

ENVIRONMENT AND ECOLOGY**Green Minerals Race**

- **In Context-Recently, Ghana approved a new policy for the exploitation, management and regulation of lithium and other green minerals in the country.**

About:

- Critical minerals are elements that are the building blocks of essential modern-day technologies, and are at risk of supply chain disruptions.
- These minerals are now used everywhere from making mobile phones, computers to batteries, electric vehicles and green technologies like solar panels and wind turbines.

Lists of critical minerals:

- Based on their individual needs and strategic considerations, different countries create their own lists. Such lists mostly include
 - ✓ Graphite, lithium and cobalt, which are used for making EV batteries;
 - ✓ Rare earths that are used for making magnets and
 - ✓ Silicon which is a key mineral for making computer chips and solar panels.
- Aerospace, communications and defense industries also rely on several such minerals as they are used in manufacturing fighter jets, drones, radio sets and other critical equipment.

What are the Green Minerals?

- Often referred to as “minerals of the future”, green minerals are metals and other mineral resources that are needed to support the transition to clean energy technologies aimed at reducing carbon emissions.
- These include — bauxite, cobalt, copper, lithium, granite, manganese and nickel.

Demand of clean energy technologies:

- According to the International Energy Agency, electric vehicles (EV) and battery storage account for about half of the mineral demand growth from clean energy technologies over the next two decades, spurred by the surging demand for battery materials.
- Mineral demand for use in EVs and battery storage is expected to grow around 30 times in the period to 2040.
- Lithium will see the fastest growth rate, with demand growing by over 40 times in the sustainable development scenario, stated the Africa Development Bank in a paper on African Green Minerals Strategy.

Africa & critical rare earth elements:

- Africa’s store of critical rare earth elements: As global demand for critical rare earth elements rises, many countries have looked to Africa’s abundant stores of cobalt, lithium, copper and other minerals vital to the manufacturing of modern technologies.
- Extraction of Africa’s reserves has been largely hindered by weak domestic governance structures and policy impediments.
- But the continent is set to remain one of the major suppliers of a number of commodities in the coming years.
- Export bans by African Countries: Ghana’s new policy prohibits export of critical minerals including lithium, bauxite and iron, among others, in their raw state since this denies the country opportunity to add real value to the economy
- In 2023, the Namibia government banned the bulk export of unprocessed minerals including lithium, graphite and cobalt, known in the industry as direct shipping ore (DSO).
- In 2022, Zimbabwe prohibited export of raw lithium from its mines to stop losing billions of dollars in mineral proceeds to foreign companies.
- Significance of the export bans: China is among the largest players on the continent with billions invested in the African mining and mineral extraction sectors.
- As countries, especially China, rush to Africa, these developments across Africa are in accordance with the “continental strategy” to ensure larger and just share of the profits from “green minerals”.

India’s critical minerals:

- Minerals such as antimony, cobalt, gallium, graphite, lithium, nickel, niobium, and strontium are among the 22 assessed to be critical for India.
- Many of these are required to meet the manufacturing needs of green technologies, high-tech equipment, aviation, and national defense.
- While India has a significant mineral geological potential, many minerals are not readily available domestically.

Challenges for India

- Scarce reserves: Manufacturing renewable energy technologies would require increasing quantities of minerals, including copper, manganese, zinc, and indium.

- Likewise, the transition to electric vehicles would require increasing amounts of minerals, including copper, lithium, cobalt, and rare earth elements.
- However, India does not have many of these mineral reserves, or its requirements may be higher than the availability, necessitating reliance on foreign partners to meet domestic needs.
- Inadequate listing: Many critical and strategic minerals constitute part of the list of atomic minerals in the Mines and Minerals (Development and Regulation) (MMDR) Act, 1957.
- However, the present policy regime reserves these minerals only for public sector undertakings.

Suggestions and Way Forward

- **Creating a new list:** Given the increasing importance of critical and strategic minerals, there is an imperative need to create a new list of such minerals in the MMDR Act.
- The list may include minerals such as molybdenum, rhenium, tungsten, cadmium, indium, gallium, graphite, vanadium, tellurium, selenium, nickel, cobalt, tin, the platinum group of elements, and fertilizer minerals such as glauconitic, potash, and phosphate (without uranium).
- These minerals must be prospected, explored, and mined on priority, as any delays may hinder India's emissions reduction and climate change mitigation timeline.
- **Encouraging exploration:** The reconnaissance and exploration of minerals must be encouraged, with particular attention given to deep-seated minerals.
- This will call for a collective effort by the government, 'junior' miners, and major mining companies.
- **Processing & assembly:** India needs to determine where and how the processing of minerals and assembly of critical minerals-embedded equipment will occur.
- **Securing supply chain:** In addition, India must actively engage in bilateral and plurilateral arrangements for building assured and resilient critical mineral supply chains.
- **Periodic assessment:** Furthermore, the assessment of critical minerals for India needs to be updated every three years to keep pace with changing domestic and global scenarios.
- **Atma Nirbhar in critical minerals:** India requires a critical minerals strategy comprising measures aimed at making the country Aatma Nirbhar (self-reliant) in critical minerals needed for sustainable economic growth and green technologies for climate action, national defence, and affirmative action for protecting the interests of the affected communities and regions.
- **National critical minerals strategy:** A national critical minerals strategy for India, underpinned by the minerals identified in this study, can help focus on priority concerns in supply risks, domestic policy regimes, and sustainability.

SCIENCE AND TECHNOLOGY

Agnikul's Agnibaan space vehicle

- **Context:** Chennai-based space-tech startup Agnikul Cosmos announced that it had taken a rocket that it has developed to a launch pad in Sriharikota to "commence integration checks" for a proposed suborbital space flight.

Key details:

- A successful flight will make Agnikul the second Indian space-tech company to send a vehicle to space after Hyderabad-based Skyroot Aerospace.
- The launch of Skyroot's 545-kg rocket named Vikram-S in 2022 marked the launch of India's private space industry.

About Agnikul's space vehicle

- Agnikul's Suborbital Tech Demonstrator (SorTeD) single-stage launch vehicle, called Agnibaan, is driven by the company's patented Agnilet engine.
- Agnibaan SOrTeD will lift off vertically & follow a predetermined trajectory.
- Agnibaan can carry payloads up to 100 kg to a low Earth orbit (LEO) up to 700 km and can carry one or more satellites.

Engine:

- The Agnilet engine is an entirely 3D-printed, single-piece, 6 kN semi-cryogenic engine.
- The engine uses a mixture of liquid kerosene at room temperature and supercold liquid oxygen as propellant.
- In 2021, Skyroot had successfully demonstrated the country's first privately developed cryogenic engine, Dhawan-1, which too was completely 3D printed, using a superalloy, by a process that cut the manufacturing time by 95 per cent.

Concerns about 3d printing in space vehicles:

- While it does allow engineers to reiterate designs faster than with conventional manufacturing techniques, it is not as scalable.

- With conventional techniques, once a design has been set, multiple copies can be made much faster.
- 3D printing is still slow if you compare it to injection moulding or planar-based manufacturing where you can manufacture millions of pieces every month.
- So it is not meant for manufacturing in large volumes.

Role of the private sector in space

- In 2020, the government approved the creation of the Indian National Space Promotion and Authorization Centre (IN-SPACe) to ensure greater private participation in India's space activities.
- At the time that Indian industry had a barely 3% share in the rapidly growing global space economy, which was already worth at least \$360 billion.
- Only 2% of this market was for rocket and satellite launch services, the rest 95% related to satellite-based services and ground-based systems.
- Indian industry was unable to compete, because its role has traditionally been to supply components and sub-systems.
- Indian industries did not have the resources or the technology to undertake independent space projects of the kind that companies such as SpaceX have been doing in the United States.
- ISRO was unable to keep up with the growing demand for space-based applications and services even within India.
- ISRO would provide all its facilities to private players whose projects had been approved by IN-SPACe.
- Private companies could even build their own launch pad within the Sriharikota launch station, and ISRO would provide the necessary land.

Benefit to ISRO:

There are two main reasons why enhanced private involvement in the space sector is important:

- **Strategic:**
 - ✓ Private participation will free up ISRO to concentrate on science, research and development, interplanetary exploration, and strategic launches.
 - ✓ Right now, too much of ISRO's resources are consumed by routine activities that delay its more strategic objectives.
- **Commercial:**
 - ✓ There is no reason why ISRO alone should be launching weather or communication satellites.
 - ✓ The world over, an increasing number of private players are taking over this activity for commercial benefits.
 - ✓ And ISRO, like NASA, is essentially a scientific organization whose main objective is exploration of space and carrying out scientific missions.
 - ✓ ISRO can earn some money by making its facilities and data available to private players.

PRELIMS FACT

1. India's first 3D-printed post office

Context: India's first 3D-printed post office was recently in Bangalore's Cambridge Layout.

Key details:

- Multinational company Larsen & Toubro Limited built the post office with technological support from IIT Madras.

Relevance of 3D printing:

- Invented in the 1980s, 3D printing burst into the mainstream around the 2010s.
- The technology at the time was expensive, slow and prone to making errors.
- In recent years, some of these flaws have been done away with, making 3D printing more prevalent than ever before.
- For instance, it's being used in automotive and aerospace sectors to make parts of cars and rockets respectively.

What is 3D printing?

- 3D printing, also known as additive manufacturing, is a process that uses computer-created design to make three-dimensional objects layer by layer.
- It is an additive process, in which layers of a material like plastic, composites or bio-materials are built up to construct objects that range in shape, size, rigidity and colour.

How is 3D printing done?

- To carry out 3D printing, one needs a personal computer connected to a 3D printer.
- All they need to do is design a 3D model of the required object on computer-aid design (CAD) software and press 'print'.
- The 3D printer does the rest of the job.
- 3D printers construct the desired object by using a layering method.

- 3D printers build from the bottom up by piling on layer after layer until the object looks exactly like it was envisioned.
- It essentially adds hundreds or thousands of 2D prints on top of one another to make a three-dimensional object.

Notable examples of 3D printing

- Recently, aerospace manufacturing company Relativity Space launched a test rocket made entirely from 3D-printed parts, measuring 100 feet tall and 7.5 feet wide.
- Shortly after its take off, however, it suffered a failure.
- At the peak of the Covid-19 pandemic in 2020, the healthcare industry used 3D printers to make much-needed medical equipment, like swabs, face shields, and masks, as well as the parts to fix their ventilators.

2. AI Index Report, 2023

In News- India ranked fifth in Artificial Intelligence (AI)-based investments according to Stanford University's annual AI Index report 2023.

Global rankings:

- India ranked fifth in terms of investments received by startups offering artificial intelligence (AI)-based products and services in 2022.
- Total investments in AI startups in India stood at \$3.24 billion in 2022, placing it ahead of South Korea, Germany, Canada and Australia, among others.
- Those ahead of India in the list are the US, China, the UK and Israel.

Prediction of revival:

- Though globally AI investment has declined since 2021 due to the recessionary conditions, experts are expecting a revival in Venture capital (VC) funding this year, especially due to the massive interest in generative AI products and OpenAI's ChatGPT among enterprises and consumers.

Research & development on LLMs:

- The report stated that 54% of researchers working on large language models (LLMs) were from American institutions.
- However, last year researchers from Canada, Germany, and India contributed to the development of LLMs for the first time.

AI Index report

- The AI Index is an independent initiative at the Stanford Institute for Human-Centered Artificial Intelligence (HAI).
- The annual report tracks, collates, distills, and visualizes data relating to artificial intelligence, enabling decision-makers to take meaningful action to advance AI responsibly and ethically with humans in mind.

3. Kuwi and Desia Books

- **Context-** Union Ministers of Education and Skill Development & Entrepreneurship and Finance & Corporate Affairs launched 'Kuwi and Desia' books at Bhubaneswar in Odisha with the aim of shaping a strong educational foundation, preserving & fostering cultural, linguistic heritage and identity of tribal community of Odisha.

About the books:

- The National Council of Educational Research and Training (NCERT), in collaboration with the Central University of Odisha, and Department of Posts has developed the 'Kuwi Primer' and 'Desia Primer'.
- These books are specifically tailored for children speaking the Kuwi and Desia tribal languages in the undivided Koraput district of Odisha.
- It aims to shape a strong educational foundation of children along with preserving and fostering the cultural, linguistic heritage and identity of the tribal community of Odisha.

Tribes in Odisha

- As per the Census 2011, the state of Odisha has the third highest percentage of tribal population in the country.
- They constitute about 23% of the total population of the state and contribute 9.17% to the total tribal population of the country.
- Birhor, Bonda Poraja, Chuktia Bhunjia, Didayi, Dongria Kandha, Hill Kharia, Juang, Kutia Kandha, Lanjia Saora, Lodha, Mankirdia, Paudi Bhuyan and Saora etc are the famous tribal communities living in the Odisha.
- So, it becomes necessary to teach students with the help of pictures, stories and songs based on their local nature and culture to improve their speaking skill, learning outcome and cognitive development.

Meri Maati Mera Desh

- Ministers visited Sand Art on 'Meri Maati Mera Desh' by Padmashri Awardee Sand Artist Shri Sudarshan Patnaik at Puri Beach and dedicated Shilaphalakam (memorial plaques), planted saplings, administered Panch Pran pledge along with 1000 students.

- A 'Memorial Plaque' in memory of Martyrs was installed under the 'Dedication of Shilaphalakam' and 'Vasudha Vandan' initiative of Meri Maati Mera Desh.
- Ministers collected soil and rice in 'amrit kalash' from house to house from Biraharekrushnapur, village of Puri district, the birthplace of the Martyr Jayee Rajguru to create an 'Amrit Vatika' in Delhi.

4. Reforms for Mobile User Protection

News- Two reforms introduced for Mobile User Protection to promote a cleaner and safer digital ecosystem.

Abou

- The two reforms are in the direction of earlier reforms introduced with a launch of Sanchar Saathi, a citizen centric portal that has empowered India's fight against the menace of cybercrimes and financial frauds.

- The reforms are as;

1. KYC Reforms

- KYC is a process to uniquely identify a customer and enable his traceability before providing him telecom services.
- To prevent misuse of printed Aadhaar, the demographic details will mandatorily be captured by scanning QR code of printed Aadhaar. In case of disconnection of a mobile number, it will not be allocated to any other new customer till expiry of 90 days.
- In addition to thumb impression and iris-based authentication in Aadhaar E-KYC process, facial based biometric authentication is also permitted.

2. Point-of-Sale (POS) Registration Reforms

- This reform introduces the process for mandatory registration of Franchisee, Agents and Distributors (PoS) by Licensees. It mandates a written agreement between the PoS and the Licensees.
- This will help in eliminating the rogue PoS who by fraudulent practices issue SIMs to anti-social/anti-national elements.
- If a PoS indulges in any illegal activities, it will be terminated and blacklisted for a period of 3 years.

ANSWER WRITING

Q. What are the research and developmental achievements in applied biotechnology? How will these achievements help to uplift the poorer sections of the society?

- Biotechnology is technology based on biology. Biotechnology generates cellular and biomolecular processes to develop technologies and products that help improve our lives and the health of our planet. Biotechnology is helping to heal the world by harnessing nature's own toolbox and using our own genetic makeup.

Research and developmental achievements:

- **Stem Cell Research:** Stem cells have the ability to keep on dividing infinitely and have the capacity to distinguish into different types of body cells during the early development of an organism. Researchers can program these stem cells to differentiate into specific types of cells.
- **Human Genome Project:** It was an international scientific research project coordinated by the National Institutes of Health and the U.S. Department of Energy. Officially launched in 1990, it had the goal of determining the sequence of nucleotide base pairs that make up human DNA. It has supported researchers in identifying genes that cause diseases.
- **Targeted Cancer Therapies:** The established standard chemotherapies are toxic for healthy cells at present. Targeted cancer therapies are drugs that operate either by interfering with the function of specific molecules or by only targeting known cancerous cells in order to reduce damage to healthy cells.
- **CRISPR:** Clustered Regularly Interspersed Short Palindromic Repeats (CRISPR) is a relatively new gene-editing system that has been hailed as a groundbreaking tool in medical research. HIV research is one of its many uses.

Role in uplifting poorer sections of society:

- Biotechnology is assisting to expand the income of marginal farmers by increasing crop yield and making it climate and pest resilient.
- It has revolutionized the medical science leading to controlled death rate and world class treatment possible in India itself.
- By genome sequencing, biotechnology helps in accessing health of the people from the corners of India which ultimately proves conducive for the government in framing targeted policy initiatives.
- It also proves beneficial in expanding the shelf life of food products, which in turn, keeps their price in check for the poor.
- Pollution attacks poor the most. Biotechnology helps in reducing pollution and, thus, alleviates their suffering. For example, landfills are cleaned through bioremediation techniques.

MCQs

1. Consider the following statements.
 1. Multinational company Larsen & Toubro Limited built the post office with technological support from IIT Madras.
 2. India's first 3D-printed post office was recently in Bengaluru's Cambridge Layout.
 3. 3D printers build from the bottom up by piling on layer after layer until the object looks exactly like it was envisioned.
 How many of the above statements is/are correct.
 - a) Only one
 - b) Only two
 - c) **Only three**
 - d) None
2. Consider the following pairs of volcanic summits with countries
 1. Ojos del Salado – Chile
 2. Mt Kilimanjaro – Tanzania
 3. Mount Elbrus – Russia
 4. Mount Pico de Orizaba – Mexico
 5. Mt Damavand – Iran
 How many of the above pairs are correct?
 - a) Only one
 - b) Only two
 - c) Only three
 - d) **All four**
3. With reference to Registration of Births and Deaths (Amendment) Bill, 2023, consider the following statements
 1. The Bill proposes to make it obligatory for States to register births and deaths on the Centre's Civil Registration System (CRS) portal.
 2. The registration of births and deaths falls under the Union list.
 3. The Bill proposes linking Aadhaar details of parents and informants to birth certificates.
 How many of the above statements is/are incorrect?
 - a) **Only one**
 - b) Only two
 - c) All three
 - d) None
4. With reference to Artificial Intelligence Index Report, consider the following statements
 1. The AI Index is an independent initiative at the Stanford Institute for Human-Centered Artificial Intelligence (HAI).
 2. As per report, India is ranked fifth in terms of investments received by startups offering AI-based products and services in 2022.
 Which of the above statements is/are incorrect?
 - a) 1 only
 - b) 2 only
 - c) Both 1 and 2
 - d) **Neither 1 nor 2**
5. "3D printing" has applications in which of the following?
 1. Preparation of confectionery items
 2. Manufacture of bionic ears
 3. Automotive industry
 4. Reconstructive surgeries
 5. Data processing technologies
 How many of the above statements is/are correct.
 - a) Only one
 - b) Only two
 - c) Only three
 - d) **All four**
6. Recently Flood Watch app was launched by which organization to forecast the chances of floods.
 - a) **The Central Water Commission**
 - b) The Ministry of Electronics and Information Technology
 - c) The Ministry of Earth Sciences
 - d) The Ministry of Environment, Forest and Climate Change
7. Consider the following statements about National Disaster Management Authority (NDMA)
 1. The National Disaster Management Authority (NDMA) has started testing the emergency cell broadcast technology developed by Centre for Development of Telematics (C-DOT).
 2. It is the apex statutory body for Disaster Management in India, established through the Disaster Management Act, 2005.
 3. It is headed by the Prime Minister.
 How many of the above statements is/are incorrect?
 - a) Only one
 - b) Only two
 - c) All three
 - d) **None**
8. Consider the following statements about VS Arunachalam.
 1. He became the first DRDO scientist to lead the organisation.
 2. In 2015, he received the DRDO's Lifetime Achievement Award.
 3. He was well-known for his executive positions at DRDO, where he was instrumental in establishing India's defense capabilities.
 How many of the above statements is/are correct?
 - a) Only one
 - b) Only two
 - c) **All three**
 - d) None
9. Consider the following statements.
 1. Sanchar Saathi portal is an initiative of the Department of Telecommunications for the protection of mobile users.
 2. KYC is a process to uniquely identify a customer and enable his traceability before providing him telecom services.
 Which of the above statements is/are incorrect?
 - a) 1 only
 - b) 2 only
 - c) Both 1 and 2
 - d) **Neither 1 nor 2**
10. Consider the following statements about Tribes in Odisha.
 1. As per the Census 2011, the state of Odisha has the third highest percentage of tribal population in the country.
 2. The National Council of Educational Research and Training (NCERT), in collaboration with the Central University of Odisha, and Department of Posts has developed the 'Kuwi Primer' and 'Desia Primer'.
 3. These books are specifically tailored for children speaking the Kuwi and Desia tribal languages in the undivided Koraput district of Odisha.
 How many of the above statements is/are correct?
 - a) Only one
 - b) Only two
 - c) **All three**
 - d) None