7th Jan, 2025

1. Vembanad Lake
GS 3 (Environment)

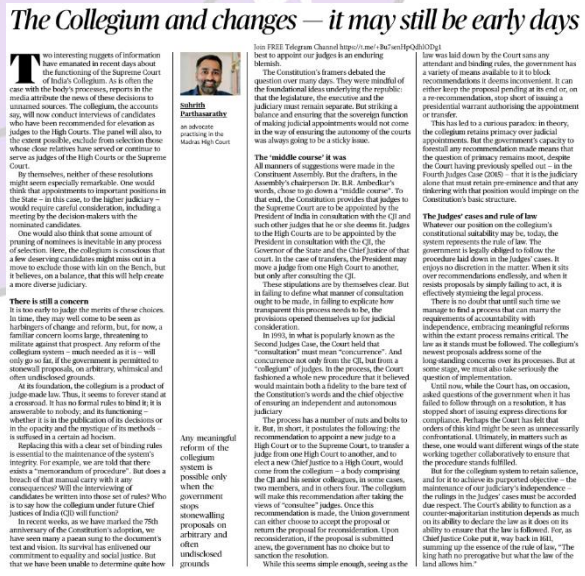
- **Why in News:** Climate change and pollution from slaughterhouses and shrimp peeling sheds are choking the ecosystem of Vembanad Lake, which is rapidly shrinking in acreage.
- **About Vembanad Lake:**
  - It is the **longest lake in India** and the **largest lake** of **Kerala**.
  - It is spread across an area of 2,033 sq.km., across Alappuzha, Kottayam, and Ernakulam districts.
  - It is also known as Vembanad Kayal, Vembanad Kol, **Punnamada Lake** (in Kuttanad), and **Kochi Lake** (in Kochi).
  - **Formed from four rivers – the Meenachil, Achankovil, Pampa, and Manimala**, it also **has an outlet to the Arabian Sea** in the west.
  - The lake **surrounds the islands of Pathiramanal, Perumbalam, and Pallippuram** and is a popular backwater stretch in Kerala.
  - **Vallam Kali (i.e Nehru Trophy Boat Race**) is a **Snake Boat Race** held every year in the month of August in Vembanad Lake.
  - The **Kumarakom Bird Sanctuary**is located on the east coast of the lake.
  - It was declared as a **Ramsar site** of international importance in 2002.

Troubled waters

Gasping ecosystem: Fishermen cast nets in the Vembanad lake on Monday. Climate change and pollution from slaughterhouses and shrimp peeling sheds are choking the ecosystem of the lake, which is rapidly shrinking in acreage. H. VIBHU

2. The Collegium and Changes, It May Still Be Early Days
GS 2 (Judiciary)

- **Why in News:**
  - The **recent developments concerning the Supreme Court of India's Collegium system have rekindled debates** about its effectiveness and necessity for reform.
  - Two **noteworthy resolutions have come to light: the Collegium's decision to conduct interviews of candidates for High Court judgeships and its intention to limit the selection of candidates** with close familial ties to existing judges.
  - However, **these steps, laudable as they might be, must be viewed alongside the long-standing concerns surrounding the Collegium's structure,** transparency, and its interplay with the executive branch.
- **Evolution of the Collegium System**
  - The Collegium system **owes its existence to judicial interpretations rather than constitutional directives**
  - Envisioned as a mechanism to safeguard judicial independence, **it emerged from the Second Judges Case (1993), where the Supreme Court interpreted 'consultation' in Article 124 of the Constitution to mean 'concurrence' by a Collegium** comprising the Chief Justice of India (CJI) and senior judges.
  - This decision **aimed to protect judicial appointments from undue executive influence**, establishing the judiciary as a self-regulating institution.



The Collegium and changes — it may still be early days

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Two interesting nuggets of information have emanated in recent days about the functioning of the Supreme Court of India's Collegium. As is often the case with the body's processes, reports in the media attribute the news of these decisions to unnamed sources. The collegium, the accounts say, will now conduct interviews of candidates who have been recommended for elevation as judges to the High Courts. The panel will also, to the extent possible, exclude from selection those whose close relatives have served or continue to serve as judges of the High Courts or the Supreme Court.

By themselves, neither of these resolutions might seem especially remarkable. One would think that appointments to important positions in the State – in this case, to the higher judiciary – would require careful consideration, including a meeting by the decision-makers with the nominated candidates.

One would also think that some amount of pruning of nominees is inevitable in any process of selection. Here, the collegium is conscious that a few deserving candidates might miss out in a move to exclude those with kin on the Bench, but it believes, on a balance, that this will help create a more diverse judiciary.

There is still a concern

It is too early to judge the merits of these choices. In time, they may well come to be seen as harbingers of change and reform, but, for now, a familiar concern looms large, threatening to militate against that prospect. Any reform of the collegium system – much needed as it is – will only go so far, if the government is permitted to stonewall proposals, on arbitrary, whimsical and often undisclosed grounds.

At its foundation, the collegium is a product of judge-made law. Thus, it seems to forever stand at a crossroad. It has no formal rules to bind it; it is answerable to nobody; and its functioning – whether it is in the publication of its decisions or in the opacity and the mystique of its methods – is suffused in a certain ad hocism.

Replacing this with a clear set of binding rules is essential to the maintenance of the system's integrity. For example, we are told that there exists a "memorandum of procedure". But does a breach of that manual carry with it any consequences? Will the interviewing of candidates be written into those set of rules? Who is to say how the collegium under future Chief Justices of India (CJI) will function?

In recent weeks, as we have marked the 75th anniversary of the Constitution's adoption, we have seen many a paean sung to the document's text and vision. Its survival has enlivened our commitment to equality and social justice. But that we have been unable to determine quite how best to appoint our judges is an enduring blemish.

Suhrith Parthasarathy

an advocate practising in the Madras High Court

The Constitution's framers debated the question over many days. They were mindful of the foundational ideas underlying the republic: that the legislature, the executive and the judiciary must remain separate. But striking a balance and ensuring that the sovereign function of making judicial appointments would not come in the way of ensuring the autonomy of the courts was always going to be a sticky issue.

The 'middle course' it was

All manners of suggestions were made in the Constituent Assembly. But the drafters, in the Assembly's chairperson Dr. B.R. Ambedkar's words, chose to go down a "middle course". To that end, the Constitution provides that judges to the Supreme Court are to be appointed by the President of India in consultation with the CJI and such other judges that he or she deems fit. Judges to the High Courts are to be appointed by the President in consultation with the CJI, the Governor of the State and the Chief Justice of that court. In the case of transfers, the President may move a judge from one High Court to another, but only after consulting the CJI.

These stipulations are by themselves clear. But in failing to define what manner of consultation ought to be made, in failing to explicate how transparent this process needs to be, the provisions opened themselves up for judicial consideration.

In 1993, in what is popularly known as the Second Judges Case, the Court held that "consultation" must mean "concurrence". And concurrence not only from the CJI, but from a "collegium" of judges. In the process, the Court fashioned a whole new procedure that it believed would maintain both a fidelity to the bare text of the Constitution's words and the chief objective of ensuring an independent and autonomous judiciary.

The process has a number of nuts and bolts to it. But, in short, it postulates the following: the recommendation to appoint a new judge to a High Court or to the Supreme Court, to transfer a judge from one High Court to another, and to elect a new Chief Justice to a High Court, would come from the collegium – a body comprising the CJI and his senior colleagues, in some cases, two members, and in others four. The collegium will make this recommendation after taking the views of "consultee" judges. Once this recommendation is made, the Union government can either choose to accept the proposal or return the proposal for reconsideration. Upon reconsideration, if the proposal is submitted anew, the government has no choice but to sanction the resolution.

While this seems simple enough, seeing as the law was laid down by the Court sans any attendant and binding rules, the government has a variety of means available to it to block recommendations it deems inconvenient. It can either keep the proposal pending at its end or, on a re-recommendation, stop short of issuing a presidential warrant authorising the appointment or transfer.

This has led to a curious paradox: in theory, the collegium retains primacy over judicial appointments. But the government's capacity to forestall any recommendation made means that the question of primacy remains moot, despite the Court having previously spelled out – in the Fourth Judges Case (2015) – that it is the judiciary alone that must retain pre-eminence and that any tinkering with that position would impinge on the Constitution's basic structure.

The Judges' cases and rule of law

Whatever our position on the collegium's constitutional suitability may be, today, the system represents the rule of law. The government is legally obliged to follow the procedure laid down in the Judges' cases. It enjoys no discretion in the matter. When it sits over recommendations endlessly, and when it resists proposals by simply failing to act, it is effectively stymieing the legal process.

There is no doubt that until such time we manage to find a process that can marry the requirements of accountability with independence, embracing meaningful reforms within the extant process remains critical. The law as it stands must be followed. The collegium's newest proposals address some of the long-standing concerns over its processes. But at some stage, we must also take seriously the question of implementation.

Until now, while the Court has, on occasion, asked questions of the government when it has failed to follow through on a resolution, it has stopped short of issuing express directions for compliance. Perhaps the Court has felt that orders of this kind might be seen as unnecessarily confrontational. Ultimately, in matters such as these, one would want different wings of the state working together collaboratively to ensure that the procedure stands fulfilled.

But for the collegium system to retain salience, and for it to achieve its purported objective – the maintenance of our judiciary's independence – the rulings in the Judges' cases must be accorded due respect. The Court's ability to function as a counter-majoritarian institution depends as much on its ability to declare the law as it does on its ability to ensure that the law is followed. For, as Chief Justice Coke put it, way back in 1611, summing up the essence of the rule of law, "The king hath no prerogative but what the law of the land allows him."

Any meaningful reform of the collegium system is possible only when the government stops stonewalling proposals on arbitrary and often undisclosed grounds

- **A Deeper Examination of Challenges to Collegium's Effectiveness**
  - **Opacity in Functioning**
    - The **decision-making process is conducted behind closed doors**, with no formal minutes or publicly available records of deliberations.
    - **This secrecy undermines public trust** in the judiciary and creates an environment where allegations of favouritism, nepotism, and bias can thrive.
    - The **absence of clear criteria for evaluating candidates further complicates this issue**, leaving the process vulnerable to subjectivity and inconsistency.
  - **Executive Interference and Delay**
    - Despite the judiciary's primacy in appointments, **the executive wields significant power to delay or obstruct Collegium recommendations.**
    - The **government can employ various tactics to impede the process**, such as:
      - The **executive often sits on recommendations indefinitely**, neither rejecting nor approving them.
      - This **stalling tactic creates uncertainty** and undermines judicial efficiency
      - The **government may cherry-pick recommendations**, accepting some while returning others for reconsideration without adequate justification.
  - **Nepotism and Lack of Diversity**
    - **Judges are often accused of favouring candidates** with familial or professional ties to existing members of the judiciary.
    - This **practice limits opportunities for deserving candidates** from diverse backgrounds, leading to a judiciary that is not representative of the broader society.
    - **While the recent resolution to exclude candidates with close familial ties to serving judges is a step in the right direction**, its implementation remains uncertain.
    - Moreover, **excluding candidates solely based on familial connections may inadvertently disqualify highly competent individuals,** highlighting the need for nuanced reforms.
  - **Absence of Binding Rules**
    - The Collegium **operates without a codified set of rules**, relying instead on informal practices and traditions.
    - This **lack of a binding framework creates inconsistencies** in its functioning. For example, there is no guarantee that the Collegium under different Chief Justices of India (CJIs) will adhere to the same standards or priorities.
    - **This ad hoc approach not only undermines predictability but also makes the system vulnerable** to manipulation.
- **Attempts to Reform the Collegium System and SC Verdict on It**
  - The **National Judicial Appointments Commission (NJAC) Act, 2014** sought to replace the **Collegium System** with a commission, for the purpose of appointment and transfer of judges in the **Supreme Court** and **High Courts** of India.
  - The act aimed to make the process of judicial appointments more transparent and accountable.
  - However, the **Constitution Bench** (4:1 majority) of the SC struck down the NJAC Act and the 99th Constitutional Amendment as unconstitutional.
  - The Court reinstated the collegium system, emphasizing the importance of judicial independence.
- **Proposals to Reform the Collegium System**
  - **Introduction of Candidate Interviews**
    - The **decision to interview candidates for High Court judgeships aims to provide a more holistic evaluation**
    - **Interviews can help assess a candidate's judicial temperament**, ethical outlook, and understanding of constitutional principles, which are not always evident from written records.
    - **This reform can create merit-based appointments** by ensuring that candidates' skills, perspectives, and values align with the judiciary's needs.

- **Addressing Nepotism**
  - By discouraging the selection of candidates with close familial ties to serving judges, the Collegium seeks to enhance diversity and meritocracy in judicial appointments.
  - This move could break entrenched power structures within the judiciary, opening the door for individuals from diverse backgrounds, including first-generation lawyers and underrepresented communities.
- **Codification of Collegium Processes**
  - Formalising the Collegium's functioning through a codified set of rules is essential to ensure consistency and predictability.
  - **A clear framework outlining eligibility criteria**, selection processes, and timelines can **eliminate ambiguities and reduce discretionary decision-making**.
  - Codification would bring much-needed structure to the Collegium's operations, making it more transparent and less susceptible to allegations of arbitrariness.
- **Time-Bound Approvals**
  - **Instituting a fixed timeline for the government** to act on Collegium recommendations **would address delays in judicial appointments.**
  - This **could include binding deadlines** for either accepting or returning recommendations with detailed reasons.
  - **Such a mechanism would reduce judicial vacancies**, alleviate case backlogs, and improve overall efficiency in the judiciary.
- **Transparency Through Public Disclosures**
  - **Publishing detailed justifications for appointments and rejections could enhance public trust**.
  - This **includes disclosing reasons for selecting certain candidates and rejecting others**, as well as addressing concerns raised during the selection process.
  - **Transparency would not only bolster accountability but also deter frivolous challenges** to the Collegium's decisions.
- **Independent Oversight Mechanism**
  - **Establishing an independent body to oversee the implementation of Collegium** recommendations and address disputes between the judiciary and the executive could **improve accountability without compromising independence.**
  - Such a body could act as a mediator, ensuring that the judicial appointment process adheres to constitutional principles while resolving conflicts collaboratively.

- **The Way Forward to Ensure the Success of the Reforms**
  - **Comprehensive Consultations:** Engaging stakeholders, including senior judges, legal experts, and civil society, in drafting codified rules to ensure inclusivity and legitimacy.
  - **Capacity Building:** Strengthening administrative infrastructure to handle the additional demands of a reformed appointment process.
  - **Enforcement Mechanisms**: Introducing legal provisions to penalize non-compliance with timelines or procedural lapses by the executive.
  - **Periodic Reviews:** Conducting regular assessments of the Collegium's functioning to identify and address emerging challenges.
- **Conclusion**
  - Post the NJAC judgment, the **Collegium System continues to be the method for appointing judges to the higher judiciary.**
  - **The Collegium system,** despite its flaws, **represents an effort to preserve the judiciary's independence.**
  - **However, its survival and efficacy depend on meaningful reforms** that address both structural and procedural deficiencies.

3. US eases curbs to push nuclear deal
GS 2 (International Relations)

- **Why in News:**
  - The US is finalizing measures to ease regulations hindering civil nuclear cooperation with India, as part of advancing the Indo-US nuclear deal.
  - US National Security Advisor Jake Sullivan announced plans to remove Indian government entities, including Bhabha Atomic Research Centre (BARC), Indira Gandhi Atomic Research Centre (IGCAR), and Indian Rare Earths Limited (IREL), from the **US entity list**.
  - This move aims to facilitate collaboration between India's nuclear institutions and US companies.

U.S. to remove Indian entities from restricted lists, says Jake Sullivan

Kallol Bhattacherjee
NEW DELHI

The United States will soon remove Indian scientific and nuclear entities from the "restricted lists" in order to "fully realise" the potential of the India-U.S. nuclear deal that was signed between Prime Minister Manmohan Singh and President George W. Bush, visiting U.S. National Security Adviser Jake Sullivan said here on Monday. Speaking at the Indian Institute of Technology, Delhi, Mr. Sullivan presented the space and nuclear sectors as arenas of greater cooperation between the two sides.

"So today I can announce that the U.S. is now finalising the necessary steps to remove long-standing regulations that have prevented civil nuclear cooperation between India's leading nuclear entities and U.S. companies. The formal paper work will be done soon," said Mr. Sullivan declaring the initiative. He described the move by the Biden administration as an "an opportunity to turn the page on some of the frictions of the past and create opportunities for the Indian entities that have been on the restricted list of the United States". He called upon the U.S. private sector and scientists and technologists to collaborate with Indian entities to "move civil nuclear cooperation" between the two countries.

Mr. Sullivan met External Affairs Minister S. Jaishankar and Prime Minister Narendra Modi during his visit. Following the meeting, Mr. Modi remarked, "The India-U.S. Comprehensive Global Strategic Partnership has scaled new heights, including in the areas of technology, defence, space, biotechnology and Artificial Intelligence. Look forward to building upon this momentum in ties between our two democracies for the benefit of our people and global good."

The External Affairs Ministry, in a statement, announced that Mr. Sullivan met his Indian counterpart, National Security Adviser Ajit Doval, and briefed him about the "updates brought out by the Biden administration to U.S. missile export control policies under the Missile Technology Control Regime (MTCR) that will boost U.S. commercial space cooperation with India."

Strong ties: External Affairs Minister S. Jaishankar with U.S. National Security Adviser Jake Sullivan in New Delhi on Monday. PTI

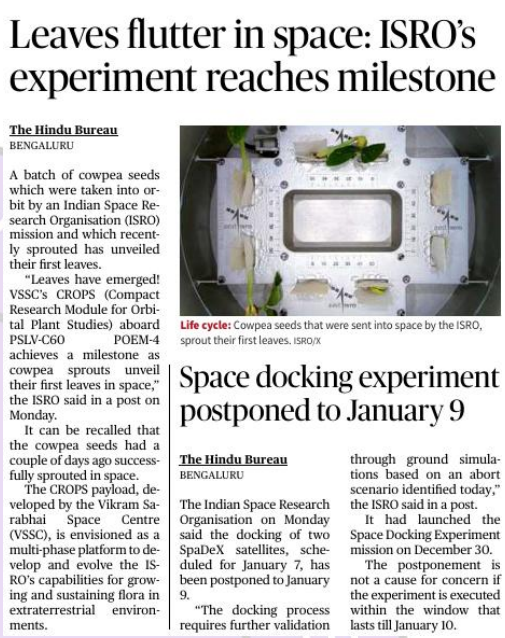
- **What is US Entity List?**
  - **About**
    - The US Entity List includes foreign individuals, businesses, and organizations subject to export restrictions and licensing requirements for specific goods and technologies.
  - **Purpose of the List**
    - Compiled by the Bureau of Industry and Security (BIS) under the U.S. Department of Commerce, it aims to prevent unauthorized trade that could support:
      - Terrorism
      - Weapons of Mass Destruction (WMD) programs
      - Activities against US foreign policy or national security interests.
- **Indo-US Civil Nuclear Deal**
  - **About**
    - The Indo-US Civil Nuclear Deal, signed in **2008**, marked a watershed moment in India-US relations.
    - It allowed India to engage in nuclear trade despite not being a signatory to the Non-Proliferation Treaty (NPT).
    - The agreement granted India access to nuclear fuel, reactors, and technology for civilian purposes while committing to the separation of its civilian and military nuclear programs under IAEA safeguards.
  - **Progress**
    - The deal received initial enthusiasm, leading to amendments in US laws like the Hyde Act to accommodate India's unique status.
    - India signed agreements with several countries for nuclear fuel and reactor technologies.
    - However, the operationalization of the agreement has been slow, with limited progress in the construction of nuclear reactors or the flow of significant US investments.
  - **Why Progress Has Been Slow**
    - **Key Legal Barriers** (discussed separately below)
    - **High Costs**: Setting up nuclear reactors involves significant costs, making nuclear energy less competitive.
    - **Regulatory and Bureaucratic Hurdles**: Long-standing regulatory issues, including delays in clearances and approvals, have hindered progress.
    - **Public Opposition**: Concerns over nuclear safety, particularly after incidents like the Fukushima disaster (2011), have slowed reactor projects due to protests and resistance.
    - **Geopolitical Factors**: Divergences over non-proliferation commitments and strategic priorities, as well as legacy issues in bilateral relations, have created friction.

        - **Technological Constraints in India's Nuclear Programme**
            - India's civil nuclear programme primarily relies on Pressurised Heavy Water Reactors (PHWRs) using heavy water and natural uranium.
            - PHWRs are becoming outdated compared to the more widely adopted Light Water Reactors (LWRs), where the US, Russia, and France lead in technology.

- **Key Legal Barriers to Indo-US Civil Nuclear Deal**
    - **US Regulatory Impediments (10CFR810)**:
        - Part 810 of Title 10, Code of Federal Regulations, under the US Atomic Energy Act of 1954, restricts US nuclear vendors from manufacturing equipment or performing nuclear design work in India.
        - This limitation hinders India's aspiration to participate in the manufacturing value chain and co-produce nuclear components for joint projects.
    - **India's Civil Liability for Nuclear Damage Act, 2010**:
        - The Act holds suppliers liable for damages in case of a nuclear accident, deterring foreign vendors like GE-Hitachi, Westinghouse, and Orano from investing in India's nuclear sector.
        - Concerns about future liability remain a significant hurdle for international players.
- **Indo-US Civil Nuclear Collaboration: Opportunities**
    - **The Role of iCET in Strengthening Collaboration**
        - The US-India Initiative on Critical and Emerging Technology (iCET) aims to address these barriers by fostering innovation and enabling joint manufacturing of nuclear components.
        - A breakthrough under iCET could facilitate deployment of American atomic reactors in India and enhance mutual cooperation.
    - **India's Push for Small Modular Reactors (SMRs)**
        - India is positioning itself as a manufacturing hub for nuclear reactors, particularly SMRs with capacities between 30 MWe and 300 MWe.
        - SMRs are cost-effective and scalable, making them attractive for global markets, especially in the Global South.
        - China, however, is actively working to dominate the SMR industry, posing stiff competition to India and the US.
    - **Collaboration in Light Water Reactors (LWRs)**
        - India could gain access to advanced LWR technology, addressing its technological constraints.
        - The US could leverage India's cost-efficient manufacturing ecosystem to offset its high labour costs and protectionist policies.
        - Collaboration could strengthen both nations' ability to compete with China in the global nuclear reactor market.
- **US eases curbs to push nuclear deal – Key Highlights**
    - **Challenges in Bilateral Relations**
        - Sullivan acknowledged challenges in trade, human rights, and rule of law but emphasized long-term strategic alignment between the two nations.
    - **Reducing Dependency on China**
        - Sullivan criticized China's "**predatory industrial strategies**" in sectors like chip manufacturing and clean energy.
        - US companies, including Apple, are diversifying supply chains and expanding into India, with over 25% of iPhones expected to be made in India soon.
        - Sullivan stressed the importance of India-US collaboration to safeguard critical supply chains and technologies.
    - **Ensuring Dual-Use Technologies' Security**
        - Sullivan highlighted the need to prevent advanced technologies from falling into the wrong hands, referencing Russia and its S-400 air defence system.
        - He underscored India-US cooperation for peace and stability in the Indo-Pacific region.

4. ISRO's Breakthrough in Space Agriculture
GS 3 (Science and Tech)

- **Why in News:**
  - ISRO has achieved a groundbreaking milestone in space agriculture with its Compact Research Module for Orbital Plant Studies (**CROPS**) aboard the PSLV-C60 mission. The successful germination of cowpea seeds in space marks **a major step in understanding plant biology in microgravity conditions.**



Leaves flutter in space: ISRO's experiment reaches milestone

The Hindu Bureau
BENGALURU

A batch of cowpea seeds which were taken into orbit by an Indian Space Research Organisation (ISRO) mission and which recently sprouted has unveiled their first leaves.

"Leaves have emerged! VSSC's CROPS (Compact Research Module for Orbital Plant Studies) aboard PSLV-C60 POEM-4 achieves a milestone as cowpea sprouts unveil their first leaves in space," the ISRO said in a post on Monday.

It can be recalled that the cowpea seeds had a couple of days ago successfully sprouted in space.

The CROPS payload, developed by the Vikram Sarabhai Space Centre (VSSC), is envisioned as a multi-phase platform to develop and evolve the ISRO's capabilities for growing and sustaining flora in extraterrestrial environments.

Life cycle: Cowpea seeds that were sent into space by the ISRO, sprout their first leaves. ISRO/X

Space docking experiment postponed to January 9

The Hindu Bureau
BENGALURU

The Indian Space Research Organisation on Monday said the docking of two SpaDeX satellites, scheduled for January 7, has been postponed to January 9.

"The docking process requires further validation through ground simulations based on an abort scenario identified today," the ISRO said in a post.

It had launched the Space Docking Experiment mission on December 30.

The postponement is not a cause for concern if the experiment is executed within the window that lasts till January 10.

- **Key Highlights of the ISRO's CROPS Mission:**
  - **About:** The CROPS payload, developed by the Vikram Sarabhai Space Centre (**VSSC**), is envisioned as a multi-phase platform to develop and evolve ISRO's capabilities for growing and sustaining flora in extra-terrestrial environments.
  - **Successful germination in space:**
    - **Launch details:** The CROPS experiment was launched on December 30, 2024, aboard ISRO's PSLV-C60 mission.
    - **Experiment setup:** Cowpea seeds were housed in the **POEM-4 platform**, which repurposes the PSLV rocket's fourth stage for scientific research.
    - **Results:** Within four days of launch, eight cowpea seeds sprouted their first leaves, demonstrating plant growth potential in space.
  - **Significance of the CROPS experiment:**
    - **Understanding microgravity effects:** The experiment provides crucial insights into how plants adapt and grow in the unique environment of space.
    - **Supporting deep space exploration:** Insights from the CROPS experiment are essential for long-duration missions, such as those to Mars, by helping develop sustainable life support systems.
    - **Contributions to astrobotany:** The successful sprouting of seeds enhances global research on growing food in extraterrestrial environments.
  - **Broader implications:** (POEM-4 and collaborative research)
    - **Payload diversity:** The POEM-4 module carries 24 payloads, including experiments from ISRO and academic institutions.
    - **Public-private collaboration:** The mission underscores the importance of cooperation between government and private entities to advance space science.
  - **Future applications:**
    - **Ensuring food security in space:** The data from this experiment could pave the way for sustainable agricultural systems in space, ensuring food availability for astronauts on extended missions.
    - **Deep space mission readiness:** Research like CROPS is instrumental foer humanity's ambitious goals of Mars colonization and beyond.
- **What is the POEM-4 Platform?**
  - **About:**
    - Also known as PSLV Orbital Experiment Module (POEM)-4, it is a space research platform that uses the spent fourth stage of the Polar Satellite Launch Vehicle (PSLV) to **conduct experiments in microgravity.**
    - It is part of the **ISRO SpaDeX Mission**, and is the fourth deployment of the POEM platform. It has **a capacity that is three times greater than the previous POEM-3 platform**.
  - **Other facts:**
    - **Experiments:** Includes experiments on robotics, sensors, space science, and proof-of-concept technologies.

- **Benefits:** Helps validate technologies for future missions, and provides data for space medicine and Earth applications.
- **Payloads:** 24 payloads from ISRO, start-ups, and educational institutions.

  - **Some of the payloads on the POEM-4 platform include:**
    - **Walking Robotic Arm (RRM-TD):** A robotic manipulator that can move in an inchworm-like motion for inspection and servicing.
    - **Debris Capture Robotic Manipulator:** A VSSC innovation that can capture and manipulate debris to help with space clean-up.
    - **Gradient Control Reaction Wheel Assembly (RWA):** An IISU payload that uses reaction wheels to improve the POEM platform's attitude stabilization.

- **What is the SpaDeX Mission?**
  - SpaDeX mission is **a cost-effective technology demonstrator mission for the demonstration of in-space docking** using two small spacecraft launched by PSLV.
  - This technology is essential for India's space ambitions such as Indian on Moon, sample return from the Moon, the building and operation of Bharatiya Antariksh Station (BAS), etc.
  - In-space docking technology is essential when multiple rocket launches are required to achieve common mission objectives.
  - Through this mission, India is marching towards becoming the fourth country in the world to have space docking technology.
- **Conclusion:**
  - ISRO's CROPS experiment represents **a significant leap in space research**, demonstrating India's capability in astrobotany and its commitment to addressing the challenges of long-term space exploration.
  - The successful germination of cowpea seeds aboard the PSLV-C60 mission sets the stage for further advancements in **sustainable space agriculture and deep-space missions.**

5. Water gushes out from underground in Rajasthan village

Recent events of importance

- **Why in News:**
  - Residents of Taranagar village in Jaisalmer, Rajasthan, experienced a unique phenomenon from December 27 to December 29, when large amounts of water unexpectedly gushed out from underground. The flow stopped naturally without any external intervention.
  - Social media speculated the event's connection to the Saraswati River, referenced in ancient texts like the Rig Veda and believed to have flowed through the region in the past. Experts do not consider this to be linked with the Saraswati River. They believe that this water is millions of years old and in no way linked with the river.

ARTESIAN WELL

When water is confined under pressure between layers of impermeable rock, and gushes forth on its own

EXPRESS NEWS SERVICE
JAIPUR, JANUARY 6

THE RESIDENTS of Taranagar village in Rajasthan's Jaisalmer district witnessed an unusual phenomenon last month — large amounts of water began to gush out of the ground. The flow began on December 27, and stopped without any external intervention in the night of December 29.

Some on social media claimed the flow was from the underground Saraswati river, mentioned in ancient Vedic texts. Scientists have pointed to a geological event instead.

What happened in Jaisalmer?

A local farmer had contracted a firm to dig a tube well on his land to extract groundwater. On the morning of December 27, when the well had reached a depth of 850 feet, water began spouting from the ground.

In about an hour, it began to flow at high pressure — so much so that a truck and a drilling machine were stuck in it. Around 25 *bighas* of land was submerged by the water, which created a large depression in the ground. A small amount of non-inflammable gas was released along with the water.

Dr Narayan Das Inakhiya, Senior Hydro-Geologist at the Rajasthan State Ground Water Department, attributed the incident to an "artesian condition".

What are artesian conditions?

According to the United States Geological Survey website, an artesian aquifer refers to water stored under pressure between layers of sediments and soil below the Earth's surface. It is also described as "confined" water because of the hardy materials that lie above and below the subterranean reservoir.

Unlike water that is extracted through tube wells or wells, however, artesian water can spout on its own; the reservoir is also located deeper below the Earth's surface. The water is surrounded by poorly permeable rocks that result in high pressure. When a rupture (like through drilling) happens, the underground pressure forces the water upward.

The word "artesian" is specifically used when water is "confined under pressure below layers of relatively impermeable rock". It comes from the town of Artois in France, the old Roman city of Artesium, where the best known flowing artesian wells were drilled in the Middle Ages, the USGS says on its website.

Is it unusual for this water to gush out in the desert?

Dr Inakhiya explained that in desert regions, water is confined underneath a geological layer of sandstone. As soon as the top layer is punctured, water starts flowing upwards due to the high pressure. This phenomenon has previously been observed in Rajasthan in places such as Mohangarh and Nachana Samiti Panchayat.

"But the intensity with which the water was flowing (in Taranagar) has never been seen before," Dr Inakhiya said.

Artesian conditions have also been seen in desert regions of Australia and Africa.

Gushing subterranean water flooded a large area. *Screengrab from video*

- **Unexpected Water Flow in Jaisalmer During Tube Well Drilling**
  - **Incident Details**
    - In the Mohangarh area of Jaisalmer, a farmer hired a firm to dig a tube well on December 27.
    - After reaching a depth of 850 feet, water began gushing out at high pressure, trapping a truck and a drilling machine.
    - Around 25 bighas of land nearby were submerged due to the water flow, which also created a large pit.
  - **Gas Release**
    - A small amount of non-inflammable gas accompanied the water flow.

- **Experts Explanation**
  - Geologists at Rajasthan's State Ground Water Department, explained the phenomenon as an **"artesian condition**," where water flows naturally due to underground pressure.

- **Understanding Artesian Aquifers**
  - **Definition of Artesian Aquifer**:
    - According to the United States Geological Survey, an artesian aquifer stores water under pressure between impermeable layers of sediment and soil below the Earth's surface.
    - It is also referred to as “confined” water due to the presence of hardy materials above and below it.
  - **Key Characteristics**:
    - **Confined Water**: The water is confined in layers of rock or soil, creating pressure that forces it to the surface when tapped.
    - **Natural Flow**: Due to the underground pressure, water can flow freely from the well once it is drilled, often without the need for a pump.
    - Depth: Artesian wells typically tap into deeper underground sources compared to regular wells.
  - **Formation**
    - Artesian wells are formed when water from a higher elevation is trapped between two impermeable layers, and the pressure from the surrounding rock forces it upward when a hole or well is drilled.
    - Artesian wells are commonly found in areas with specific geological conditions, and they can provide a steady flow of water for various uses, including irrigation and drinking water.
  - **Difference from Normal Wells**
    - Unlike regular tube wells or wells, artesian water can naturally sprout from underground due to high pressure.
    - This water is located deeper below the surface and is surrounded by poorly permeable rocks that trap the pressure.
    - Drilling or rupturing the confining layers releases this pressure, forcing water upward.
- **Artesian Aquifers in the Desert Region**
  - **Water Confined Under Sandstone Layers**
    - In desert areas, water is trapped beneath a geological layer of sandstone.
    - When this top layer is punctured, water flows upward due to intense underground pressure.
  - **Unique Observation in Taranagar**
    - While this phenomenon has been seen in places like Mohangarh and Nachana Samiti Panchayat in Rajasthan, the intensity of water flow observed in Taranagar was unprecedented.
  - **Global Occurrence of Artesian Phenomena**
    - Similar artesian conditions have been documented in desert regions of Australia and Africa.

6. Deciphering the Indus Valley Script
GS 1 (Art and Culture)

- **Why in News:**
  - Tamil Nadu Chief Minister M.K. Stalin has announced a $1 million prize for deciphering the Indus Valley script, sparking interest in a 5,000-year-old mystery.
  - Beyond its scholarly value, the initiative underscores political and cultural ambitions, particularly positioning Stalin as a champion of Dravidian identity.
- **What is the Indus Valley Script?**
  - **About:** Also known as the Harappan script, it is a **collection of symbols created by the Indus Valley Civilization**. It is **one of the oldest writing systems in the Indian subcontinent**.
  - **Other facts about the Indus Valley Script:**
    - **Script:** The script is **boustrophedon**, meaning it is written right to left in one line and then left to right in the next line.
    - **Time period:** The script was used **from about 2,500 BC to about 1,900 BC**.

- **Language:**
  - The language of the Indus script is **unknown**, and there are no known bilingual inscriptions to help decipher it.
  - The script may have represented several major language families, including **Dravidian, Mundari, Indo-Aryan, Sino-Tibetan**, and Language "X" of the Neolithic Period.
- **Symbols:** About 400 symbols are known.
- **Found on:** The script has been found on many objects, including pottery, seals, bronze and copper tables, bronze tools, bones, and clay tablets.


Mystery of the Indus script

For a century, scholars have tried and failed to decipher the script of the Indus Valley Civilisation. There is now a $1-million prize for anyone who succeeds. Why is the answer so elusive? Is the 'script' not for real?

ADRIJA ROYCHOWDHURY

Why is it so difficult to decipher the Harappan writing system?

ARJUN SENGUPTA

- **Development:** The script's development trajectory includes early incised pottery marks, geometric button seals, and animal motifs with signs above them.
- **Purpose:** Some researchers believe the script was mainly used for **commercial purposes**, with seals used as tax stamps and tablets used as permits for tax collection, craft making, or trading.

- **Challenges in Deciphering the Indus Script:**
  - **Complexities of the writing system:** Deciphering the Indus script remains challenging due to:
    - **Lack of multilingual inscriptions:** Unlike the Rosetta Stone, no bilingual artefacts have been found.
    - **Unknown language:** The script likely represents an unknown language, complicating phonetic assignments.
    - **Limited artefacts:** With only 3,500 seals discovered, each having an average of five characters, the available material is insufficient for comprehensive analysis.
  - **Future prospects:** More archaeological excavations and analyses are essential to provide scholars with data to unravel the script.
- **Connecting Indus Valley and Tamil Nadu:**
  - **Research basis:** A study documented over 15,000 graffiti-bearing pot shards from 140 Tamil Nadu sites and compared them to 4,000 Indus Valley artefacts.
  - **Key findings include:**
    - Identification of 42 base signs, 544 variants, and 1,521 composite forms.
    - **60% of Tamil Nadu signs had parallels in the Indus script, and 90% of graffiti marks in both regions were comparable.**
  - **Significance of similarities:** The study, focused on key Tamil Nadu sites like Keeladi, Sivagalai, and Thulukarpatti, suggests:
    - Evidence of cultural contact between the Indus Valley (Copper Age) and Tamil Nadu (Iron Age).
    - Possibility of direct or intermediary cultural exchanges, warranting further material evidence.
- **Political and Cultural Implications of TN CM's Attempt to Decipher Indus Script:**
  - **Dravidian identity and historical reframing:** Stalin's initiatives aim to **challenge Aryan-centric narratives** by emphasizing:
    - **Tamil Nadu's parallel development** alongside the Indus Valley Civilisation.
    - Advanced carbon dating from Keeladi, showing Tamil Brahmi script dates back to 600 BCE, **narrowing the historical gap**.
    - Highlighted symbols like the bull, connecting Indus seals to Tamil traditions like **Jallikattu**.
  - **Broader Dravidian image:** Stalin has actively emphasized Dravidian governance through initiatives like:
    - Adding "**Belongs to Dravidian Stock**" to his social media profile.
    - Defining the "**Dravidian Model**" as inclusive growth in governance and budgeting.
  - **Political confrontations:** Stalin's efforts align with his party's stance against BJP's cultural narratives, highlighting Tamil Nadu's unique cultural heritage and historical significance.
- **Conclusion:**

- Stalin's initiative not only seeks to decipher an ancient script but also asserts Tamil Nadu's historical significance and cultural identity
- The integration of archaeological findings into political narratives **highlights a broader effort to reshape India's history from a Dravidian perspective**