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REPORT ON DATASETS FOR STATE FINANCE COMMISSIONS

Context

- The Ministry of Panchayati Raj has released the **Report of the Committee on Datasets for State Finance Commissions (SFCs)** to strengthen evidence-based fiscal decentralisation.

State Finance Commissions (SFCs)

- **Constitutional Status:** State Finance Commissions are constitutional bodies constituted under **Article 243-I** of the Constitution following the enactment of the **73rd Constitutional Amendment Act, 1992**.
 - ♦ Every State Government is **required to constitute a State Finance Commission every five years** to review the financial position of Panchayats.
- **Functions:** State Finance Commissions **recommend principles governing the distribution of financial resources** between State Governments and Panchayati Raj Institutions.
 - ♦ It recommends the **sharing of taxes, duties, tolls and fees** between State Governments and Panchayats.
 - ♦ It also recommends **grants-in-aid** to Panchayats from the **Consolidated Fund of the State**.

Challenges Faced by State Finance Commissions

- **Lack of Consolidated Accounts:** Financial statements from Panchayats are usually incomplete using **varied and non-standard methods**.
 - ♦ It becomes **extremely difficult for SFCs to prepare a clear, accurate, and complete picture** of the overall financial position of local bodies across the entire state.
- **Capacity Gaps at the Local Level:** Many Gram Panchayats do **not have** trained accountants, **book-keepers, or staff** who understand modern accounting and data management.
- **Fragmented Data Systems:** Data relating to finances, assets, governance and service delivery is scattered across multiple departments.
 - ♦ The absence of integrated databases **increases delays and reduces the quality of SFC assessments**.
- **Delays in SFC Reports:** Delays in the constitution and submission of SFC reports continue to weaken fiscal decentralisation.

- ♦ The Fifteenth Finance Commission noted that the average delay in submission of SFC reports was about **sixteen months**.

Key Recommendations of the Committee

- **Classification of Panchayat Advancement Index Indicators:** Panchayat Advancement Index indicators should be classified into categories such as **needs, performance and backwardness** to facilitate objective fiscal analysis by SFCs.
- **Standard Reporting Framework:** SFCs should adopt a common reporting template to improve consistency and comparability of reports.
- **Supplementary Budget Document:** States should publish a supplementary budget document detailing all transfers made to rural and urban local bodies, including Gram Panchayat-wise allocations.
- **Permanent State Finance Commission Cells:** States should establish permanent SFC Cells to maintain and periodically update fiscal and governance data.
- **Performance Audit:** The Ministry should request the **Comptroller and Auditor General of India** to undertake a performance audit of the implementation of the 73rd Constitutional Amendment.
- **Capacity Building of SFCs:** State Finance Commissions should receive regular training on data systems, analytical tools and digital platforms such as eGramSwaraj.
- **A comprehensive SFC Manual** should be prepared to guide future State Finance Commissions on methodology, data usage and best practices.
- **The National Institute of Rural Development and Panchayati Raj (NIRDPR)** should undertake training programmes and compile best practices for SFCs.

Concluding remarks

- The Report on Datasets for State Finance Commissions recognises that effective **fiscal decentralisation** depends on reliable and granular local governance data.
- By strengthening data systems, and institutional mechanisms the report seeks to make State Finance Commissions more effective instruments of **fiscal devolution** and empower Panchayati Raj Institutions as **engines of grassroots development and self-governance**.

Source: PIB

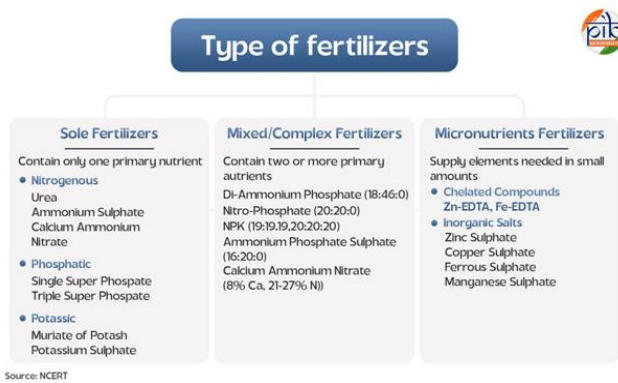
RISE IN INDIA'S FERTILISER SUBSIDY BURDEN

Context

- India's fertiliser subsidy burden is expected to rise sharply to around **₹3.4 lakh crore in 2026-27**, nearly double the Budget Estimate of **₹1.71 lakh crore**, due to surging global fertiliser prices, supply disruptions, and geopolitical tensions in West Asia.

What are Fertilizers?

- Fertilizers are **concentrated plant nutrients** made from **inorganic chemicals**.
- Unlike organic manure, fertilizers contain nutrients in higher amounts and are **applied in smaller quantities**.



Mechanism of Subsidy

- Subsidy on Sale Price:** The government provides financial support to fertilizer manufacturers or importers, lowering the price of fertilizers sold to farmers.
- Direct Benefit Transfer (DBT):** In some cases, the subsidy is transferred directly to farmers through their bank accounts to reduce intermediaries and ensure transparency.
- Fixed Subsidy Rates:** For urea, the subsidy is fixed per kilogram of the product, and for others like DAP, it is adjusted periodically based on market prices.

Why is the Fertiliser Subsidy Rising?

- Global Supply Disruptions:** The ongoing conflict in West Asia and disruption of the **Strait of Hormuz** have increased fertilizer and energy prices globally.
 - Major suppliers, including **China**, have restricted exports to secure domestic supplies.

- Sharp Increase in Import Prices:** India's recent urea imports were contracted at **\$935–959 per tonne**, compared to \$410–420 per tonne a year earlier.
 - The cost of a fertiliser sack has increased from around **₹3000 post-Covid to ₹4,500**, while farmers continue to receive it at heavily subsidised rates.
- Dependence on Imports:** India remains one of the world's largest fertiliser importers. Gulf countries such as **Oman, Qatar, Saudi Arabia, UAE, and Bahrain** account for around **40%** of India's urea imports.

Government's Initiatives in the Fertilizer Sector

- PM PRANAM scheme:** PM Programme for Restoration, Awareness Generation, Nourishment and Amelioration of Mother – Earth (PMPRANAM) was launched to incentivize States/ Union Territories to promote alternate fertilizers and balanced use of chemical fertilizers.
- Neem-coated urea:** The government has introduced **100% Neem Coating** on all subsidized agricultural grade urea in the country in order to increase the nutrient efficiency, crop yield, soil health and check the diversion of agricultural grade urea for non-agricultural activities.
- Sulfur Coated Urea (Urea Gold)** was introduced to overcome the sulfur deficiency in the soil and reduce the input cost of the farmers.
- Nutrient-based subsidy policy:** It aims to promote the balanced use of fertilizers by linking subsidies to the nutrient content (nitrogen, phosphorus, potash, and sulfur) rather than the final product.
 - Under this scheme, the government sets a fixed subsidy amount per kilogram for each nutrient in P&K fertilizers.
- Nano Urea:** It is a liquid fertilizer developed by **IFFCO**. It is an alternative to conventional urea.

Way Ahead

- Capacity Expansion:** Speeding up commissioning of domestic urea plants under "Atmanirbhar Bharat" will reduce import reliance.
- Sustainable Practices:** Wider adoption of nano-urea, bio-fertilisers, and soil health cards can reduce chemical fertiliser intensity over time.
- Improving Supply Chain Resilience:** India should diversify its import sources to reduce dependence on specific regions. Strategic reserves of fertilisers should be developed to manage future disruptions.

- **Encouraging Biostimulants:** Biostimulants should be promoted as they enhance nutrient uptake and improve plant metabolism.
 - ♦ These products can reduce the effective requirement of chemical fertilisers by improving their efficiency.

Source: IE

INFRASTRUCTURE AT THE CORE OF INDIA'S DEVELOPMENT

Context

- Over the past decade, **India accelerated infrastructure creation** across transport, housing, water, energy, logistics, and digital networks.

Infrastructure Development in India

Transport & Connectivity:



- **Major Railway Bridges:** Chenab Bridge (2025), Anji Khad Bridge (2025), Pamban Bridge (2025) and Bairabi–Sairang (2025)
- **Roads and Highways:** National Highways expanded by 61% to 1.46 lakh km; 3,644 km of expressways operational.
- **Operational airports** increased from 74 (2014) to 165 (2026); UDAN connected 95 airports and benefited 1.64 crore passengers.
- **Operationalisation of GAGAN in 2015**, world's first equatorial Satellite-Based Augmentation System (SBAS) enhanced navigation accuracy and flight safety.

Maritime & Logistics Infrastructure:

- Port capacity nearly doubled to 1,726 MMTPA.
- National Waterways increased from 5 to 111.
- India's rank in the World Bank Logistics Performance Index improved from 54 (2014) to 38 (2023).

- India has expanded its network of National Waterways from 5 in 2014 to 111 in 2026.

Water Infrastructure:

- Under Jal Jeevan Mission, rural tap water coverage increased from 17% (2019) to about 82% (2026).
- Progress in irrigation, river rejuvenation, and river-linking projects such as Ken–Betwa.

Energy Security:

- Installed power capacity increased from 248 GW to 533 GW.
- Power shortages reduced from 4.2% to 0.03%.
- India became the world's 3rd-largest clean energy producer.
- Nearly 2.86 crore households electrified under Saubhagya scheme.

Clean Cooking Fuel:

- LPG coverage increased from 55.9% to 107.2%.
- PM Ujjwala Yojana expanded clean cooking access to poor households, with over 33 crore LPG consumers nationwide.

Digital Infrastructure:

- Internet connections rose from 25 crore to over 100 crore.
- Broadband connections reached nearly 100 crore.
- As of 2026, 5G services are available in 99.9% of districts with about 85% population coverage.

Challenges in India's Infrastructure Development

- **Financing Constraints:** Large infrastructure projects require massive investments, creating pressure on public finances and increasing dependence on private capital.
- **Land Acquisition Issues:** Delays due to disputes, rehabilitation concerns, and lengthy approval processes increase project costs and timelines.
- **Environmental and Social Concerns:** Infrastructure expansion can lead to ecological degradation, deforestation, biodiversity loss, and displacement of communities.
- **Implementation Delays:** Bureaucratic hurdles, litigation, and coordination problems among multiple agencies often slow project execution.
- **Regional Imbalances:** Infrastructure development remains uneven, with northeastern, hilly, and remote regions lagging behind.

- **Urban Infrastructure Stress:** Rapid urbanization has outpaced the development of transport, housing, water supply, and waste management systems.
- **Operation and Maintenance Gaps:** Inadequate maintenance reduces the efficiency and lifespan of infrastructure assets.
- **Climate and Disaster Risks:** Extreme weather events, floods, cyclones, and heatwaves pose increasing risks to infrastructure resilience.
- **Nearly Universal Access: While 95.1% of households own a mobile device** and 74.8% have access to a smartphone or internet-enabled phone, **only 39.7% of individuals aged 15 and above use the internet.**
- **Connectivity Gaps also Persist:** Around 27.5% of households remain offline, including 32.2% in rural India and 52.1% among the poorest consumption group.

Way Ahead

- Strengthen public-private partnerships (PPPs).
- Accelerate land and environmental clearances through transparent mechanisms.
- Promote climate-resilient and sustainable infrastructure.
- Enhance maintenance and asset management systems.
- Improve last-mile connectivity in underserved regions.
- Build institutional and technical capacities for efficient project execution.
- **Usage Pattern:** Even among connected households, **internet use is largely entertainment-driven.**
 - ♦ About 66% use it to watch movies, television or news content, and 53.8% use social media, compared with 16.1% who use it for online courses and 11.4% who access government services digitally.
- **Hidden Divide:** One in five households requires help from someone outside, rising to one in three among households with no formal education.
- **Gender Disparities:** Internet use among working-age adults stands at 57.6% for men and 35.6% for women, while only 37.8% of children aged 13-16 actively use the internet.

Conclusion

- India's infrastructure transformation has emerged as a key driver of economic growth, connectivity, and social inclusion.
- While significant progress has been made in transport, energy, housing, water, and digital infrastructure, addressing challenges remains crucial.
- A balanced approach that emphasizes quality, resilience, and inclusiveness will be essential to realize the vision of a developed and globally competitive India by 2047.
- **The study calls for four priorities:** expanding affordable broadband and public Wi-Fi, improving access to computers and shared devices, strengthening digital literacy and skills, and targeting women, rural households, poorer families and disadvantaged communities.

Government Initiatives for Digital Inclusion

- **The Digital India program** was launched by the Government on **July 1, 2015, envisions transforming India** into a knowledge-based economy and digitally empowered society.
- **Unified Payments Interface (UPI):** It enables instant, interoperable and secure transactions between individuals and merchants in real time.
 - ♦ The International Monetary Fund, in its 2025 report on growing retail digital payments, recognised UPI as the world's largest retail fast payment system by transaction volume.
 - ♦ Within India, 81% of total retail payment transactions are processed on UPI.
- **The PM-WANI (Wi-Fi Access Network Interface) framework,** launched in 2020, expanded affordable public internet access through decentralized public Wi-Fi hotspots. As of June 2026, over 4.10 lakh Wi-Fi hotspots operate across States and Union Territories.

Source: PIB

EVOLVING LANDSCAPE OF DIGITAL INCLUSION IN INDIA REPORT

Context

- 'The Evolving Landscape of Digital Inclusion in India', released by the National Council of Applied Economic Research argues that **India's digital divide has entered a new phase.**

Major Highlights

- **India's digital revolution** has succeeded in **putting mobile phones** in **nearly every household**, but it has fallen short of **delivering meaningful digital inclusion.**

- **DigiLocker:** Launched in 2015, DigiLocker introduced a secure digital document wallet for citizens. It allows individuals to store, access and share authenticated electronic documents with consent-based access.
- **UMANG:** Launched in 2017, UMANG, or the Unified Mobile Application for New age Governance, was designed to advance mobile governance in India. It provides a single window mobile and web platform to access services from central, state and local government bodies.
- **Initiatives such as BharatNet and the National Broadband Mission** strengthened rural broadband connectivity and public Wi-Fi access.
- **Common Service Centres (CSCs)**, which have grown from 0.83 lakh centres in 2014 to over 5.01 lakh functional centres by April 2026, improve digital access and delivery of citizen services across rural and urban areas.
- **DIKSHA (Digital Infrastructure for Knowledge Sharing)**, with over 2 crore registered users, serves as a unified, AI-enabled digital education platform, with all States/UTs onboarded and hosting 7,497 Energized Textbooks and over 3.74 lakh e-content resources.
- **E-Governance:** E-Governance in India has revolutionized the way citizens interact with the government by making services more accessible, transparent, and efficient. It involves initiatives like **Mission Karmayogi, DigiLocker, and UMANG App.**
- **Strengthen Public-Private Partnerships:** Foster collaboration among government, industry, civil society, and academia to create inclusive digital ecosystems.

Conclusion

- Digital inclusion should move beyond mere internet access to ensuring affordability, accessibility, digital skills, cybersecurity, and meaningful participation in the digital economy, thereby supporting the vision of a digitally empowered and inclusive India.

Source: TOI

NEWS IN SHORT

RULES GOVERNING ELECTION SYMBOLS IN INDIA

Context

- The satirical Cockroach Janta Party (CJP) has sparked debate over whether a cockroach can be allotted as an election symbol if it registers as a political party.

Election Symbols in India

- Election symbols are governed by the **Election Symbols (Reservation and Allotment) Order, 1968**, administered by the **Election Commission of India.**
- **Types of Symbols:**
 - ◆ **Reserved Symbols:** Exclusively allotted to recognised national and state parties (e.g., lotus, hand).
 - ◆ **Free Symbols:** Allotted to registered unrecognised parties and independent candidates from a notified list.

What Symbols Are Available?

- The EC's latest free-symbol list (May 2025) contains **184 symbols.**
- These include **household items, fruits, vegetables, sports equipment, and tools** such as air-conditioner, dustbin, frying pan, grapes, toothbrush, TV remote, etc.
- Some symbols are **unavailable in certain states** because they are already reserved for recognised state parties.

Can the Cockroach Be Allotted?

- Following concerns raised by animal welfare groups in the **1990s**, the EC stopped allotting new animal-based symbols.

Way Ahead

- **Strengthen Digital Infrastructure:** India should accelerate broadband connectivity under BharatNet, especially in remote and tribal areas. Expand 4G/5G coverage and improve internet reliability.
- **Enhance Digital Literacy:** Scale up digital literacy programs, particularly for women, senior citizens, and rural populations.
- **Bridge the Gender Digital Divide:** Implement targeted initiatives to improve women's access to mobile phones, internet services, and digital skills training.
- **Promote Regional Language Content:** Expand digital services and applications in Indian languages.
- **Expand Digital Public Infrastructure (DPI):** Deepen the reach of platforms such as Aadhaar, Unified Payments Interface (UPI), and DigiLocker while ensuring inclusivity and privacy safeguards.

- Under the Symbols Order, a newly proposed symbol:
 - ♦ Must **not resemble an existing symbol**.
 - ♦ Must **not have religious or communal connotations**.
 - ♦ Must **not depict any bird or animal**.
- Since a cockroach is an insect belonging to the animal kingdom, it would ordinarily **fall within this prohibition**.
- A few recognised parties continue to use animal symbols because they **were allotted before the restriction came into effect**. Examples include:
 - ♦ **Bahujan Samaj Party**: Elephant
 - ♦ **All India Forward Bloc**: Lion

Source: IE

PRIME MINISTER OF INDIA

In News

- Prime Minister Narendra Modi has overtaken Jawaharlal Nehru as the longest-serving Prime Minister in India to remain in office through consecutive electoral mandates.

About Prime Minister of India

- **Constitutional Position (Article 75)**: The Prime Minister is appointed by the President and serves as the head of the Union government, exercising actual executive authority.
- **Leader of the Council of Ministers (Article 74)**: The Prime Minister leads the Council of Ministers, which assists and advises the President in carrying out constitutional functions.
- **Role**: The Prime Minister acts as the chief link between the President and the Council of Ministers, conveying decisions of the Cabinet and advising the President on matters such as appointments, convening Parliament, and dissolution of the Lok Sabha.
- **Head of Key Bodies**: The Prime Minister presides over several major institutions and councils, including NITI Aayog, the National Integration Council, and the Inter-State Council.

Source: TH

AYUSHMAN BHARAT SCHEME

Context

- West Bengal has formally joined the flagship health insurance programme, Ayushman Bharat Pradhan Mantri Jan Arogya Yojana (AB-PMJAY),

becoming the last state in India to come under its ambit.

Ayushman Bharat Scheme

- It was launched in **2018**, by the Government of India with the aim of achieving universal health coverage. It has two key components;
- Ayushman Bharat Pradhan Mantri- Jan Arogya Yojana (AB PM-JAY)
- Ayushman Arogya Mandir

Ayushman Bharat Pradhan Mantri- Jan Arogya Yojana (AB PM-JAY)

- **AB PM-JAY** is the largest publicly funded health assurance scheme in the world which provides health cover of **Rs. 5 lakhs per family per year** for **secondary** and **tertiary care** hospitalization.
- **Coverage**: It covers up to **3 days** of pre-hospitalization and **15 days** of post-hospitalization expenses such as **diagnostics and medicines**.
 - ♦ The beneficiary can visit any empanelled public or private hospital in India to avail cashless treatment.
 - ♦ There is **no restriction** on the **family size, age or gender**.
- **Eligibility**: The inclusion of households is based on the deprivation and occupational criteria of the Socio-Economic Caste Census 2011 (SECC 2011) for rural and urban areas, respectively.
 - ♦ This number also includes families that were covered in the **Rashtriya Swasthya Bima Yojana (RSBY)** but were not present in the **SECC 2011** database.
- **Funding**: The funding for the scheme is shared by the Centre and the state in a **60:40 ratio**.
 - ♦ However, for North-Eastern states, Himalayan states (such as Uttarakhand, Himachal Pradesh), and Union Territories, the **ratio is 90:10**.

Ayushman Arogya Mandir

- The component led to creation of **1,50,000** Health and Wellness Centres (AB-HWCs), renamed as Ayushman Arogya Mandir.
- They are created by upgrading the **Sub Health Centres (SHCs)** and rural and urban **Primary Health Centres (PHCs)**, to bring health care closer to the community.
- The **aim** is to provide Comprehensive Primary Health Care (CPHC) along with the provision of **follow-up care** to the patients in the community.

- The essential health services along with the **provisioning of essential medicines and diagnostics** are provided closer to the community through these centers.

Source: IE

₹95,962 CRORE SET ASIDE FOR VB-G RAM G

Context

- The government has proposed an interim budget allocation of 95,692 crore rupees to states and union territories to ensure a **smooth transition from MNREGA to Viksit Bharat-Guarantee for Rozgar and Aajeevika Mission Gramin (VB-G RAM G)**.

About VB-G RAM G

- It will replace the **Mahatma Gandhi National Rural Employment Guarantee Act, 2005 (MGNREGA)**.
 - ♦ The move will mark a shift from a “**demand-driven framework**” to a “**supply-driven scheme**”.
- **Enhanced Livelihood Guarantee:** It will enhance the statutory wage employment guarantee to **125 from 100 days per rural household in every financial year**, for adults who volunteer to undertake **unskilled manual work**.
- **Centrally Sponsored Scheme:** The scheme will be implemented as a Centrally Sponsored Scheme with a sharing pattern of **90:10 for North-Eastern** and Himalayan States/UT and **60:40 for all other States**.
- **Normative Allocation to States based:** States will ensure transparent and need-based intra-State distribution of funds across Districts and Gram Panchayats, taking into account the category of the Panchayats and local developmental needs.
- **Unemployment allowance:** If eligible applicants are not provided work within the stipulated period, **State Governments will be obliged** to pay **unemployment allowance**.
- **VGPP based planning:** Planning will be undertaken through Viksit Gram Panchayat Plans, prepared by Gram Panchayats and integrated with national spatial planning systems.
- **Institutional Oversight:** The Central Gramin Rozgar Guarantee Council and the State Gramin Rozgar Guarantee Councils shall be constituted for review, monitoring and effective

implementation of the provisions of the legislation in their respective areas.

Source: AIR

LAND PORT MANAGEMENT SYSTEM (LPMS): VINIMAY

In News

- Union Home Minister Amit Shah inaugurated the **Land Port Management System (LPMS), named ‘Vinimay’**, in New Delhi under the **Smart Borders initiative**.

About

- It is a centralized **digital platform designed to digitize and integrate cargo processing and passenger movement across India’s land borders** through real-time data sharing and coordinated operations.
- A Land Port is a **notified road or rail border point used for customs, immigration, and trade-related activities**.
- LPMS has been developed by the **Land Ports Authority of India (LPAI), a statutory body under the Ministry of Home Affairs** established through the Land Ports Authority of India Act, 2010, for developing and managing Integrated Check Posts (ICPs).
- Key features of LPMS include a Single Electronic Window, integration with agencies such as CBIC and BSF, secure real-time exchange of logistics and regulatory data, and Automatic Number Plate Recognition (ANPR) for automated gate management.

Source: TH

CHANDRAYAAN-3 REVEALS DEEP LUNAR SECRETS FROM SHIV SHAKTI POINT

Context

- Data from Chandrayaan-3’s **Pragyan rover** has revealed that the **soil at Shiv Shakti Point** near the **Moon’s South Pole** is chemically very similar to a **lunar meteorite (ALHA 81005)** discovered in **Antarctica**.
 - ♦ The findings are based on observations made by the **Alpha Particle X-ray Spectrometer (APXS)** onboard the rover.

Significance of the Chemical Similarity

- The composition differs from conventional lunar highland rocks dominated by **ferroan anorthosite**.
- The soil shows a mixture of:
 - ◆ **Ferroan anorthosite materials.**
 - ◆ **Magnesium-rich (Mg-suite) rocks.**
- This suggests that **materials from deeper layers of the Moon** have mixed with the surface regolith.

Validation of the Lunar Magma Ocean Theory

- The findings provide fresh evidence for the **Lunar Magma Ocean Theory**, which states that:
 - ◆ The early Moon was covered by a **global ocean of molten rock**.
 - ◆ As it cooled, lighter minerals floated upward to form the crust, while **denser iron- and magnesium-rich minerals sank deeper**.
 - ◆ Detection of deep-seated iron and magnesium-bearing materials at the surface supports this model of lunar evolution.

Source: IE

SCIENTISTS FIND A BLOOD TEST THAT PREDICTS LUNG CANCER EARLY

Context

- A new study has zeroed in on a set of **14 blood plasma proteins**, called the '**14-protein signature**', as a **strong predictor of being diagnosed with lung cancer years in advance**.

About

- **Blood plasma** is the liquid portion of the blood that flows in the human body. It contains **thousands of proteins** that come from every organ and tissue.
 - ◆ This entire set of proteins is called the **plasma proteome**.
 - ◆ The large-scale systematic study of the proteome is called **proteomics**.
- **The plasma proteomics** profile provides a **real-time snapshot of health and disease**.
 - ◆ If scientists could compare the profiles of people before and after the onset of a disease, they can predict important clues about changes.
- Scientists are currently on the threshold of finding a new way to identify people who may be

predisposed to developing lung cancer and protect them proactively.

- **Lung cancer** is mainly due to smoking and, to a lesser extent, air pollution and occupational exposure.
 - ◆ According to the latest World Health Organization estimates, **there are about 2.5 million new cases and 1.8 million deaths every year.**

Source: TH

BATTERY ENERGY STORAGE SYSTEM

In News

- The Defence Ministry has approved the establishment of a 250 MW Solar Power Project with Battery Energy Storage System (BESS) at Sitapur (Ex-Cantonment) in Uttar Pradesh.

About Battery Energy Storage System

- Battery Energy Storage System (BESS) refers to a technology that **stores electrical energy in rechargeable batteries for later use**.
 - ◆ It helps **balance electricity demand and supply by storing excess power** generated from renewable sources such as solar and wind energy.
 - ◆ **BESS improves grid stability, reduces power fluctuations, and supports peak load management**. It also enhances energy access in remote areas and strengthens energy security.

Major Storage Technologies

- **Electrochemical (Battery-Based):**
 - ◆ **Lithium-ion:** Most widely deployed globally, energy density 150 to 300 Wh/kg, round-trip efficiency 90 to 95%, used in EVs and gridscale storage but dependent on imported lithium and cobalt.
 - ◆ **Lithium Iron Phosphate (LFP):** Safer, cheaper, longer life cycle, increasingly preferred for utility-scale Battery Energy Storage Systems (BESS) and electric buses.
 - ◆ **Sodium-ion:** Abundant domestic sodium, lower cost and reduced geopolitical dependence. Strategically important for India given limited domestic lithium reserves.
 - ◆ **Solid-state:** Next-generation with solid electrolyte, higher density and improved safety. Still high cost and limited scalability.

- ◆ **Flow batteries (Vanadium Redox, ZincBromine):** Long-duration storage, minimal degradation, suited for utility-scale renewable integration.
 - ◆ Molten salt and ice thermal storage are used in concentrated solar and industrial applications.
Source: TH
- **Mechanical and Thermal**
 - ◆ **Pumped Storage Hydropower (PSH):** Most mature large-scale technology globally, using height difference to store and release energy.

