (LDES Council) एक अंतरराष्ट्रीय निकाय है, जो उद्योग के अग्रणी व्यक्तियों, प्रौद्योगिकी विकासकर्ताओं, निवेशकों, नीति-निर्माताओं तथा अन्य हितधारकों को **LDES प्रौद्योगिकियों** के नवाचार और व्यावसायीकरण में तेजी लाने के लिए एक साथ लाती है।
- It has projected a significant decrease in **LDES costs** by **2030**, making it an economically feasible storage solution.
  इसने **2030** तक **LDES की लागत** में उल्लेखनीय कमी का अनुमान व्यक्त किया है, जिससे यह आर्थिक रूप से व्यवहार्य भंडारण समाधान बन सकेगा।
- According to a study by **Pacific Northwest National Laboratory**, a research body under the **U.S. Department of Energy**, **PHES** and **CAES** are the most cost-effective and commercially viable technologies at present, at **$0.12/kWh** and **$0.10/kWh**, respectively.
  अमेरिकी ऊर्जा विभाग (U.S. Department of Energy) के अंतर्गत कार्यरत अनुसंधान संस्था **पैसिफिक नॉर्थवेस्ट नेशनल लेबोरेटरी** के एक अध्ययन के अनुसार, वर्तमान में **PHES** और **CAES** क्रमशः **$0.12 प्रति kWh** तथा **$0.10 प्रति kWh** की लागत पर सबसे अधिक लागत-प्रभावी और व्यावसायिक रूप से व्यवहार्य प्रौद्योगिकियाँ हैं।
- However, both technologies need specific site conditions.
  हालाँकि, दोनों प्रौद्योगिकियों के लिए विशिष्ट स्थल परिस्थितियों की आवश्यकता होती है।

- **PHES** requires two water reservoirs at different heights so that water can be pumped to the upper reservoir when surplus electricity is available and released downhill to generate power when needed.
  PHES के लिए अलग-अलग ऊँचाइयों पर स्थित दो जलाशयों की आवश्यकता होती है, ताकि अतिरिक्त विद्युत उपलब्ध होने पर जल को ऊपरी जलाशय में पंप किया जा सके तथा आवश्यकता पड़ने पर नीचे की ओर प्रवाहित कर विद्युत उत्पन्न की जा सके।
- Thus, the site must have enough land for the reservoirs, an optimal height difference for the water to flow down with force, and of course water.
  अतः स्थल पर जलाशयों के लिए पर्याप्त भूमि, जल के तीव्र प्रवाह हेतु उपयुक्त ऊँचाई का अंतर तथा स्वाभाविक रूप से पर्याप्त जल उपलब्ध होना आवश्यक है।
- Likewise, **CAES** needs large underground spaces, such as **salt caverns** or **depleted gas fields**, that can safely hold high-pressure air without major leaks.
  इसी प्रकार, **CAES** के लिए बड़े भूमिगत स्थानों, जैसे **लवणीय गुफाएँ (Salt Caverns)** अथवा **समाप्त गैस क्षेत्र (Depleted Gas Fields)** की आवश्यकता होती है, जो उच्च दाब वाली वायु को बिना बड़े रिसाव के सुरक्षित रूप से संग्रहीत कर सकें।
- Where such sites are not available, other **LDES** options, such as **hydrogen**, **thermal storage** or **vanadium flow batteries** — which depend less on specific land, water, and subterranean conditions, may be more suitable.
  जहाँ ऐसे स्थल उपलब्ध नहीं हैं, वहाँ **हाइड्रोजन**, **ऊष्मीय भंडारण (Thermal Storage)** अथवा **वैनेडियम फ्लो बैटरियों** जैसे अन्य **LDES** विकल्प अधिक उपयुक्त हो सकते हैं, क्योंकि वे भूमि, जल तथा भूमिगत परिस्थितियों पर अपेक्षाकृत कम निर्भर होते हैं।

India's position on LDES
LDES पर भारत की स्थिति

- The **California Public Utilities Commission**, California's primary utility regulator responsible for overseeing electricity, natural gas, telecommunications, and other public utility services, has set an **LDES procurement target of 2 GW**.
  कैलिफोर्निया पब्लिक यूटिलिटीज़ कमीशन, जो कैलिफोर्निया में विद्युत, प्राकृतिक गैस, दूरसंचार तथा अन्य सार्वजनिक उपयोगिता सेवाओं का प्रमुख नियामक है, ने **2 गीगावाट LDES खरीद लक्ष्य** निर्धारित किया है।
- It has said this capacity will be deployed between **2031 and 2037**.
  इसने कहा है कि इस क्षमता को **2031 से 2037** के बीच स्थापित किया जाएगा।
- Similarly, to unlock investments and accelerate deployment, the **U.K.** has launched a **financial framework for LDES** that provides a safety net for investors.
  इसी प्रकार, निवेश को प्रोत्साहित करने तथा तैनाती में तेजी लाने के लिए **यूनाइटेड किंगडम (U.K.)** ने **LDES के लिए एक वित्तीय ढाँचा** प्रारंभ किया है, जो निवेशकों को सुरक्षा प्रदान करता है।
- Among other measures, it will ensure **LDES projects** have a **minimum revenue**, even in poor market conditions.
  अन्य उपायों के साथ-साथ यह सुनिश्चित करेगा कि **LDES परियोजनाओं** को प्रतिकूल बाजार परिस्थितियों में भी **न्यूनतम राजस्व** प्राप्त हो।
- Per a **2026 report** by the **Central Electricity Authority**, India's **PHES potential** is about **267 GW**.
  केंद्रीय विद्युत प्राधिकरण (Central Electricity Authority) की **2026 की रिपोर्ट** के अनुसार, भारत की **PHES क्षमता** लगभग **267 गीगावाट** है।
- The report also said India plans to install **PHES projects** with an aggregate capacity of **100.8 GW** by **2035-2036**.
  रिपोर्ट में यह भी कहा गया है कि भारत **2035-2036** तक कुल **100.8 गीगावाट** क्षमता वाली **PHES परियोजनाएँ** स्थापित करने की योजना बना रहा है।

- Of this, **11.6 GW** is currently under construction.
  इनमें से **11.6 गीगावाट** क्षमता की परियोजनाएँ वर्तमान में निर्माणाधीन हैं।
- In early **2025**, India also launched a **160-MWh carbon dioxide battery storage system** at the **National Thermal Power Corporation (NTPC)** in **Kudgi, Karnataka**.
  2025 की शुरुआत में भारत ने **कर्नाटक के कुडगी** स्थित **नेशनल थर्मल पावर कॉरपोरेशन (NTPC)** में **160 मेगावाट-घंटा कार्बन डाइऑक्साइड बैटरी भंडारण प्रणाली** भी प्रारंभ की।
- It works by cycling **carbon dioxide** between liquid and gas phases and has an operational life exceeding **25 years**.
  यह **कार्बन डाइऑक्साइड** को द्रव एवं गैसीय अवस्थाओं के बीच चक्रित करके कार्य करती है तथा इसकी परिचालन आयु **25 वर्ष** से अधिक है।
- This was followed by inaugurating the country's **first MWh-scale vanadium redox flow battery system** — a **3-MWh** facility installation at **NTPC** in **Greater Noida**.
  इसके पश्चात **ग्रेटर नोएडा** स्थित **NTPC** में देश की **प्रथम मेगावाट-घंटा स्तर की वैनेडियम रेडॉक्स फ्लो बैटरी प्रणाली** — **3 मेगावाट-घंटा** क्षमता वाली सुविधा — का उद्घाटन किया गया।

Proposed roadmap
प्रस्तावित कार्य-रोडमैप

- While the **Long-Term National Resource Adequacy Plan** acknowledges the role of **energy storage** in maintaining **power grid reliability**, it does not specifically recognise the need for **LDES**.
  यद्यपि **दीर्घकालिक राष्ट्रीय संसाधन पर्याप्तता योजना (Long-Term National Resource Adequacy Plan) विद्युत ग्रिड की विश्वसनीयता** बनाए रखने में **ऊर्जा भंडारण** की भूमिका को स्वीकार करती है, किंतु यह **LDES** की आवश्यकता को विशेष रूप से मान्यता नहीं देती।
- To address this gap, **LDES** should be incorporated into the **Ministry of Power's National Framework for Promoting Energy Storage Systems**, accompanied by guidelines on its deployment and integration into **grid operations**.
  इस कमी को दूर करने के लिए **LDES** को **विद्युत मंत्रालय के ऊर्जा भंडारण प्रणालियों के संवर्धन हेतु राष्ट्रीय रूपरेखा (National Framework for Promoting Energy Storage Systems)** में सम्मिलित किया जाना चाहिए तथा इसके परिनियोजन और **ग्रिड संचालन** में एकीकरण संबंधी दिशानिर्देश भी जारी किए जाने चाहिए।
- Similarly, while the **National Electricity Plan** outlines projected capacities for **battery ESS** and **PHES**, it does not provide **technology-specific assessments** or deployment pathways for **LDES**.
  इसी प्रकार, यद्यपि **राष्ट्रीय विद्युत योजना (National Electricity Plan) बैटरी ऊर्जा भंडारण प्रणाली (Battery ESS)** तथा **PHES** की अनुमानित क्षमताओं का उल्लेख करती है, किंतु यह **LDES** के लिए **प्रौद्योगिकी-विशिष्ट आकलन** अथवा परिनियोजन मार्ग प्रस्तुत नहीं करती।
- Given the growing importance of **LDES** in a **renewable-rich power system**, future planning exercises should include estimates of **LDES requirements** and identify technologies best suited to India's **extreme weather** and **geographical conditions**.
  नवीकरणीय ऊर्जा-प्रधान विद्युत प्रणाली में **LDES** के बढ़ते महत्व को देखते हुए, भविष्य की योजनाओं में **LDES की आवश्यकताओं** का आकलन शामिल किया जाना चाहिए तथा भारत की **चरम मौसमीय** एवं **भौगोलिक परिस्थितियों** के अनुरूप सर्वाधिक उपयुक्त प्रौद्योगिकियों की पहचान की जानी चाहिए।
- Faster **environmental** and **land clearances**, **transmission alignment**, and clear **regulatory classification** are also important to unlock investments.
  निवेश को प्रोत्साहित करने के लिए त्वरित **पर्यावरणीय** एवं **भूमि स्वीकृतियाँ**, **संचरण अवसंरचना का समन्वय**, तथा स्पष्ट **नियामकीय वर्गीकरण** भी अत्यंत महत्वपूर्ण हैं।

- The **incentive structure**, including **subsidies** and **viability-gap funding**, must be **technology-agnostic** and incentivise **co-location opportunities** with **data centres**.
प्रोत्साहन संरचना, जिसमें **सब्सिडी** तथा **व्यवहार्यता-अंतर वित्तपोषण (Viability Gap Funding)** शामिल हैं, **प्रौद्योगिकी-निरपेक्ष** होनी चाहिए तथा **डेटा केंद्रों** के साथ **सह-स्थान (Co-location) के अवसरों** को प्रोत्साहित करना चाहिए।
- As the market matures, the focus must shift to **long-term revenue contracts**, **tariff structures**, and **procurement frameworks**.
जैसे-जैसे बाजार परिपक्व होगा, ध्यान **दीर्घकालिक राजस्व अनुबंधों**, **टैरिफ संरचनाओं**, तथा **क्रय रूपरेखाओं** की ओर स्थानांतरित किया जाना चाहिए।
- Intense efforts should be made to build awareness among all **stakeholders** of the available **LDES solutions**, and their **grid use cases** should be presented.
उपलब्ध **LDES समाधानों** के संबंध में सभी **हितधारकों** के बीच जागरूकता बढ़ाने के लिए व्यापक प्रयास किए जाने चाहिए तथा उनके **ग्रिड उपयोग संबंधी अनुप्रयोगों** को प्रस्तुत किया जाना चाहिए।
- As part of this effort, **dispatch centres** should be directed to post staff for **skill enhancement** and **training** to support **optimal dispatch**, **multi-day charge–discharge decisions**, **state-of-charge management** across seasons, and coordination across **storage assets** with proper **guidelines** and **protocols** for **LDES**.
इस प्रयास के अंतर्गत **डिस्पैच केंद्रों** को **कौशल उन्नयन** एवं **प्रशिक्षण** के लिए कर्मचारियों की नियुक्ति करने का निर्देश दिया जाना चाहिए, ताकि **इष्टतम विद्युत प्रेषण**, **बहु-दिवसीय चार्ज–डिस्चार्ज निर्णय**, विभिन्न ऋतुओं में **चार्ज की स्थिति (State-of-Charge) का प्रबंधन**, तथा **भंडारण परिसंपत्तियों** के बीच समन्वय सुनिश्चित किया जा सके। इसके लिए **LDES** संबंधी उपयुक्त **दिशानिर्देश** एवं **प्रोटोकॉल** भी विकसित किए जाने चाहिए।
- Without planning to include **LDES**, however, India's **clean energy future** could be forced to rest on favourable **weather** and **market conditions**.
हालाँकि, यदि योजनाओं में **LDES** को शामिल नहीं किया गया, तो भारत का **स्वच्छ ऊर्जा भविष्य** अनुकूल **मौसम** एवं **बाज़ार परिस्थितियों** पर निर्भर होने के लिए विवश हो सकता है।

- **Aedna Kurian** is an **analyst** and **Ammu Susanna Jacob** is a **senior research scientist** in the **Energy Storage** group, at the **Center for Study of Science, Technology and Policy (CSTEP)**, a **research-based think-tank**.
एडना कुरियन एक **विश्लेषक** हैं तथा **अम्मू सुसन्ना जैकब सेंटर फॉर स्टडी ऑफ साइंस, टेक्नोलॉजी एंड पॉलिसी (CSTEP)** के **ऊर्जा भंडारण** समूह में **वरिष्ठ अनुसंधान वैज्ञानिक** हैं। **CSTEP** एक **अनुसंधान-आधारित थिंक-टैंक** है।

Security meets ecology as BSF mulls fence in Sundarbans

GS III: Environment

Divya Gandhi
BENGALURU

Just a few months after the Border Security Force (BSF) explored the curious prospect of releasing snakes and crocodiles into rivers on the Indo-Bangladesh border to deter "illegal activities", it has now initiated another controversial feasibility study for a project to safeguard the area.

As *The Hindu* reported, the BSF is mulling installing physical fences along a 90-km stretch of the Sundarbans mangroves, habitat to rich flora and fauna, including the iconic tiger that swims in the brackish water.

Installing physical fences here is going to be no easy task as the thick mangrove forests, creeks, and swamps make it inaccessible.

The government has also sanctioned the construction of flood-light illuminated fences – a non-physical barrier – according to reports.

The Sundarbans Wildlife Sanctuary will "remain touched" by the fencing, one BFS official told *The Hindu*, adding that the structures will not affect the area's biodiversity as it is being envisaged for the banks of the Ichamati river in the northern reaches.

The official also said all those who lose their land in the process will be compensated.

But one scientist familiar with the Sundarbans has expressed fear that the fence will adversely affect the movement of deer, wild boar, crocodiles, and tigers, all of which constantly cross rivers and sand banks.

Megnaa Mehtta, an assistant professor in social anthropology at University College London, said, "I'm not sure why the Ichamati would be out of bounds to them... It is like any other river or forest sandbank."

The idea of a fence in the fluid ecology of the Sundarbans is a colossal waste of government resources, both funds and labour, Dr. Mehtta added: "In an area that requires several other fundamental infrastructural improvements, this should certainly not be a priority for the government."

On the other hand, Krishna Ray, associate professor of the department of botany, West Bengal State University, said the area chosen for the fencing need not necessarily present problems for either the local fishers or biodiversity.

"Being a porous border area, it should be well protected," Dr. Ray told *The Hindu*. "In my opinion, fencing in non-protected areas along the Bangladesh border might not harm the ecosystem very much, if the BSF people took care of the mangroves on shoreline and wildlife while setting up their fencing."

He "welcomed" the fencing because he said he believes in regulatory control. "At present I do not think regulations are being followed there. The mangrove ecosystem has already suffered enough from illegal fisheries and construction all over Sundarbans in nonprotected areas."

On the other hand, Dr. Mehtta said decades of research in the area has shown that this is not a common route for any form of antisocial infiltration or one that could be a threat to the security of the nation. Border crossings will continue, but because of the fence, they will become even more "risky", she added.

"Previous attempts at acquiring land, for example for building embankments, have resulted in dispossessing already vulnerable populations from their homes," according to Dr. Mehtta. "And in most cases, rehabilitation was not provided [nor] was any financial compensation."

21J7. Security meets ecology as BSF mulls fence in Sundarbans सुंदरबन में बाड़ लगाने पर बीएसएफ के

विचार के साथ सुरक्षा और पारिस्थितिकी का संगम

- Just a few months after the **Border Security Force (BSF)** explored the curious prospect of releasing **snakes** and **crocodiles** into rivers on the **Indo-Bangladesh border** to deter **illegal activities**, it has now initiated another controversial **feasibility study** for a project to safeguard the area.
  सीमा सुरक्षा बल (BSF) द्वारा **भारत-बांग्लादेश सीमा** की नदियों में **साँपों** और **मगरमच्छों** को छोड़कर **अवैध गतिविधियों** को रोकने की असामान्य संभावना पर विचार किए जाने के कुछ ही महीनों बाद, अब इस क्षेत्र की सुरक्षा के लिए एक अन्य विवादास्पद **व्यवहार्यता अध्ययन** प्रारंभ किया गया है।
- As **The Hindu** reported, the **BSF** is mulling installing **physical fences** along a **90-km stretch** of the **Sundarbans mangroves**, habitat to rich **flora** and **fauna**, including the iconic **tiger** that swims in the brackish water.
  द हिंदू की रिपोर्ट के अनुसार, **BSF सुंदरबन के मैंग्रोव वनों** के **90 किलोमीटर लंबे क्षेत्र** में **भौतिक बाड़** लगाने पर विचार कर रहा है, जो समृद्ध **वनस्पति** और **जीव-जंतुओं** का आवास है, जिसमें खारे जल में तैरने वाला प्रसिद्ध **बाघ** भी शामिल है।
- Installing **physical fences** here is going to be no easy task as the thick **mangrove forests**, **creeks**, and **swamps** make it inaccessible.
  यहाँ **भौतिक बाड़** स्थापित करना सरल कार्य नहीं होगा, क्योंकि घने **मैंग्रोव वन**, **जलधाराएँ (Creeks)** तथा **दलदली क्षेत्र** इसे दुर्गम बनाते हैं।
- The government has also sanctioned the construction of **flood-light illuminated fences** — a **non-physical barrier** — according to reports.
  रिपोर्टों के अनुसार, सरकार ने **फ्लडलाइट से प्रकाशित बाड़** — एक **अभौतिक अवरोध** — के निर्माण को भी स्वीकृति प्रदान की है।
- The **Sundarbans Wildlife Sanctuary** will "remain touched" by the fencing, one **BSF official** told **The Hindu**, adding that the structures will not affect the area's **biodiversity** as it is being envisaged for the banks of the **Ichamati River** in the northern reaches.
  एक **BSF अधिकारी** ने **द हिंदू** को बताया कि **सुंदरबन वन्यजीव अभयारण्य** इस बाड़बंदी से "प्रभावित रहेगा", परंतु इन संरचनाओं से क्षेत्र की **जैव विविधता** पर प्रतिकूल प्रभाव नहीं पड़ेगा, क्योंकि इन्हें उत्तरी भाग में **इच्छामती नदी** के तटों पर स्थापित करने की योजना है।
- The official also said all those who lose their land in the process will be **compensated**.
  अधिकारी ने यह भी कहा कि इस प्रक्रिया में जिन लोगों की भूमि जाएगी, उन्हें **मुआवज़ा** दिया जाएगा।
- But one scientist familiar with the **Sundarbans** has expressed fear that the fence will adversely affect the movement of **deer**, **wild boar**, **crocodiles**, and **tigers**, all of which constantly cross rivers and sand banks.
  किन्तु **सुंदरबन** से परिचित एक वैज्ञानिक ने आशंका व्यक्त की है कि यह बाड़ **हिरणों**, **जंगली सूअरों**, **मगरमच्छों** तथा **बाघों** की आवाजाही को प्रतिकूल रूप से प्रभावित करेगी, क्योंकि ये सभी नियमित रूप से नदियों और रेतीले तटों को पार करते हैं।
- **Megnaa Mehtta**, an assistant professor in **social anthropology** at **University College London**, said, "I'm not sure why the **Ichamati** would be out of bounds to them… It is like any other river or forest sandbank."
  यूनिवर्सिटी कॉलेज लंदन में **सामाजिक मानवशास्त्र** की सहायक प्रोफेसर **मेगना मेहत्ता** ने कहा, "मुझे समझ नहीं आता कि **इच्छामती** उनके लिए निषिद्ध क्यों होगी… यह किसी अन्य नदी या वन के रेतीले तट की तरह ही है।"
- The idea of a fence in the fluid ecology of the **Sundarbans** is a colossal waste of government resources, both **funds** and **labour**, Dr. Mehtta added.
  डॉ. मेहत्ता ने आगे कहा कि **सुंदरबन** जैसी गतिशील पारिस्थितिकी में बाड़ लगाने का विचार सरकारी **धन** और **श्रम** दोनों का अत्यधिक अपव्यय है।
- "In an area that requires several other fundamental infrastructural improvements, this should certainly not be a priority for the government."

"ऐसे क्षेत्र में, जहाँ अनेक अन्य बुनियादी अवसंरचनात्मक सुधारों की आवश्यकता है, यह निश्चित रूप से सरकार की प्राथमिकता नहीं होनी चाहिए।"

- On the other hand, **Krishna Ray**, associate professor of the **Department of Botany**, **West Bengal State University**, said the area chosen for the fencing need not necessarily present problems for either the local **fishers** or **biodiversity**.
दूसरी ओर, **पश्चिम बंगाल राज्य विश्वविद्यालय** के **वनस्पति विज्ञान विभाग** के एसोसिएट प्रोफेसर **कृष्ण राय** ने कहा कि बाड़बंदी के लिए चुना गया क्षेत्र आवश्यक रूप से स्थानीय **मछुआरों** या **जैव विविधता** के लिए समस्या उत्पन्न नहीं करेगा।
- "Being a **porous border area**, it should be well protected," Dr. Ray told **The Hindu**.
डॉ. राय ने **द हिंदू** से कहा, "यह एक **छिद्रयुक्त सीमा क्षेत्र** है, इसलिए इसकी उचित सुरक्षा होनी चाहिए।"
- "In my opinion, fencing in **non-protected areas** along the **Bangladesh border** might not harm the ecosystem very much, if the **BSF** people took care of the **mangroves** on shoreline and **wildlife** while setting up their fencing."
"मेरे विचार से, **बांग्लादेश सीमा** के **असंरक्षित क्षेत्रों** में बाड़ लगाने से पारिस्थितिकी तंत्र को अधिक हानि नहीं होगी, यदि **BSF** के कर्मचारी बाड़ निर्माण के दौरान तटीय **मैंग्रोवों** और **वन्यजीवों** का समुचित ध्यान रखें।"
- He "welcomed" the fencing because he said he believes in **regulatory control**.
उन्होंने बाड़बंदी का "स्वागत" किया, क्योंकि उनका मानना है कि **नियामक नियंत्रण** आवश्यक है।
- "At present I do not think regulations are being followed there."
"वर्तमान में मुझे नहीं लगता कि वहाँ नियमों का पालन किया जा रहा है।"
- "The **mangrove ecosystem** has already suffered enough from **illegal fisheries** and **construction** all over **Sundarbans** in **non-protected areas**."
"**मैंग्रोव पारिस्थितिकी तंत्र** पहले ही **असंरक्षित क्षेत्रों** में **अवैध मत्स्य गतिविधियों** और **निर्माण कार्यों** के कारण पूरे **सुंदरबन** में पर्याप्त क्षति झेल चुका है।"
- On the other hand, Dr. Mehtta said decades of research in the area has shown that this is not a common route for any form of **antisocial infiltration** or one that could be a threat to the **security of the nation**.
दूसरी ओर, डॉ. मेहत्ता ने कहा कि इस क्षेत्र में दशकों के शोध से यह स्पष्ट हुआ है कि यह किसी भी प्रकार की **असामाजिक घुसपैठ** अथवा **राष्ट्रीय सुरक्षा** के लिए खतरा बनने वाला सामान्य मार्ग नहीं है।
- **Border crossings** will continue, but because of the fence, they will become even more **risky**, she added.
उन्होंने आगे कहा कि **सीमा पार करना** जारी रहेगा, किंतु बाड़ के कारण यह और भी अधिक **जोखिमपूर्ण** हो जाएगा।
- "Previous attempts at acquiring **land**, for example for building **embankments**, have resulted in dispossessing already vulnerable populations from their homes," according to Dr. Mehtta.
डॉ. मेहत्ता के अनुसार, "पूर्व में **भूमि** अधिग्रहण के प्रयास, जैसे **तटबंधों** के निर्माण के लिए, पहले से ही संवेदनशील आबादी को उनके घरों से विस्थापित करने का कारण बने हैं।"
- "And in most cases, **rehabilitation** was not provided nor was any **financial compensation**."
"और अधिकांश मामलों में न तो **पुनर्वास** प्रदान किया गया और न ही कोई **वित्तीय मुआवज़ा** दिया गया।"

Number of polluted river stretches in India in 2025

GS III: Environment

296 The number of polluted river stretches declined to 296 in 2025 from 351 in 2018, according to the Central Pollution Control Board report. The government said rivers are polluted mainly due to untreated or partially treated sewage, industrial effluents, inadequate dilution, dumping of solid waste, and other non-point sources of pollution. PTI

21J7. Number of polluted river stretches in India in 2025

भारत में 2025 में प्रदूषित नदी खंडों की संख्या

- The number of **polluted river stretches** declined to **296 in 2025** from **351 in 2018**, according to the **Central Pollution Control Board report**.

केंद्रीय प्रदूषण नियंत्रण बोर्ड की रिपोर्ट के अनुसार, **प्रदूषित नदी खंडों** की संख्या **2018 में 351** से घटकर **2025 में 296** हो गई।

- The government said rivers are polluted mainly due to untreated or partially treated sewage, industrial effluents, inadequate dilution, dumping of solid waste, and other non-point sources of pollution.
  सरकार ने कहा कि नदियाँ मुख्य रूप से अनुपचारित या आंशिक रूप से उपचारित सीवेज, औद्योगिक अपशिष्ट, अपर्याप्त तनुकरण, ठोस कचरे के डंपिंग तथा प्रदूषण के अन्य गैर-बिंदु स्रोतों के कारण प्रदूषित होती हैं।

GS Paper IV: Ethics	21 July 2026
TOPICS COVERED	
21J7	Tripura DGP found dead; investigation launched त्रिपुरा के पुलिस महानिदेशक मृत पाए गए; जाँच शुरू

Tripura DGP found dead; investigation launched

GS IV: Ethics

AGARTALA

Tripura Director-General of Police Anurag Dhankar was found dead under mysterious circumstances in his office on Monday. His body was reportedly found in the washroom adjoining his chamber at the police headquarters in Agartala around 11.40 a.m.

Sources indicate that Mr. Dhankar entered the office bathroom around 11 a.m. and after a prolonged absence, his staff forced open the door only to find him hanging. He was swiftly transported to Agartala Medical College and GBP Hospital, where he was admitted to the ICU before being declared dead. The police have registered a case of unnatural death and begun investigation.

(Those in distress can call the Tele-MANAS helpline 14416)

21J7. Tripura DGP found dead; investigation launched
त्रिपुरा के पुलिस महानिदेशक मृत पाए गए; जाँच शुरू

- **Tripura Director-General of Police (DGP) Anurag Dhankar** was found dead under **mysterious circumstances** in his **office** on **Monday**.

त्रिपुरा के पुलिस महानिदेशक (डीजीपी) अनुराग ढांकर सोमवार को अपने **कार्यालय** में **रहस्यमय परिस्थितियों** में मृत पाए गए।

- His **body** was reportedly found in the **washroom** adjoining his chamber at the **Police Headquarters** in **Agartala** around **11:40 a.m.**

बताया गया कि उनका **शव अगरतला** स्थित **पुलिस मुख्यालय** में उनके कक्ष से सटे **शौचालय** में लगभग **सुबह 11:40 बजे** मिला।

- Sources indicate that **Mr. Dhankar** entered the **office bathroom** around **11:00 a.m.** and after a prolonged absence, his **staff** forced open the door only to find him **hanging**.

सूत्रों के अनुसार, **श्री ढांकर** लगभग **सुबह 11:00 बजे कार्यालय के शौचालय** में गए थे। काफी देर तक बाहर न आने पर उनके **कर्मचारियों** ने दरवाज़ा तोड़ा, जहाँ वे **फाँसी के फंदे से लटके हुए** पाए गए।

- He was swiftly transported to **Agartala Medical College and GBP Hospital**, where he was admitted to the **Intensive Care Unit (ICU)** before being declared dead.

उन्हें तुरंत **अगरतला मेडिकल कॉलेज एवं जीबीपी अस्पताल** ले जाया गया, जहाँ उन्हें **गहन चिकित्सा इकाई (आईसीयू)** में भर्ती किया गया, लेकिन बाद में चिकित्सकों ने उन्हें मृत घोषित कर दिया।

- The **police** have registered a case of **unnatural death** and begun an **investigation**.

पुलिस ने **अप्राकृतिक मृत्यु** का मामला दर्ज कर **जाँच** शुरू कर दी है।