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Date: 16-02-2026

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BIO-BASED CHEMICALS AND ENZYMES: A NEW FRONTIER IN INDIA'S BIOECONOMY

Context

- India is promoting bio-based chemicals and enzymes as key pillars of a green bioeconomy, linking climate action, industrial growth, and rural income diversification.

What Are Bio-Based Chemicals and Enzymes?

- **Bio-Based Chemicals:** Bio-based chemicals are industrial chemicals produced from **biological feedstocks such as sugarcane, corn, starch, agricultural residues,** or other forms of biomass.
    - They are manufactured through **fermentation, microbial processes, or enzymatic pathways**, replacing fossil fuel-based raw materials.
    - Examples include o**rganic acids (such as lactic acid), bio-alcohols, solvents, surfactants,** and intermediates used in plastics, cosmetics, and pharmaceuticals.
- **Enzymes:** Enzymes are **biological catalysts** that **accelerate chemical reactions** under mild conditions.
    - Enzymes typically **function at lower temperatures and pressures,** thereby reducing energy consumption and emissions.
    - They are widely used in detergents, food and beverage processing, pharmaceuticals and vaccines, textile and leather processing, pulp and paper industries and advanced biomanufacturing.

Why Does India Need Bio-Based Chemicals?

- **Reducing Import Dependence:** India remains dependent on petrochemical imports for several industrial intermediates. For example, India imported roughly **$479.8 million** worth of acetic acid in 2023.
    - Bio-based alternatives can **reduce exposure to volatile fossil fuel markets.**
- **Leveraging Agricultural Strength:** India possesses a large agricultural base capable of supplying biomass feedstocks. This creates opportunities for;
    - Diversified farmer income.
    - Value addition to crop residues.
    - Development of rural bio-industrial clusters.
- **Strengthening Climate Commitments:** Bio-based chemicals align with **India's Net Zero** commitments and circular economy goals. They

reduce lifecycle carbon emissions compared to fossil-based products.
- **Industrial Competitiveness:** India has deep expertise in fermentation technologies due to its strong pharmaceutical and vaccine ecosystem.
    - Scaling bio- manufacturing can position India as a global supplier of sustainable industrial inputs.

Policy Framework in India

- **BioE3 Policy:** The Department of Biotechnology has prioritised bio-based chemicals and enzymes under the **BioE3 (Biotechnology for Economy, Environment and Employment) policy**. It focuses on;
    - Biomanufacturing infrastructure.
    - Technology translation and scale-up.
    - Employment generation.
- **Bio-RIDE Scheme:** A ₹**9,197 crore outlay** to support biotechnology research and industrial development, including a specific component for Biomanufacturing and Biofoundry.
- **Infrastructure Development:** Setting up Biomanufacturing Hubs and Bio-AI hubs to accelerate the transition from lab-to-market for sustainable materials.

What are the global best practices?

- **The EU Bioeconomy Strategy and Action Plan** provides coordinated support for bio-based chemicals as part of circular bioeconomy goals.
    - It **links industrial transformation to climate goals**, waste reduction, and sustainable growth.
- **In the U.S., the USDA BioPreferred Program** mandates federal procurement preference for certified bio-based products, including chemicals and enzymes, creating early markets for producers.
- **China's bioeconomy** development plans explicitly prioritise high-value bio-based chemicals and enzyme technologies as strategic sectors.
- **In Japan**, priority projects funded through METI/NARO integrate bio-based chemical research with manufacturing readiness.

Risk in Developing Bio-Based Chemicals Sector

- **Cost Competitiveness:** Bio-based products have **higher production costs** compared to their petrochemical counterparts.
    - This cost disadvantage creates a potentially temporary barrier to private investment in the early stages of scale-up.

- **Feedstock Availability:** Reliable, sustainable, and affordable biomass supply chains remain a constraint.
  - There is intense **competition for raw materials from other sectors,** such as food and animal feed, which can constrain the availability of feedstock for chemical production.
- **Market Adoption:** There are concerns whether bio-based chemicals can seamlessly **substitute existing inputs** in manufacturing pipelines and whether **downstream manufacturers** are willing to switch, even when costs are comparable.

Way Ahead

- Develop shared biomanufacturing infrastructure such as **biofoundries, pilot plants, and demonstration facilities** to reduce capital risks.
- Establish **robust standards, certification systems, and carbon accounting frameworks** to build market confidence.
- Promote R&D in **synthetic biology, enzyme engineering, and Bio-AI integration** to enhance productivity and cost efficiency.

Source: TH

## RENEWABLE ENERGY TO DOMINATE INDIA'S GRID BY 2070: NITI AAYOG

Context

- As per NITI Aayog India's electricity mix **could shift decisively from coal-heavy to renewable-led by 2070.**

Major Highlights of the Study

- **Coal** remains the backbone of India's electricity landscape, **accounting for nearly 74%** of generation and providing dependable, low-cost base-load power.
- **Under the Current Policy Scenario (CPS) renewable energy's share in electricity generation** could rise from around 20% in 2024-25 to more than 80% by 2070.
- In the same scenario, coal's share in electricity generation could **decline sharply to 6-10 per cent by 2070.**
- As coal's role shrinks, **nuclear power is expected to expand gradually,** increasing its share from about 3% at present to 5-8% by 2070.

India's Energy Share

- **As of 2025,** the country's total installed electricity capacity has crossed **500 GW, reaching 500.89 GW.**

The total installed electricity generation capacity has increased.
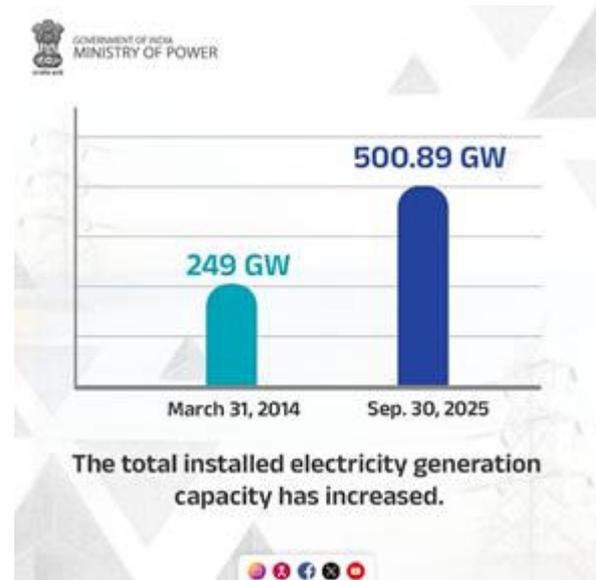
- **Non-fossil fuel sources (renewable energy, hydro, and nuclear):** 256.09 GW – over 51 % of the total.
- **Fossil-fuel-based sources:** 244.80 GW, about **49 % of the total,** making coal a source of up to almost half the energy needs. Also, coal contributes about **74% of total electricity production in India.**
- Within renewables:
  - **Solar power:** 127.33 GW.
  - **Wind power:** 53.12 GW.
- **During FY 2025–26** India added 28 GW of non-fossil capacity and 5.1 GW of fossil-fuel capacity.

Challenges in Transition

- **Limited Share in Actual Generation:** Despite rapid capacity addition, RE's share in electricity generation rose only from 19.6% (2013-14) to 22% (2024-25) due to structural issues.
- **Intermittency Challenge:** Solar and wind are variable in nature, making round-the-clock supply difficult. Hence, coal remains essential for grid stability and meeting peak demand.
- **Limited energy storage:** Large-scale energy storage (like battery systems) remains underdeveloped, restricting the grid's ability to use RE during peak demand or low generation periods.
- **Import dependence:** India relies heavily on imported critical minerals (like lithium, cobalt, rare earth elements) for batteries, solar, and wind technologies, exposing it to global supply risks.
- **Financial & Policy Hurdles:** High upfront costs for solar, wind, and storage systems.
  - There are delays in policy implementation and regulatory approvals.

- **Land & Resource Constraints:** Limited availability of land for large-scale solar/wind projects.
  - Environmental and social conflicts in land acquisition.
- **Technological & Skill Gaps:** Need for advanced technologies in storage, smart grids, and hybrid systems.
  - Shortage of skilled workforce in RE installation and maintenance.

Government Initiatives

- **National Solar Mission (NSM):** It was launched in 2010, it has set ambitious targets for solar capacity installation, including grid-connected and off-grid solar power projects.
- **National Clean Energy Fund (NCEF):** It was established to support research and innovation in clean energy technologies and projects that help in reducing greenhouse gas emissions.
- **National Wind Energy Mission:** Focuses on the development and expansion of wind energy in India. The target for wind energy capacity is set at 140 GW by 2030.
- **Financial Support & Incentives:** Viability Gap Funding (VGF) for large-scale solar and hybrid projects.
  - Production Linked Incentive (PLI) scheme for solar PV manufacturing.
  - Subsidies for rooftop solar and off-grid systems.
  - Renewable Energy Certificates (RECs) to promote green power trading.
- **Infrastructure Development:** Green Energy Corridor to improve RE grid integration.
  - PM-KUSUM Scheme for solarizing agricultural pumps.
  - Revamped Distribution Sector Scheme (RDSS) to strengthen DISCOMs.
- **Emerging Technologies & Projects:** Support for Battery Storage, hybrid systems, and RTC power.
  - Promotion of offshore wind and floating solar projects.
  - Focus on Hydrogen Mission for green hydrogen development.
- **International Partnerships:** ISA (International Solar Alliance) launched by India to promote global solar cooperation.
  - Collaboration with countries & global funds for clean energy investment and technology.

Way Ahead

- **Nuclear Power as Strategic Pillar:** Nuclear capacity is projected to increase from 8.18 GW (2025) to 90–135 GW by 2070.

- This provides firm low-carbon power, supports green hydrogen, and ensures 24×7 supply.
- **Coal's Continued Role:** Coal capacity may peak at 450–470 GW in 2050, and some coal plants are likely to operate as reserve/low-utilisation capacity.
- **Core Constraint:** Transition depends on cost reduction, land availability, grid expansion, storage scalability, and faster nuclear deployment.

Source: IE

BRIDGING A DIVIDE WITH AN 'INDIAN SCIENTIFIC SERVICE'

Context

- India's generalist post-Independence service rules, once vital for nation-building, now hinder effective scientific governance in an era driven by technology and complex environmental challenges.

The Core Issue

- Scientists entering government are governed by **general civil service rules.**
- **Administrative systems prioritise** hierarchy, uniformity, and procedural compliance.
- **Scientific work requires** evidence-based reasoning, transparency, peer review, and open discussion of uncertainty.
- This mismatch **weakens the effective use** of scientific expertise in policymaking.

Impact of this System

- Scientific advice remains **reactive** rather than institutionalised.
- **Experts often lack autonomy** to record long-term risks or dissenting technical opinions.
- **Science becomes advisory** and peripheral instead of central to decision-making.
- **Limited career mobility and recognition** discourage top scientific talent from entering governance roles.

International Government Models

- Many advanced democracies have dedicated scientific cadres or advisory systems within government. These systems:
  - Protect scientific integrity.
  - Institutionalise expert input in policymaking.
  - Balance democratic authority with technical expertise.
- India lacks such a specialised governance framework.

Need for the Reforms

- **Changing Nature of Governance:** Modern policymaking increasingly involves climate science, AI, biotechnology, epidemiology, and environmental risk areas requiring specialised scientific expertise.

- **Mismatch in Service Rules:** Existing generalist civil service rules are not designed to accommodate scientific methods, peer review culture, or documentation of uncertainty.

- **Weak Integration of Scientific Advice:** Scientific input remains advisory and reactive rather than structurally embedded in decision-making processes.

- **Long-Term Risk Assessment Gaps:** Issues like climate change, water stress, pandemics, and technological disruption require long-term forecasting something administrative systems are not structurally designed for.

- **Protection of Scientific Integrity:** Scientists need institutional safeguards to present evidence-based opinions without bureaucratic or political pressure.

- **Attracting and Retaining Talent:** Lack of clear career progression and recognition discourages top scientific professionals from entering public policy roles.

- **Global Best Practices:** Many advanced democracies have institutionalised scientific cadres within governance, India lacks such a structured framework.

Way Ahead

- **Creation of an Indian Scientific Service (ISS):** Establish a dedicated scientific cadre within government. Key features:
  - Separate recruitment based on scientific credentials.
  - Independent professional evaluation system.
  - Clear career progression pathways.
  - Safeguards for scientific independence.
  - Embedding scientists directly in ministries and regulatory bodies.

- **Institutional Context:** India has recently created the Anusandhan National Research Foundation (ANRF) to strengthen research funding.
  - However, ANRF focuses on research promotion not on embedding scientists into governance structures.
  - Hence, a separate Scientific Service is needed for policy integration.

Source: TH

ARTIFICIAL INTELLIGENCE (AI) TRANSFORMING INDIAN AGRICULTURE

Context

- India, ranked **third** in the world in artificial intelligence by Stanford University's 2025 Global AI Vibrancy rankings and is increasingly using Artificial Intelligence to strengthen sustainability, and resilience in its agriculture sector.

How is AI in Agriculture Critical for India?

- Indian agriculture faces structural constraints such as **fragmented landholdings, climate variability, price volatility, and low productivity.**

- **Climate change** has **increased the frequency of extreme weather events,** making predictive technologies essential.

- Small and marginal farmers (over **85% of total farmers**) require affordable, data-driven advisory systems.

- **Efficient risk management and market access** are necessary to enhance farmer incomes in line with national development goals.

### Role of Artificial Intelligence in Agriculture

- **Soil Health Diagnostics:** AI uses deep learning and image recognition to monitor soil health by **analysing signals from satellite imagery**, drone-based observations, and farm-level images.

- **Farm Mechanisation Efficiency:** AI technologies, such as **machine learning, drone applications, and remote sensing,** are revolutionizing farming efficiency.
  - In horticulture, where crops require continuous monitoring across multiple growth stages, AI-based systems offer **round-the-clock surveillance** of high-value crops.

- **Price Realisation for Farmers:** AI-driven predictive analytics leverage large datasets from platforms such as **e-NAM, AGMARKET, the Agricultural Census,** and the **Soil Health Card programme** to assess price movements, arrival trends, and regional demand patterns.

- **Climate-Smart Agriculture:** AI can predict weather patterns and provide early warnings for extreme weather events, enabling farmers to take preventive measures.
  - Integration with platforms like **WINDS (Weather Information and Network Data System)** strengthens risk assessment.

Government Initiatives in AI-Driven Agriculture

- **Kisan e-Mitra**, launched in 2023, is a voice-enabled, AI-powered chatbot designed to support farmers by answering queries on key government

schemes, including **PM Kisan Samman Nidhi, the Kisan Credit Card, and the Pradhan Mantri Fasal Bima Yojana.**

- ◆ The platform operates in **11 regional languages** and currently addresses over 8,000 farmer queries each day.
- **The National Pest Surveillance System (NPSS),** launched in **2024,** utilises AI and Machine Learning (ML) to enable early detection of pest infestations and crop diseases.
- The Union Budget 2026-27 proposed **Bharat-VISTAAR,** a multilingual AI tool to integrate the **AgriStack portals** and the **ICAR package** with AI systems.
- **AI-Enabled Crop Insurance:**
  - ◆ **CROPIC (Collection of Real-Time Observations and Photographs of Crops)** uses geotagged, time-stamped images uploaded via mobile apps, enhancing transparency in crop damage assessment.
  - ◆ **YES-TECH (Yield Estimation System based on Technology)** uses remote sensing and AI analytics for scientific yield estimation.
- **The Krishi Decision Support System (KDSS)** integrates data from multiple sources, to generate comprehensive analytical outputs such as digital crop maps, soil maps, yield estimates, and drought and flood monitoring assessments.

Source: Ministry of Agriculture & Farmers Welfare
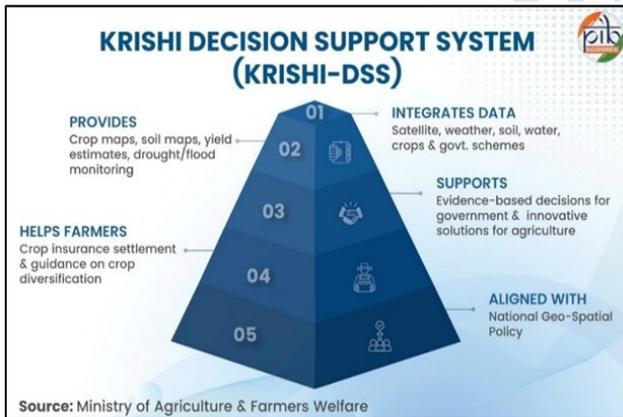
Challenges in AI Adoption in Indian Agriculture

- **Rural Connectivity Gaps:** Small and marginal farmers often lack access to smartphones, IoT devices, or digital infrastructure, creating an access asymmetry.
  - ◆ Power supply disruptions in rural areas further constrain the effective use of AI-enabled devices.
- **Data Privacy:** AI systems rely on large datasets including land records, crop patterns, financial details, and yield data collected under platforms like AgriStack.

- ◆ Absence of a clearly defined farmer-centric data ownership framework may lead to misuse or commercial exploitation of farm-level data.
- **High Cost of Advanced Technologies:** Precision agriculture tools such as drones, AI-based sensors, robotics, and automated machinery involve high initial capital investment.
  - ◆ Small landholdings (average size ~1–1.2 hectares) reduce economies of scale, making individual adoption financially unviable.

Way Ahead

- While Artificial Intelligence holds transformative potential for Indian agriculture, its success depends on addressing structural inequities, governance gaps, and capacity limitations.
- There is a need to **strengthen rural digital infrastructure** along with establishing a robust agricultural data governance framework ensuring farmer consent, data security, and transparency.
- Also promote **shared-service models through FPOs and cooperatives** to reduce technology costs.

Source: PIB

REFURBISHED MEDICAL DEVICES IN INDIA: ACCESS VS. REGULATION

Context

- The import of refurbished high-end medical equipment has major implications for healthcare access, industry policy, and patient safety.

What Are Refurbished Medical Devices?

- Refurbished medical devices are previously used systems that have been restored to their original operating specifications and resold at significantly lower prices.
- These are typically capital-intensive machines used in advanced diagnostics and surgery.
- Examples include **MRI scanners (Magnetic Resonance Imaging); CT scanners (Computed Tomography); PET-CT systems (Positron Emission Tomography–CT);** Advanced endoscopy and laparoscopy units; and Robotic navigation and surgery systems;

Why Does Cost Matters?		
Equipment	**New Price**	**Refurbished Price**
1.5T MRI	₹4–8 crore	₹1–3.5 crore
PET-CT	About ₹20 crore	₹60 lakh–₹3.5 crore
CT scanner	₹2–4 crore	₹20 lakh–₹2.5 crore

For **hospitals in Tier-2 and Tier-3 cities, district centres, and standalone diagnostic facilities,** these savings can determine whether advanced diagnostics are available locally at all.

Current Regulatory Landscape in India

- **No Dedicated Regulatory Pathway:** India currently lacks a specific regulatory framework governing refurbished devices under the **Medical Devices Rules, 2017**.

- In 2020, all medical devices were **notified as 'drugs' under the Drugs and Cosmetics Act**, expanding central oversight, but **no specific licensing pathway** was created for refurbished products.

How Imports Are Currently Allowed?

- Imports of used medical equipment are governed primarily under the **Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016**. Under **amendments introduced in December 2022:**

  - Certain high-end used devices may be imported.

  - Prior permission is required from the MoEFCC.

  - Maintenance history, quality assurance reports, and compliance documentation must be submitted.

  - Technical input from the Central Drugs Standard Control Organisation (CDSCO) is required.

  - Import authorisation from the Directorate General of Foreign Trade (DGFT) is mandatory.

- **Regulatory Issues:** CDSCO, in January 2025, stated **refurbished devices cannot be imported for sale or distribution** because there is **no licensing provision** under the **Medical Devices Rules.**

  - However, in November 2025, a **technical expert committee under MoEFCC cleared multiple refurbished devices,** including CT scanners, MRI systems, and robotic surgical units **for reuse.** This created a legal inconsistency:

    - **MoEFCC approval under waste rules;**

    - **CDSCO prohibition under medical device laws;**

- **Import Dependency:** India continues to depend heavily on imports for high-end imaging technologies due to complex manufacturing requirements, including **precision detectors, advanced software systems, and sophisticated supply chains.**

- Refurbished equipment is **typically sourced from developed markets such as the US, Germany, Japan, and the Netherlands,** where hospitals upgrade equipment before its full functional life ends.

New Policy Committee

- The **Department of Pharmaceuticals** informed the Rajya Sabha that the **Ministry of Health and Family Welfare**, in February 2026, has **constituted a committee** to **develop a formal policy on refurbished medical devices.**

- The committee aims to:

  - define what qualifies as 'refurbished';

  - develop methods to evaluate safety, performance, and remaining useful life;

  - recommend guidance on waste disposal;

  - examine regulatory alignment;

Stakeholder Perspectives

International Manufacturers (MTAI): The **Medical Technology Association of India (MTAI)**, representing over 50 international manufacturers, argues that:

  - A blanket ban would hurt affordability.

  - India needs a **globally aligned, time-bound policy.**

  - Refurbished devices should be **allowed only through original equipment manufacturers (OEMs)** to ensure legal accountability, proper servicing, and patient safeguards.

- MTAI maintains that refurbished equipment:

  - Expands access in smaller cities;

  - Supports healthcare worker training goals;

  - Aligns with India's export ambitions for healthcare professionals;

Domestic Manufacturers (AiMeD): The **Association of Indian Medical Device Industry (AiMeD)** strongly opposes relaxing restrictions without a robust framework aligned with international regulatory standards.

- Their concerns include unknown usage histories, inconsistent performance, limited traceability, shorter remaining lifespan, and risk of India becoming a 'dumping ground'.

- **AiMeD** argues that legalising imports could undermine 'Make in India' initiatives and weaken preparedness during future health emergencies.

Way Ahead: What Happens Next?

- The government's policy committee will need to establish a clear legal definition, align environmental and medical regulations, create a **licensing pathway under Medical Devices Rules**, define quality, testing, and lifespan standards, and ensure transparency for buyers and patients.

- If crafted carefully, the framework **could improve patient safety, expand affordable access, support domestic industry, and ensure regulatory coherence.**

- The outcome will **shape India's diagnostic infrastructure** and its **long-term medical technology ambitions.**

Source: IE

NEWS IN SHORT

CHINCHA INDIANS

Context

- A recent study shows that the Chincha Indians used **nitrogen-rich seabird guano** to significantly boost maize production in coastal Peru and strengthened the pre-Inca **Chincha Kingdom.**

Chincha Indians

- The Chincha were a **pre-Inca civilisation** located in the **Chincha Valley** on the southern coast of present-day **Peru.**

- They flourished between **1000–1400 CE.**

- At their peak, their population is estimated to have reached nearly **100,000.**

Seabird guano

- Seabird guano is a natural, **highly effective fertilizer** composed of accumulated, nutrient-rich excrement, carcasses, and eggshells from seabirds.

- It is **exceptionally rich in nitrogen** due to birds' marine diets of fish and seafood.

- **The Chincha harvested guano** from the nearby Chincha Islands and transported it to mainland fields.

- The **fertiliser restored soil nutrients** in the dry coastal environment, where soils lose fertility quickly.

Source: DTE

INHALED NITRIC OXIDE: A POTENTIAL TOOL AGAINST DRUG-RESISTANT PNEUMONIA

Context

- A recent study by researchers has explored that the **high-dose inhaled nitric oxide can significantly reduce multidrug-resistant bacteria.**

About the discovery

- India faces a **high burden of antimicrobial resistance (AMR)** and hospital-acquired infections where drug-resistant pneumonia is a serious threat in **Intensive Care Units (ICUs).**

- A significant contributor is **Pseudomonas aeruginosa**, a bacterium responsible for nearly **one-fifth** of hospital-acquired pneumonias.

- The research shows that at **high concentrations (around 300 ppm)**, inhaled nitric oxide can act as a direct **antimicrobial agent.**

What is Nitric Oxide?

- Nitric oxide (NO) is a **colorless, gaseous free radical** molecule composed of one nitrogen and one oxygen atom.

- **Production:** It is a **gas naturally produced by the human body from** the amino acid L-arginine, a process that can be boosted by dietary intake of nitrate-rich foods like leafy greens, beets, and garlic.

- **Functions:** It acts as a neurotransmitter, immune system regulator, and aids in angiogenesis (new blood vessel formation).

- **In clinical practice**, it is used at **low doses (20–80 ppm)** as a **selective pulmonary vasodilator in patients** with acute respiratory failure, particularly in neonatal care.

  - It improves oxygenation by widening blood vessels in the lungs.

- **Toxicity Risks:** High doses can lead to **methemoglobinemia** and **potential lung injury.**

Source: TH

FIRST ROAD-CUM-RAIL TUNNEL UNDER BRAHMAPUTRA RIVER

In News

- Recently, the Union cabinet has approved the construction of the c**ountry's first underwater twin tube road-cum-rail tunnel project** under the **Brahmaputra River** in Assam at an estimated cost of Rs 18,662 crore.

About the Project

- It is a around 34 kilometre-long four-lane access-controlled G**reenfield connectivity project.**

- It will feature two parallel tunnels, designed to facilitate smooth and high-capacity movement of both road and rail traffic.

- The stretch will connect **Gohpur on NH-15 and Numaligarh on NH-715 in Assam**, cutting short the distance between the two Assam cities to just 34 kilometres from the current 240 kilometres.

◆ The travel time will be reduced to just 20 minutes from six hours now.

- **Importance:** The project will provide significant benefit to Assam, Arunachal Pradesh, Nagaland and other North -Eastern States.

  ◆ This will enhance the efficiency of freight movement, reducing logistics cost and driving socio-economic growth in the region.

  ◆ It will enhance connectivity, reduce logistics costs and accelerate growth across Assam and the entire Northeast.

  ◆ It will play a pivotal role in strategic considerations, regional economic growth, strengthening connectivity between major economic centers and opening new avenues for trade and industrial development.

About Brahmaputra River

- The Brahmaputra is a major **transboundary river in Asia**. It originates from the Chemayungdung Glacier near Lake Manasarovar (Mapam Yumco) in Tibet.

- It is known variably as **Yarlung Tsangpo in Tibet (its longest upper stretch), Siang or Dihang in Arunachal Pradesh, Brahmaputra in Assam & Jamuna in Bangladesh**.

- It flows east through Tibet's plateau, enters India via Arunachal Pradesh, widens in Assam's plains, and merges with the **Ganges in Bangladesh before reaching the Bay of Bengal.**

Source :Air

STARTUP INDIA FUND OF FUNDS 2.0

In News

- Recently, the Union Cabinet has approved the **establishment of the Startup India Fund of Funds 2.0 (FoF 2.0)** with a corpus of 10,000 crore to mobilise venture capital for the country's **rapidly expanding startup ecosystem.**

Venture capital

- It is funding provided to emerging companies by wealthy individuals or institutional investors (venture capitalists) seeking long-term growth.

- It is high-risk but potentially high-return and can be provided through equity, debentures, or conditional loans.

Startup India Fund of Funds 2.0 (FoF 2.0)

- **Startup India Fund of Funds 2.0 (FoF 2.0)** follows the success of the Fund of Funds for Startups (FFS 1.0), launched in 2016 to address funding gaps and catalyse domestic venture capital investments.

  ◆ It was launched under the **Startup India initiative**. Under FFS 1.0, the entire 10,000 crore corpus was committed to 145 **Alternative Investment Funds (AIFs)**, which have collectively invested over 25,500 crore in more than 1,370 startups across sectors such as artificial intelligence, robotics, clean technology, fintech, healthcare, manufacturing, biotechnology and space technology, among others.

  ◆ The first phase played a key role in **nurturing first-time founders** and crowding in private capital to build a strong venture capital ecosystem.

Objectives

- The scheme aims to **expand investment beyond major metropolitan centres** to ensure that innovation thrives across the country.

- It is expected to play a critical role in **advancing India's innovation-driven growth agenda** by supporting startups that develop globally competitive technologies, products and solutions.

- It is aligned with the **government's vision of Viksit Bharat @ 2047** and is expected to contribute to economic resilience, enhanced manufacturing capabilities, job creation and India's emergence as a global innovation hub.

Conclusion

- The startup has grown from fewer than 500 startups to more than 2 lakh startups recognised by the Department for Promotion of Industry and Internal Trade (DPIIT), with 2025 recording the highest-ever annual startup registrations.

- With the approval of Startup India FoF 2.0, the government has reaffirmed its commitment to empowering entrepreneurs and unlocking the full potential of India's startup ecosystem.

- The new fund aims to accelerate the next phase of India's startup journey by mobilising long-term domestic capital, strengthening the venture capital landscape and supporting innovation-led entrepreneurship across sectors.

Source :PIB

LHS 1903

In News

- Recently, astronomers found a rocky planet orbiting beyond its gaseous neighbors, challenging current planet formation theories.

About the discovered planetary system

- The system was observed using the European Space Agency's Cheops space telescope.

- It consists of four planets, two rocky and two gaseous, orbiting a relatively small and dim star called a **red dwarf about 117 light-years from the earth.**

  - The star, named LHS 1903, is about **50% as massive and 5% as luminous as our sun.**

  - **LHS 1903 is a small red M-dwarf star** that is cooler and shines less brightly than our Sun

- The innermost planet is rocky, the next two are gaseous and the fourth, which current planetary formation theory suggests should be gaseous, is rocky.

  - The two rocky planets are superearths, meaning rocky like the earth but two to ten times more massive. The two gas planets are categorised as mini-Neptunes: gaseous and smaller than Neptune but larger than the earth.

Source :TH

'ANUPAM' MODEL OF WASTE MANAGEMENT

Context

- Following the New Delhi Municipal Council (NDMC) decision to eliminate the need to transport household waste, **Anupam Colonies now segregate and process waste within their own premises.**

Anupam Model

- **Segregation at Source:** Under the Anupam model, waste is segregated at source into wet, dry and sanitary waste.

- **Further Segregation:** Dry waste is further sorted into many categories, including paper, metal, glass, e-waste, and non-recyclables.

- **Compost Generation:** Wet waste is composted on site, along with horticultural waste, using wire-mesh composting bins placed in parks and green belts, eliminating the need to transport the waste to NDMC plants.

  - E-waste is sent to Central Pollution Control Board-authorised recyclers, the compost generated is distributed free of cost to residents, with surplus used by NDMC's horticulture department.

- Each Anupam Colony has dedicated **sanitation inspectors and additional NDMC staff** for composting work and operating mechanical sweeping machines.

- Together, these complexes generate **around 300 kg of wet waste daily.**

  - Thirteen wire-mesh composters and 10 horticulture pits have been installed, producing around 800 kg of compost.

Source: TH

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