

The Hindu Important News Articles & Editorial For UPSC CSE

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The Union Cabinet's approval of caste enumeration in the next Census marks a historic shift in post-Independence demographic data collection, with far-reaching implications for policy-making, social justice, and political representation.

Cabinet clears caste enumeration in Census

Caste count would be held for the first time in Independent India; the Census would be conducted in digital mode; dates for the delayed Census yet to be notified; Amit Shah says the count will promote inclusion and pave new paths of progress; the findings likely to become basis of the next delimitation exercise to decide the number of LS seats

Vijaita Singh
NEW DELHI

The Union Cabinet has decided to include caste enumeration as part of the next Census exercise, Union Minister Ashwini Vaishnaw announced on Wednesday. Though the decision comes months ahead of the Bihar Assembly election, the dates for the next decennial Census exercise, last held in 2011, are yet to be notified by the government. The 2021 Census has been postponed indefinitely, initially due to the COVID-19 pandemic. The last time that India's entire population was counted by caste was in pre-Independent India, in 1931. Since then, only Scheduled Castes and Sched-

uled Tribes have been counted in the Census exercises.

However, reservation measures for education and employment have expanded to include Other Backward Classes (OBCs), all based on projection and estimates from the British-era head count.

Unlike the 2011 Socio-Economic Caste Census (SECC), which was done outside the purview of the Census exercise and did not mandate caste disclosure, this time, caste will be enumerated in the second and final phase of the Census, giving the count a statutory backing.

Digital mode

A senior government official told *The Hindu* that as the next Census would be



Finer details: Union Minister Ashwini Vaishnaw briefing the media on the cabinet decision on Wednesday. SHIV KUMAR PUSHPAKAR

conducted in digital mode for the first time, an "other" column with a drop down code directory containing the names of the castes will likely be added in the Census mobile application.

The official added that the software for this is cur-

rently undergoing tests.

Union Home Minister Amit Shah said on X that "the Congress and its allies opposed the caste census for decades while in power and played politics over it while in the Opposition".

He said that the decision "will promote inclusion

and pave new paths for the progress of the deprived."

The Hindu reported first on August 22, 2024 that the Union government was actively considering caste enumeration.

Briefing presspersons after the Cabinet meeting on Thursday, Mr. Vaishnaw said: "Congress governments have always opposed caste census. Caste was not included in all the census operations conducted since Independence. In 2010, then Prime Minister late Manmohan Singh ji had assured the Lok Sabha that the matter of caste census should be considered in the Cabinet. A Group of Ministers was formed to consider this subject. Most of the political parties had recommended caste census. Des-

pite this, the Congress government decided to conduct merely a survey of caste instead of a caste census. That survey is known as the SECC."

Creating a list of castes

The official quoted above added that the SECC showed more than 46 lakh different caste names, whereas the total number of castes counted during the 1931 Census was 4,147.

The official added: "The SECC threw up lakhs of caste names as it was kept open ended. Respondents were asked to name their castes. For example, people wrote Gupta, Agarwal etc. for Baniya caste, which increased the numbers exponentially. This time, a code directory will likely be provided which will in-

clude approved names."

According to the latest government data, there are about 2,650 OBC communities in the Central list, 1,170 in the SC category, and 890 communities in the ST list. The State governments maintain their own list of OBC groups.

The findings of the Census will also become the basis of the next delimitation exercise for seats in the Lok Sabha, and will kick off the implementation of the 33% reservation for women in Parliament and the State Assemblies, giving additional import to the count. Around 30 lakh government officials will perform the duties of enumerators.

STRATEGIC MOVE
» PAGE 5

Significance of the Move:

1. Historic First Since Independence:

- SCs and STs have been regularly enumerated.
- OBC data based on **1931 projections**; this move fills a critical data gap.

2. Policy Formulation and Targeted Welfare:

- Reliable data will enhance **evidence-based affirmative action**.
- Helps in effective resource allocation and policy outreach to marginalized groups.

3. Basis for Political Decisions:

- Will guide **future delimitation** of Lok Sabha and State Assembly seats.
- Linked to **implementation of women's reservation** in legislatures.

4. Inclusion and Equity:

- Could redefine **social inclusion frameworks**.
- Helps **recognize sub-castes and micro-communities** needing support.

Challenges Ahead:

1. **Data Accuracy:**

- SECC 2011 showed **46 lakh caste names** due to self-reporting; now to be standardized through **code directories**.
- Ensuring uniform categorization without overlaps is a major task.

2. **Political Sensitivity:**

- Caste data could influence electoral politics and lead to **demands for quota expansion**.
- Risk of deepening **caste identities** rather than transcending them.

3. **Delimitation Complexities:**

- Based on caste and gender, it may **alter power dynamics** in representation.
- Requires **constitutional clarity and consensus**.

4. **Privacy and Digital Concerns:**

- With a digital census, **data protection and anonymity** must be ensured.

Criticism & Opposition:

- Critics argue that caste enumeration may **entrench social divisions**.
- Past governments, particularly the **Congress-led UPA**, hesitated or limited caste data collection.

Way Forward:

- Ensure **transparency, inclusivity, and safeguards** in data collection.
- Use data **only for welfare and representation**, not for divisive politics.
- Build robust **technological systems and training** for enumerators.
- Integrate findings into **inclusive development policies**.

UPSC Mains Practice Question

Ques :Discuss how caste enumeration in the Indian Census can influence the sociopolitical fabric of the country. What measures should be taken to ensure it promotes inclusion rather than division?

Following the **terrorist attack in Pahalgam**, Jammu & Kashmir, tensions have risen between **India and Pakistan**. The **United States** has urged both nuclear-armed neighbors to exercise restraint and avoid escalation, while also initiating diplomatic outreach.

Key Developments:

- **U.S. Mediation Attempt:**
 - U.S. Secretary of State **Marco Rubio** is engaging with both sides, urging calm and diplomacy.
 - The U.S. is "monitoring developments" and promoting a **responsible resolution**.
- **Pakistan's Allegations:**
 - PM **Shehbaz Sharif** accused India of "**provocative behavior**".
 - Pakistan's government warned of an **imminent Indian strike** within 36 hours (based on alleged intel).
- **India's Response:**
 - As of now, **no official comment** from India's Foreign Ministry.
 - India is typically firm on **cross-border terrorism** as a red line.
- **U.S. Stance on Pakistan's Past Role:**
 - Responding to Pakistani Defence Minister's controversial claim of "doing U.S.'s dirty work," U.S. officials refused direct comment but emphasized current diplomatic focus.

Strategic and Diplomatic Implications:

For India:

- **Diplomatic Leverage:**
 - The attack allows India to **re-emphasize its position on cross-border terrorism**.
 - If escalation continues, India may **recalibrate its regional security posture**, including military preparedness and international advocacy.

U.S. urges India and Pak. to 'de-escalate'; Rubio talks to Sharif

Press Trust of India
NEW YORK/WASHINGTON

The U.S. has called on India and Pakistan "not to escalate" the tension between them following the Pahalgam terror attack, the U.S. State Department said on Tuesday.

Washington was reaching out to both New Delhi and Islamabad regarding the Kashmir situation and telling them not to escalate the situation, State Department spokesperson Tammy Bruce said.

Pakistan's Prime Minister Shehbaz Sharif received a telephone call from U.S. Secretary of State Marco Rubio on Wednesday evening, Mr. Sharif's office said in a statement. Ms. Bruce had said that Mr. Rubio was expected to speak "at the earliest" to Foreign Ministers of both countries.

Sharif accuses India

Mr. Sharif accused India of "escalatory and provocative behavior" and urged the U.S. to impress upon India to dial down the rhetoric and act responsibly, the statement added.

Pakistan's Information Minister Attaullah Tarar said on Wednesday that the country had credible intelligence that India intends to launch a military strike within the next 36 hours.

India's Foreign Ministry did not immediately respond to a request for comment.

Mr. Rubio "is encouraging other national leaders and Foreign Ministers to reach out to the countries on this issue", the State Department spokesperson said.

"Obviously, we're also monitoring the developments across the board in that region, and we are in touch with the govern-



Marco Rubio

ments of India and Pakistan, not just at the Foreign Minister level, certainly, but at multiple levels. We are encouraging all parties to work together for a responsible solution. The world is watching this," she added.

Responding to a question on Pakistan's Defence Minister Khawaja Asif's comments that Pakistan has "been doing this dirty work for United States", Ms. Bruce said "the only thing I'm really prepared to discuss here is the fact that the Secretary of State is going to be speaking with the Foreign Ministers of both countries."

"So it is — again, as I've noted, every day action is being taken, in this case the Secretary speaking directly to his counterparts in India and Pakistan, and well — we expect certainly the impact he's usually had with the individuals he's spoken with and certainly with President Donald Trump's leadership, India and Pakistan having those conversations. It's very important for them," Ms. Bruce said.

Mr. Trump had said on April 26 that there had always been tensions between India and Pakistan, and the two countries would figure it out between themselves "one way or the other".

(With inputs from Reuters and AFP)

Daily News Analysis

- **Pressure to Avoid Escalation:**
 - U.S. calls for restraint reflect global anxiety about conflict in **South Asia**—a **nuclear flashpoint**.
- **Perception Management:**
 - India must balance **domestic pressure for action** and **international calls for de-escalation**.

For the U.S.:

- **Maintaining Regional Stability:**
 - The U.S. has strategic interests in South Asia, including counter-terrorism, trade, and China containment.
 - By engaging both nations, it **projects itself as a stabilizing actor**.
- **Credibility Challenges:**
 - Statements like “Pakistan has done the U.S.’s dirty work” raise **questions about past alliances and strategic trust**.

Critical Analysis :

Why U.S. Intervention Matters:

- **South Asia's Fragility:**
 - Past conflicts (e.g., **Kargil, Balakot air strikes**) show how quickly Indo-Pak ties can spiral.
- **Nuclear Deterrence & Brinkmanship:**
 - Despite nuclear deterrence, **sub-conventional warfare** (terror attacks, cyber warfare, covert ops) continues.
- **Great Power Diplomacy:**
 - U.S. involvement reflects the **geostrategic importance of India-Pak dynamics**, especially in light of **China's role in the region**.

India's Approach: Strategic Autonomy or Multilateral Coordination?

- Should India **escalate diplomatically** or **respond militarily**?
- India's consistent stance has been: **“Talks and terror cannot go together.”**
- The balancing act lies in **assertive diplomacy, calibrated response, and strategic communication** to global forums.

Conclusion:

The Pahalgam terror attack and subsequent Indo-Pak tensions once again highlight the **fragility of peace in South Asia**. While global powers like the U.S. are nudging toward diplomacy, India faces the dual challenge of ensuring **national security** and managing **international perceptions**. A **nuanced, layered strategy** will be vital in the days ahead.

UPSC Mains Practice Question

Ques : "India's response to cross-border terrorism must balance strategic assertiveness with diplomatic maturity." In light of recent Indo-Pak tensions and U.S. involvement, critically examine India's options. **(250 Words)**



In a landmark ruling, the **Supreme Court of India** declared that **inclusive and accessible digital access** to e-governance and welfare services is **an essential component of the fundamental right to life and liberty under Article 21**. The judgment addresses systemic exclusions in India's digital architecture, especially impacting **Persons with Disabilities (PwDs), acid attack survivors, the rural poor, and linguistic minorities**.

Digital access to e-governance systems a part of fundamental right to life and liberty: SC

Krishnadas Rajagopal
NEW DELHI

Inclusive and meaningful digital access to e-governance and welfare delivery systems is a part of the fundamental right to life and liberty, the Supreme Court held in a judgment on Wednesday.

A Bench of Justices J.B. Pardiwala and R. Mahadevan, hearing a petition on how people with disability find it nearly impossible to complete the digital Know Your Customer (KYC) process, said that the state has an obligation to provide an inclusive digital ecosystem to the marginalised, underprivileged, vulnerable, disabled, and historically excluded sections of society.

Amid the "wave of digital progress" in India—through Aadhaar, online service delivery platforms, and net banking—a crucial aspect often overlooked is whether this technology is truly inclusive and accessible to all, the court said.

"The right to digital access emerges as an instinc-

tive component of the right to life and liberty, necessitating the state to proactively design and implement inclusive digital ecosystems to serve not only the privileged, but also the marginalised and those who have been historically excluded," said Justice Mahadevan, who authored the judgment.

The Bench also issued 20 directions to the government to improve the KYC processes, to make them more accessible.

The judgment was based on a petition filed by a group of acid attack survivors led by Pragya Prasad and others, and a separate plea by Amar Jain, who is visually disabled. They raised concerns about how disabled people, including acid attack victims, find it nearly impossible to successfully complete the digital KYC processes, which include visual tasks.

Justice Mahadevan said that facial trauma, disfigurement, and visual impairments makes it impos-



sible for acid attack survivors to even move their heads, blink, carry out visual instructions, and position their faces within the specified frames provided on the screen.

As a result, they are unable to establish their identity digitally or face prolonged delays to even open a bank account or access essential services and government welfare schemes.

Digital divide

The top court said that the unfriendly digital atmosphere has managed to further cripple these sections of the population rather than returning them

to mainstream society.

"In the contemporary era, access to essential services, governance, education, healthcare and economic opportunities is increasingly mediated through digital platforms. Right to life under Article 21 of the Constitution has to be reinterpreted in light of these technological realities," Justice Mahadevan pointed out.

Bridging the digital divide is no longer merely a matter of policy discretion but has become a constitutional imperative to ensure a life of dignity, autonomy, equal participation in public life, the Supreme Court noted.

"Digital divide characterised by unequal access to digital infrastructure, skills, contents continue to perpetrate systemic exclusion not only of persons with disabilities (PwD), but also large sections of the rural population, senior citizens, economically weaker communities and linguistic minorities," the top court highlighted.

Invoking the 'principle of substantive equality', the Supreme Court held that digital transformation must be both inclusive and equitable. "PwD encounters unique barriers in accessing online services due to a lack of accessible websites, applications and assisted technology," the judgment said.

Similarly, rural Indians face poor connectivity, and scarce content in regional languages, which effectively deny them meaningful access to e-governance and welfare measures.

"The state's obligation under Articles 21 [right to a dignified life], 14 [equality], 15 [right against discrimination], 38 [Directive Principles of State Policy] of the Constitution must encompass the responsibility to ensure that digital infrastructure, government portals, online learning platforms and financial technology are universally accessible and responsive to all vulnerable and marginalised sections," the court held.

Daily News Analysis

Key Highlights (Prelims Focus):

Element	Details
Articles Invoked	Article 21 (Right to Life), Article 14 (Equality), Article 15 (Non-discrimination), Article 38 (DPSP)
Petitioners	Acid attack survivors (led by Pragya Prasun), Amar Jain (visually impaired)
Core Issue	Inaccessibility of digital KYC for PwDs due to lack of inclusive tech
Bench	Justices J.B. Pardiwala and R. Mahadevan
Supreme Court Directions	Issued 20 directives to make digital KYC inclusive
Legal Doctrine Invoked	Substantive Equality (equal outcomes, not just equal treatment)

Significance of the Judgment:

- Redefining Article 21 in the Digital Age:**
 - Right to life now interpreted to include **digital access to welfare, education, health, and finance**.
 - Bridges constitutional guarantees with **technological realities**.
- Digital Divide as Constitutional Violation:**
 - Exclusion from digital systems = **exclusion from essential services**.
 - Highlights how facial recognition systems, OTPs, visual instructions disadvantage PwDs.
- Empowering the Vulnerable:**
 - Prioritizes **accessibility and inclusion** for acid attack survivors, blind users, elderly, rural and non-English-speaking users.
- Obligation of the State:**
 - Moves from **policy discretion to constitutional duty** to ensure **universal digital infrastructure**.
 - Requires public platforms to follow **accessibility guidelines** (like WCAG, AI-based assistance, regional languages).
- Boost to SDGs:**

Daily News Analysis

- Aligns with **Sustainable Development Goals** – especially **Goal 10 (Reduced Inequality)** and **Goal 16 (Peace, Justice & Institutions)**.

Legal and Ethical Implications:

Issue	Implication
Substantive Equality	Justice ≠ sameness; equality must consider differing abilities and barriers
Right to Identity	Failure in digital KYC = denial of financial inclusion, PDS, healthcare access
State Responsibility	State must design inclusive systems — not burden the citizen to adapt
Ethics of Governance	True digital governance must be compassionate, accessible, and responsive

Conclusion:

This judgment transforms the concept of **e-governance from a technological ambition into a constitutional right**. It emphasizes that **digital empowerment must be human-centric**, especially for the historically marginalized. Going forward, **universal digital design** will be a cornerstone of inclusive governance.

UPSC Prelims Practice Question

Ques : With reference to the recent Supreme Court ruling regarding digital access, consider the following statements:

1. The Court held that access to digital systems is a part of the Right to Education under Article 21A.
2. The judgment emphasizes the need for substantive equality in digital inclusion.
3. The petition was filed by a group of acid attack survivors and visually impaired individuals.

Which of the statements is/are correct?

- a) 1 only
- b) 2 and 3 only
- c) 1 and 3 only

d) 1, 2 and 3

Ans : b)

UPSC Mains Practice Question

Ques : "The right to digital access is now a constitutional imperative, not just a policy objective." Critically examine the implications of the recent Supreme Court judgment on inclusive digital governance in India. **(250 Words)**



Page 05 : GS 2 : Governance and Social Justice

The Supreme Court, while hearing a suo motu case related to **food security for migrant workers**, emphasized that **free ration distribution** alone is **not a long-term solution**. The Court stressed the equal importance of **employment generation** and **infrastructure development** for sustainable poverty alleviation.

Job generation, building infrastructure as important as distribution of free ration'

The Hindu Bureau
NEW DELHI

The Supreme Court on Wednesday said it is "very easy" for States to get food grains from the Centre and distribute it for free among the people to gain political popularity. Ultimately, however, it is the taxpayer who has to bear the burden of the distribution of free ration to the burgeoning poor, a Bench headed by Justice Surya Kant said.

The court held that other activities, such as generating employment and building infrastructure, were as important as distribution of free ration.

The court was hearing a suo motu case on food security, especially for migrant workers. The case was originally based on petitions filed by activists Anjali Bharadwaj, Harsh Mander and Jagdeep Chhokar, represented by advocate Prashant Bhushan, seeking directions to the Centre and States to ensure food security, cash transfers and other welfare measures for distressed migrant workers during the



NFSA entitled 75% of rural and 50% of urban population to receive highly subsidised foodgrains, Mr. Bhushan said in court. M. SRINATH

second wave of the COVID-19 pandemic.

"Now, in 2025, are we still carrying the 'poverty' tag? States say we are ready to issue ration cards, free rations, provided the Centre gives it... The Centre will give, but at whose cost? The burden is on the taxpayer... Where will we get the money for infrastructure, generating employment... These are also issues to be addressed," Justice Kant remarked. He asked whether the nation was still, in 2025, stuck at the same level of poverty as in 2011, when the last Census was taken. Mr. Bhushan said that as the population has

increased in the past decade, the numbers of poor people would have also gone up.

In an earlier hearing, the top court had said the long-term response to problems of food security was to generate employment. Mr. Bhushan had argued that the National Food Security Act was still driven by figures from the 2011 Census. He had pointed out that the NFSA entitled 75% of the rural population and 50% of the urban population to receive highly subsidised foodgrains under two categories of beneficiaries. However, this quota was based on the 2011 Census.

Daily News Analysis

Prelims Focus:

Concept	Key Details
National Food Security Act (NFSA), 2013	Legally entitles 75% of rural and 50% of urban population to subsidized foodgrains
Coverage Based On	2011 Census (Now outdated – raises concerns about exclusion)
Petitioners	Activists Anjali Bharadwaj, Harsh Mander, Jagdeep Chhokar
Context	Filed during COVID-19 2nd wave , demanding food security and welfare for migrant workers
Bench	Led by Justice Surya Kant

Mains Relevance:

Key Issues Raised by the Supreme Court:

1. Free Ration vs. Fiscal Burden:

- Distribution of free foodgrains is often used by States to **gain political mileage**.
- Ultimately, the **burden falls on taxpayers**, affecting fiscal priorities like infrastructure and employment.

2. Outdated Data, Incomplete Coverage:

- NFSA is still based on the **2011 Census**, while the **population has increased significantly**.
- Many **eligible poor remain excluded** due to outdated quotas.

3. Structural Poverty & Policy Dependence:

- Court questioned whether India is still trapped in the **same poverty tag of 2011**.
- Warned against over-reliance on welfare without **capacity-building measures**.

4. Sustainable Solutions:

- Emphasized the need for **employment generation**, skill-building, and **infrastructure investment** as **long-term answers** to poverty.
- Welfare must not **replace economic empowerment**.

Analytical Insights :

Concern	Explanation

Daily News Analysis

Concern	Explanation
Populism vs. Development	Over-reliance on free schemes may discourage states from focusing on productive investments .
Data Gap Governance	Failure to update Census data skews policy implementation. Modern welfare requires real-time, dynamic data .
Inclusion vs. Fiscal Responsibility	Balancing universal entitlements with limited resources is a governance challenge .
Migrant Workers' Vulnerability	Lack of portability of food security and identification continues to exclude mobile populations.

Conclusion:

The Supreme Court's remarks reflect a larger truth: **Welfare must empower, not create dependency**. While food security is vital, India's poverty response must evolve to include **dynamic data systems**, **decentralized welfare**, and **growth-led empowerment** through infrastructure and job creation.

UPSC Prelims Practice Question

With reference to the National Food Security Act (NFSA), 2013, consider the following statements:

1. It provides for the coverage of 100% rural and urban populations for subsidized foodgrains.
2. It is currently implemented based on the 2011 Census population estimates.
3. It legally entitles the beneficiaries to receive pulses and oil along with foodgrains.

Which of the statements is/are correct?

- a) 1 and 2 only
- b) 2 only
- c) 2 and 3 only
- d) 1, 2 and 3

Ans : b)

UPSC Mains Practice Question

Ques : "While welfare schemes are necessary for social justice, long-term poverty alleviation demands sustainable employment and infrastructure development." Discuss in the context of recent Supreme Court observations on food security.



Natural hydrogen — also known as **white hydrogen** — is emerging as a **potential game-changer** in the global clean energy transition. While hydrogen is already in focus as a **green fuel**, the discovery of vast naturally occurring underground hydrogen reserves could significantly **reduce dependence on fossil fuels** and make the **hydrogen economy more cost-effective** and sustainable.



Daily News Analysis

Is natural hydrogen the fuel of the future?

How does hydrogen occur naturally in the environment? Why was it considered unviable to mine or harvest natural hydrogen? Can natural hydrogen as a fuel meet growing global energy demands? Why is it still an untapped industry? Does India have natural hydrogen reserves?

EXPLAINER

Kalyan Mangalapalli

The story so far:

Hydrogen is seen as the fuel of the future – one that would decarbonise world economy and stop global warming. If harvested in a sustainable manner, natural hydrogen may provide a clean and potentially low-cost fuel to satisfy the world's increasing energy needs with a considerable reduction in carbon emissions as well. And it's most likely abundant in India, too.

How is natural hydrogen extracted?

Right now, hydrogen is manufactured mostly from natural gas through an energy-intensive and polluting process. Green hydrogen made with renewable electricity, on the other hand, is still prohibitively expensive and would require vast amounts of wind and solar power to work out at scale.

Natural hydrogen occurs as a free gas in geology, produced by processes such as serpentinisation (the interaction of water and iron-containing rocks), radiolysis of water by radioactive rocks, and from organic matter at depth.

What is the history of its extraction?

In the summer of 1987, drillers arrived at Mamadou's village of Bourakébougou, Mali, to bore for water. After drilling 108m at one site, with no water to be found, one of the crew lit a cigarette – and a jet of flame shot into his face. The flame turned into a huge fire that shone crystal blue during the daytime with no sign of smoke around it. At night, it shone a glowing gold that lit its surroundings. It took weeks for the crew to extinguish the blaze and cap the well.

This unexpected event led the villagers to avoid the site until 2007 when Aliou Diallo, a successful Malian businessman, politician, and chairperson of Petroma, an oil and gas firm, purchased the rights to prospect in the area around Bourakébougou. In 2012, he hired Chapman Petroleum to figure out what was emanating from the borehole. Protected from the 50°C sun in a mobile laboratory, a team of engineers found that the gas was 98% hydrogen. Hydrogen is rarely recovered in oil operations and was not thought to exist in large reserves within the earth's crust, until then.

While the presence of naturally occurring hydrogen has been known for decades, with the discovery of its presence in gas seeps, volcanic outgassing, and even mine workings being well documented decades ago, for many years, it was viewed as a geological curiosity. Majority of the scientific opinion at the time proposed that hydrogen's small size and extreme reactivity would hinder the formation of substantial underground deposits.

Now, geological environments favourable to natural hydrogen generation and accumulation are being recognised worldwide. Active mountain ranges with tectonic activity, such as the Pyrenees, Alps, and Himalayas, are also being considered as areas for geological hydrogen production. The fact that helium co-exists with hydrogen in a few reserves points towards some geological processes, such as radiolysis, playing a role in its generation.

The presence of hydrogen in coal mines points towards generation from underlying organic matter. What was previously a specialist field of geological



Scouting for more: A 2,500 cubic-metre tank containing liquid hydrogen at Kobe Port Island plant in Kobe, Hyogo Prefecture, Japan. *XFP*

study has therefore become a growing field with enormous implications for the future of energy.

What about current reserves?

Although the total size of worldwide natural hydrogen reserves is still poorly known because of a lack of concentrated exploration, recent discoveries and current research indicate considerable potential. In contrast to conventional hydrocarbon exploration, dedicated frameworks for natural hydrogen exploration are still evolving.

In the Indian context, natural hydrogen potential is mostly untapped but found to be promising because of the existence of favourable geological structures like hard rock formations of diverse ultramafic/mafic and basaltic assemblages, Andaman and Himalayan ophiolite complexes, greenschist volcanic-sedimentary sequences in cratons (Dharwar, Singhbhum), sedimentary basins (for example, in Vindhyan, Cuddapah, Gondwana and Chhattisgarh), basement rocks with fractures, and areas where active hydrothermal systems as represented by hot springs exist.

Recent finds elsewhere in the world indicate the scale of these resources. Hundreds of hydrogen seeps have been catalogued globally in various countries, including Australia (Eyre Peninsula and Kangaroo Island), the United States (Kansas, Nebraska), Spain, France, Albania, Colombia, South Korea, and

Canada. There could be sufficient natural hydrogen to supply the growing world demand for thousands of years, based on a model run by the U.S. Geological Survey (USGS) that was unveiled in October 2022 at a Geological Society of America meeting.

Close on the heels of the USGS model, scientists, venturing into abandoned mines in France's Lorraine region chanced upon naturally occurring hydrogen in May 2023. Further excavation in March 2025 in the adjacent Moselle region yielded more reserves. Together, the deposits are estimated to be about 92 million tonnes – worth about \$92 billion and about half of the current global hydrogen production.

While it's difficult to project with certainty just how much hydrogen is available in geologic stores, the best estimate is on the order of tens of trillions of metric tonnes. If even just 2% of these reserves are commercially exploitable, they would provide about twice as much energy as all the earth's provable natural gas reserves – enough to meet projected hydrogen demand (500 million tonnes per year) for around two hundred years. However, experts note that it is still unclear how much of that potential can be tapped economically, especially if deposits are too scattered.

How has industry reacted?

The promise of so much renewable fuel sitting undiscovered beneath the surface has sparked a veritable gold rush. By the

end of 2023, 40 companies, including start-ups, were searching for deposits of natural hydrogen around the world, up from just 10 in 2020, according to research firm Rystad Energy.

They're hunting for natural hydrogen in countries such as Australia, the U.S., Spain, France, Albania, Colombia, South Korea and Canada. Producers claim they can extract the fuel for about \$1/kg, or even less – much lower than the production cost for green or even natural gas-based hydrogen.

The American Association of Petroleum Geologists have formed its first natural hydrogen committee, and USGS began its first effort to identify promising hydrogen production zones in the United States.

In the U.S., a start-up called Koloma raised \$245 million of venture funding last year to search for and extract geologic hydrogen, attracting investors including Amazon's climate fund and Bill Gates' Breakthrough Energy Ventures, which is also investing in other natural hydrogen companies, such as Mantle 8 in Europe. Even conventional energy and mining companies are in on the rush – both BP and Rio Tinto recently invested in U.K.-based start-up Snowfox Discovery.

Kalyan Mangalapalli is an expert in Energy and Emerging Technologies and serves as a member of the International Advisory Board of the Indian Institute of Petroleum Energy, Visakhapatnam. This is the first of a two part series on naturally occurring hydrogen reserves.

THE GIST

Natural hydrogen occurs as a free gas in geology, produced by processes such as serpentinisation (the interaction of water and iron-containing rocks), radiolysis of water by radioactive rocks, and from organic matter at depth.

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The American Association of Petroleum Geologists have formed its first natural hydrogen committee.

Prelims-Oriented Facts:

Feature	Details
Natural Hydrogen (White H ₂)	Hydrogen naturally occurring underground, unlike grey/blue/green hydrogen that is manufactured

Daily News Analysis

Feature	Details
Production Mechanisms	Serpentinization, radiolysis, volcanic outgassing, breakdown of organic matter
Global Reserves	Found in France (Lorraine, Moselle), U.S. (Nebraska, Kansas), Australia, Spain, Albania, etc.
India's Geological Potential	Dharwar, Singhbhum cratons; Vindhyan, Cuddapah, Gondwana basins; Andaman & Himalayas ophiolites
Discovery Highlight	Bourakébougou, Mali – site of first accidental natural hydrogen flame (1987); later confirmed as 98% hydrogen
USGS Model (2022)	Estimated tens of trillions of tonnes of natural hydrogen underground
Cost Advantage	Estimated cost: \$1/kg or less , cheaper than green hydrogen (\$4–6/kg)

Types of Hydrogen :

Type	Source	Carbon Emissions
Grey	Natural gas (steam reforming)	High
Blue	Natural gas + Carbon Capture	Medium
Green	Electrolysis using renewable energy	Zero
White	Naturally occurring underground hydrogen	Zero (if extracted cleanly)

Why Natural Hydrogen Matters:

- Low-Cost, Clean Fuel:**
 - No CO₂ emissions during formation or use.
 - Cost of extraction significantly lower** than current green hydrogen production.
- Abundant Global Reserves:**

Daily News Analysis

- Could meet **global energy demand for centuries** (e.g., USGS model suggests 2% extractable = twice the total natural gas reserves).
- Potential resource **for energy security and energy equity**.
- 3. **Boost to Global Hydrogen Economy:**
 - Supports transition to clean fuels in **hard-to-abate sectors** like steel, cement, aviation.
 - Opportunity for **developing nations like India** to leapfrog into a hydrogen-based future.
- 4. **Strategic Investments:**
 - Global startups (Koloma, Snowfox, Mantle 8) and **tech giants (Amazon, Bill Gates)** are investing in natural H₂.
 - **Oil & gas companies (BP, Rio Tinto)** diversifying into hydrogen.

Challenges Ahead:

Challenge	Explanation
Unmapped Reserves	Lack of exploratory infrastructure, research, and regulatory frameworks
Economic Viability	Reserves may be scattered , deep, or inaccessible
Environmental Risks	Extraction could still have ecological impacts if not regulated
Policy & Regulation	No standardized international framework yet; countries lack licensing systems for H₂ mining
Technological Gaps	Still an emerging field; scaling remains a challenge

India-Specific Potential and Way Forward:

- Geological regions with potential:
 - **Cratons** (Dharwar, Singhbhum)
 - **Sedimentary basins** (Vindhyan, Gondwana, Cuddapah)
 - **Fractured hard rocks, ophiolites** in Himalayas and Andamans
- India should:
 - **Launch pilot projects** for hydrogen exploration
 - **Map reserves** using geological surveys (GSI, ONGC)
 - Set up **policy framework** under the **National Green Hydrogen Mission**

- Facilitate **private-public R&D collaboration**

Conclusion:

Natural hydrogen is emerging as a serious contender in the clean energy race. While scientific curiosity has evolved into a global resource hunt, **India must not lag behind**. By leveraging its rich geological diversity and aligning with the **National Green Hydrogen Mission**, India can position itself as a **leader in the hydrogen economy of the future**.

UPSC Prelims Practice Question

Ques : Which of the following geological processes are known to produce naturally occurring hydrogen?

1. Serpentinization
2. Radiolysis
3. Volcanic Outgassing
4. Methanogenesis

Select the correct answer using the codes below:

- a) 1 and 2 only
- b) 1, 2 and 3
- c) 2 and 4 only
- d) 1, 3 and 4

Ans : b)

UPSC Mains Practice Question

Ques : Natural hydrogen is being hailed as a transformative clean energy resource. Discuss its advantages and challenges in the context of India's energy transition goals.

Page : 08 Editorial Analysis

India's shame — the trap of bonded labour

On May 1, as the world commemorates International Labour Day to honour the dignity of work and workers' rights, the stories of millions in India trapped in bonded labour cast a dark shadow.

In a quiet corner of Shivpuri, Madhya Pradesh, Mukesh Adivasi, 35, lies on a weathered charpoy, his once-robust frame now frail, his spirit scarred by a traumatic past. In 2023, enticed by promises of work in Indore, Mukesh and his family were trafficked 1,400 kilometres to Karnataka, trapped as bonded labourers. Brutal violence on a sugarcane farm left him with a painful limp and profound exhaustion. "I blame my greed," Mukesh mourns, recalling the ₹500 advance that he got and which ignited hope. Crammed into trucks, they endured a gruelling journey, only to face relentless toil — between 14 hours to 16 hours of work every day.

When Mukesh demanded payment, armed guards savagely beat him, which shattered his right leg. A failed escape attempt brought further cruelty. After weeks of torment, the police rescued Mukesh and others, but his physical and emotional scars remain.

In Puttur, Andhra Pradesh, K. Thenmozhi's childhood dreams of a bright future collapsed at the age of 13. Financial hardship drove her family to a brick kiln in Bengaluru, where an advance of ₹2,000 bound them in servitude. Excruciating work that stretched over 12 to 14 hours under the scorching sun replaced school. The kiln owner's brutality — beatings, verbal abuse and confinement — shattered their spirit. "I knew we were trapped," Thenmozhi recalls. A social worker's visit provoked the owner's fury, but his subsequent flight offered them escape. Fleeing barefoot, Thenmozhi's family left on a train, and reached their village.

The long wait for justice and freedom

The harrowing experiences of survivors such as Mukesh Adivasi and K. Thenmozhi, are among the lakhs of Indians ensnared in bonded labour, exposing the brutality of exploitation and underscoring the urgent need for systemic



Rejimon Kuttappan

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India's economy thrives on its most vulnerable, as bonded and forced labour

reforms to secure justice and freedom for all workers.

Bonded labour emerges from a web of interconnected factors. Immediate triggers, such as medical emergencies, religious ceremonies, dowries, food shortages, or the sudden loss of a job or a breadwinner, may force an impoverished worker to seek a loan or advance from an employer or labour agent. However, deeper systemic issues amplify this vulnerability: discrimination and social exclusion based on religion, ethnicity, or caste; widespread illiteracy and a lack of access to information; employer monopolies over local financial and labour markets; and the dominance of social elites. These elements transform a simple economic transaction between lender and borrower into a mechanism of social control and exploitation.

Policy and plan

India had abolished bonded labour in 1975. In 2016, the then Union Labour Minister, Bandaru Dattatreya, informed Parliament about the government's plan to release and rehabilitate 1.84 crore bonded labourers across the country as part of a 15-year vision extending until 2030.

Interestingly, in December 2021, when parliamentarian Mohammed Jawed inquired about this target in Parliament, the government stated that 12,760 bonded labourers had been rescued and rehabilitated between 2016 and 2021.

The Minister of State for Labour and Employment revealed a harsh truth: of India's estimated 1.84 crore bonded labourers, only 12,760 have been rescued and rehabilitated, leaving approximately 1.71 crore still trapped. To meet the 2030 target of eradicating bonded labour, around 11 lakh individuals would need to have been rescued annually since 2021. Given that only 12,000 bonded labourers were rescued between 2016 and 2021, expecting lakhs to be freed annually is overly optimistic.

In addition to bonded labour, crores of unorganised Indian workers, particularly migrants, endure forced labour in India, which

closely resembles bonded labour. According to a National Sample Survey Organization of India report, the country's total employment across the organised and unorganised sectors was approximately 47 crore. Of this, only 8 crore workers were in the organised sector, while the remaining 39 crore were in the unorganised sector.

The International Labour Organisation's India Employment Report 2024 also states that low-quality jobs in the informal sector and informal employment are the dominant forms of work in India.

The ground reality

Unfortunately, unorganised workers, predominantly migrants in India's informal sector, lack unionisation, depriving them of collective bargaining power. Without unionisation, unorganised workers face exploitative conditions, lack formal contracts, and risk arbitrary dismissal. In the 1940s, Dr. B.R. Ambedkar championed labour rights, mandating trade union recognition and collective bargaining, including the right to strike. However, the Labour Codes of 2019-20 have undermined Ambedkar's legacy, eroding workers' rights and prioritising profit over people, leaving them vulnerable to exploitation.

Since early 2022, investigations by this writer into forced labour across Indian industries have exposed a shameful reality: Indian industries thrive on the exploitation of forced labour, a blatant betrayal of India's workers. Interviews with hundreds of workers — mostly migrants forced from their villages by climate change, crippling poverty, and a lack of job opportunities — lay bare a system rigged against them. These workers lack stable wages, facing meagre pay, precarious conditions, and the constant threat of dismissal. This exploitation, a deliberate assault on their dignity, is perpetuated by a system prioritising profit over people, ignoring modern-day slavery. India's economy shamefully thrives on bonded and forced labour, profiting from its most vulnerable.

Paper 02 & 03 : Indian Polity, Social Justice and Indian Economy

UPSC Mains Practice Question: India's informal economy thrives on structural exploitation of labour. Critically examine the impact of the new Labour Codes on the working class. (250 words)

Daily News Analysis

Context :

On International Labour Day (May 1), the plight of **bonded labourers in India** draws urgent attention. Despite legal abolition in 1975, **millions remain trapped in exploitative conditions**, highlighting the **gap between policy intent and implementation**.

Prelims-Relevant Points:

Element	Details
Bonded Labour (Abolition) Act	Enacted in 1976 ; prohibits bonded labour system
National Target (2016)	1.84 crore bonded labourers to be rescued & rehabilitated by 2030
Actual Rescued (2016–2021)	12,760 only , as per Ministry of Labour
ILO India Employment Report 2024	Highlights dominance of low-quality informal jobs in India
Unorganised Sector Workers	~39 crore out of 47 crore total employed population
Labour Codes (2019–2020)	Rationalised labour laws; criticised for weakening collective bargaining and rights

Causes of Bonded and Forced Labour in India:

Type	Examples
Immediate Triggers	Medical emergencies, dowries, food shortages, death of breadwinner
Structural Causes	Caste-based exclusion, lack of access to formal credit, illiteracy, absence of labour regulation
Climate-Driven Migration	Rural workers migrating due to climate shocks fall prey to labour agents and exploiters

Daily News Analysis

Type	Examples
Employer Dominance	Monopoly over wages, working conditions, and local governance in informal sectors

Failure of State Action:

1. Data Gaps & Poor Rescue Rate:

- Despite setting a goal of **freeing 1.84 crore**, less than **0.01%** have been rescued.
- No centralised database**, lack of state-wise coordination.

2. Weak Implementation of Welfare Laws:

- Bonded Labour System (Abolition) Act**, **Inter-State Migrant Workmen Act**, and other laws poorly enforced.
- Victims often lack **legal awareness** and **access to rehabilitation**.

3. Labour Codes (2019-20) Concerns:

- Dismantled protective mechanisms like the **Trade Unions Act**.
- Made **union registration harder**, diluted **right to strike**, and raised **thresholds for employer compliance**.

Ethical & Constitutional Dimensions:

- Dignity of Labour (Article 21)**: Bonded labour violates **right to life and dignity**.
- Right Against Exploitation (Article 23)**: Explicitly bans **forced labour and begar**.
- Ambedkar's Vision**: Strong advocacy for **trade union rights**, fair wages, and **social justice** is undermined.

The Way Forward:

Action Area	Recommendations
Data & Rescue	Create a real-time national registry of bonded labourers; increase field inspections
Rehabilitation	Provide legal aid, health care, housing, education, and job skill training
Enforcement	Empower District Magistrates and local officials to monitor and report

Daily News Analysis

Action Area	Recommendations
Strengthen Unions	Encourage unionisation in the informal sector ; repeal anti-worker clauses in labour codes
Awareness Campaigns	National campaigns on rights of workers , trafficking risks, and grievance redressal
Technology & Mapping	Use GIS & AI to identify hotspots of exploitation (e.g., brick kilns, farms, mines)

Conclusion:

India's bonded labour problem is not just a **policy failure**, but a **moral crisis**. Until India acknowledges and addresses the systemic causes — from caste to climate — the cycle of exploitation will continue. The Constitution mandates **dignity of life**, but the ground reality reveals **modern-day slavery** in the shadows of economic growth.

