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Current Affairs, October 2024

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1. Polity and Governance

Prelims

1.1 Supreme Court says secularism a core part of the Constitution

Context:

- The Supreme Court said secularism is an indelible and core part of the Basic Structure of the Constitution.

More info:

- The court made the oral observation while hearing a batch of petitions challenging the inclusion of words 'socialist' and 'secular' in the Preamble of the Constitution.
- "This court has in a number of judgments held that secularism was always part of the Basic Structure of the Constitution.
  - If one looks right to equality and the word 'fraternity' used in the Constitution, there is a clear indication that secularism has been held as the core feature of the Constitution," a Bench of 2 Justices said.
- Justice Khanna disagreed with the petitioners' argument that the term 'socialism' would curtail personal liberty and individualism.
  - "One should not take the meaning adopted in Western countries… Socialism can also mean that there should be equality of opportunity and the wealth of the country should be distributed equally," Justice Khanna remarked.
- A petitioner said he was neither against the words "socialist, secular and integrity" nor their insertion in the Constitution but against the insertion of these words into the Preamble in 1976 and that too with a retrospective effect from November 26, 1949.
  - The Preamble was amended in December 1976 by the Indira Gandhi government to introduce the words 'socialist' and 'secular'.
  - The phrase "unity of the nation" was replaced with "unity and integrity of the nation".
  - The changes were made in the Preamble through the 42nd Constitutional Amendment during the Emergency.
- Originally, the text of the Preamble declared India as a 'sovereign, democratic republic'.
  - The words 'socialist', 'secular' were inserted between 'sovereign' and 'democratic'.
- The largest Bench in the history of the Supreme Court (13 judges) in the Kesavananda Bharati case had held that the Preamble was an integral part of the Constitution, and was subject to the amending power of the Parliament, provided the basic structure was not tinkered with.
- Another Advocate said the 42nd amendment was indeed "infamous".
  - It had after all tried to reduce the power of the Supreme Court and High Courts.
  - "While subsequent amendments more or less restored the Constitution to what it was pre-1976, this change was made in the Preamble… that we are secular and socialist… was retained."

Mains

1.2 On the exception to marital rape (MRE)

What is the legal provision under challenge? What rights does it infringe upon and what are the contentions advanced by stakeholders? What is the 'doctrine of coverture' in English common law? What was the split

verdict issued by the Delhi High Court in 2022 on the issue?

Introduction:

- A three-judge Bench headed by Chief Justice of India (CJI) has begun hearing a batch of petitions challenging the constitutional validity of Exception 2 to Section 375 of the Indian Penal Code, 1860 (IPC).
    - The challenge also extends, by implication, to Exception 2 of Section 63 of the Bharatiya Nyaya Sanhita (BNS), 2023, which supersedes the former provision.
    - These provisions grant legal immunity to Indian husbands by stipulating that "sexual intercourse or acts by a man with his wife, provided she is not under 18 years of age, do not constitute rape".

Statistics:

- While data on marital rape remains limited due to stigma and legal barriers, available statistics are deeply concerning.
    - Data from the National Family Health Survey-5, conducted between 2019 and 2021, indicates that nearly one-third of married women (18-49 years) in India have experienced physical or sexual violence at the hands of their husbands.
    - Additionally, global statistics reveal that approximately three-quarters of all sexual assaults transpire within intimate settings, often perpetrated by someone familiar to the survivor.

Genesis of the exception:

- The MRE is a colonial relic, originating from the "doctrine of coverture" in English common law, which severely curtailed a married woman's legal autonomy.
    - As elucidated by the Supreme Court in Joseph Shine versus Union of India in 2018, this doctrine assumed that the husband and wife became a single entity after marriage, that is, "the very being or legal existence of the woman is suspended during the marriage, or at least is incorporated and consolidated into that of the husband".
- One of the earliest instances of codification of the MRE can be traced back to British jurist Matthew Hale, who wrote in a 1736 treatise that "the husband cannot be guilty of a rape committed by himself upon his lawful wife, for by their mutual matrimonial consent and contract: the wife has given up herself in this kind unto her husband, which she cannot retract."
    - Hale's reasoning proved hugely influential and was subsequently adopted by several British colonies.
    - However, in 1991, England outlawed the MRE in the landmark case of R versus R underscoring that the common law doctrine no longer represented the true position of a wife in present-day society.

Challenges before the SC:

- Section 375 of the IPC delineates seven conditions under which sexual intercourse is deemed rape, such as when it occurs without the woman's consent, or when consent is obtained through coercion.
    - Those convicted are punished with a prison term of at least 10 years, which can be extended to a life sentence, along with a possible fine.
    - However, the provision stipulates two "exceptions".
        - The first exception pertains to medical procedures.
        - As per the second exception, "sexual intercourse or sexual acts by a man with his own wife" do not constitute rape if the wife is over 18 years of age.
- The MRE, therefore, creates a legal friction whereby, even if all the elements constituting the offence of rape are met, a conviction cannot take place if the parties are married and the wife is over 18 years of age.
    - However, a married woman can seek recourse to other criminal law provisions such as Section 85 of the BNS which criminalises subjecting a woman to "cruelty".

- Civil remedies can also be availed under laws such as the Protection of Women from Domestic Violence Act (2005) but they are limited to "protection orders, judicial separation and monetary compensation".

- The petitioners have argued that the exception is unconstitutional since it violates a host of fundamental rights.
  - Foremost among them is Article 14 which guarantees the equal protection of laws to all persons.
  - The MRE creates two distinct classes of victims of non-consensual sex by denying married women the protection of laws that are extended to unmarried women.
  - This, according to the petitioners, also offends the principle of "substantive equality" by failing to address systemic barriers to ensure that all women regardless of their marital status receive equal protection against sexual violence.
  - By specifically disadvantaging married women, the MRE violates their right to non-discrimination under Article 15(1).
  - Another important facet is the purported violation of the right to privacy and bodily integrity under Article 21.
    - The Supreme Court's ruling in K.S. Puttaswamy versus Union of India (2017) not only clarified that privacy was a fundamental right, it also affirmed the concept of decisional autonomy - the right of each individual to determine how and for what purposes their body may be used.
    - As noted by constitutional law expert Gautam Bhatia the true brilliance of Puttaswamy lies in clearly establishing that the right to privacy is not merely anchored in physical spaces and institutions (such as marriage), but is fundamentally tied to individual self-determination.
    - The right is, therefore, inseparable from the ability to make choices regarding the most integral aspects of one's body and life.
    - In Joseph Shine, the top court built on this jurisprudence by observing that "familial structures cannot be regarded as private spaces where constitutional rights are violated" and that doing so is "to obstruct the unfolding vision of the Constitution."

Judicial precedents:

- In March 2022, the Karnataka High Court in Hrishikesh Sahoo versus State of Karnataka and Others ruled that a married man can be prosecuted for raping his wife.
  - Relying on a 2013 report authored by the Justice J.S. Verma Committee, which recommended the abolition of the MRE, Justice M. Nagaprasanna reasoned that no legal exception can be so absolute as to licence crimes against society.
  - However, instead of striking it down, he made the exemption inapplicable in cases involving the commission of heinous sexual offences by husbands against their wives.
- Justice Rajiv Shakdher of Delhi High Court deemed the MRE unconstitutional, asserting that it violates a woman's bodily autonomy and expression.
  - He characterised the exception as "steeped in patriarchy and misogyny," adding that "the classification, in his opinion, is unreasonable and manifestly arbitrary as it implies that forced sex outside marriage constitutes 'real rape,' whereas the same act within marriage does not."
  - Conversely, Justice C. Hari Shankar opined that within marriage, sexual relations are a "legitimate expectation" making the MRE legal.
    - "Introducing, into the marital relationship, the possibility of the husband being regarded as the wife's rapist, if he has, on one or more occasions, sex with her without her consent would, in his view, be completely antithetical to the very institution of marriage, as understood in this country, both in fact and in law", he reasoned.

- While an authoritative pronouncement is awaited, the top court (SC) in 2022 recognised for the first time that "sexual assault by a man against his wife can constitute rape" in a separate case concerning an unmarried woman's right to seek medical termination of pregnancy.
- A Bench led by Chief Justice Chandrachud underscored, "We would be remiss in not recognising that intimate partner violence is a reality and can take the form of rape. The misconception that strangers are exclusively or almost exclusively responsible for sex and gender-based violence is a deeply regrettable one".

Centre's statement:

- The Union government's latest Supreme Court affidavit is the first time that it has on record opposed the striking down of the MRE.
- During the proceedings before the Delhi High Court, the government had said that the "issue needs wider consultations" and that a review of existing criminal laws was pending at that time.
- Drawing from Justice Shankar's opinion, the Centre has argued that marriage creates "a continuing expectation of reasonable sexual access" which is absent in the case of a stranger or of another intimate relationship.
- While acknowledging that a man has no fundamental right to violate his wife's consent, it has contended that classifying such acts as "rape" is "excessively harsh" and "disproportionate".
- It has also apprised the court that criminalising marital rape would affect the sanctity of the institution of marriage and potentially result in false allegations of marital rape.

'New' offence:

- A pivotal question before the top court is whether striking down the MRE would result in the creation of a new offence, as it would allow for the prosecution of husbands who engage in non-consensual sex with their wives.
- Justice Shankar, in his opinion, responded in the affirmative and cautioned that there is an "absolute proscription" against this since such an authority rests exclusively with the legislature.
    - However, senior advocate Rebecca John argued before the Delhi High Court that deeming the exception unconstitutional would not create any new offence, as the offence already exists- rather, it would simply revoke the legal immunity presently enjoyed by a specific class of individuals.
- In Independent Thought, while raising the age for the application of the MRE from 15 to 18 years, the top court noted that "by partly striking down Section 375 IPC, no new offence is being created".

2. International Relations

Prelims

2.1 China marks 75 years of Communist Party rule

Context:

- China marks 75 years of Communist Party rule as economic challenges and security threats linger

News:

- China is marking the 75th year of Communist Party rule as economic challenges and security threats linger over the massive state.

More info:

- The entirely state-controlled media ran constant reports on China's economic progress and social stability, with no mention of challenges ranging from a declining birth rate to the disruption in supply chains that has harmed the largely export-driven economy.
- Commemorations were also held in the former British colony of Hong Kong and Portugal's former territory of Macao, both of which returned to Chinese sovereignty in the late 1990s in a key indication of Beijing's determination to overcome what it has called a “Century of Humiliation.”
- In recent decades, China has mounted military parades and displays of the country's economic might only at the turn of decades, such as for the 60th and 70th anniversaries.
- The world’s second largest economy has struggled to regain momentum after the COVID-19 pandemic.
- A prolonged property slump led to a spillover effect on other parts of the economy, from construction to sales of home appliances.
    - Last week, China announced a slew of measures to boost the economy, including lower interest rates and smaller down payment requirements for mortgages.
- Party leader and head of state Xi Jinping has largely avoided overseas travel since the pandemic, while continuing with his purges at home of top officials considered insufficiently loyal or being suspected of corruption or personal indiscretions.
- "The road ahead will not be smooth, there will definitely be difficulties and obstacles, and we may encounter major tests such as high winds and rough seas, or even stormy waves” Mr. Xi warned during a banquet on the eve of the anniversary.
    - “We must be vigilant in times of peace, plan ahead, and rely closely on the entire Party, the entire army, and people of all ethnic groups across the country" he said, "no difficulties can stop the Chinese people from moving forward.”
- The anniversary also comes as China is facing growing frictions with neighbors including Japan, South Korea and the Philippines over territorial claims and their close relationships with Beijing’s chief rival, the United States.
- The Communists under Mao Zedong seized power in 1949 amid a civil war with the Nationalists, also known as the KMT, led by Chiang Kai-shek, who shifted their political, economic and military power to the now self-governing island democracy of Taiwan.
    - Beijing continues to insist Taiwan must be annexed under Communist Party rule, by force if necessary, while the U.S. has provided arms to ensure its defense.
    - China, meanwhile, has involved itself in disputes over its claims to most of the South China Sea and uninhabited islands held by Japan, the Philippines, Vietnam and other neighboring nations.

- China's military buildup and its recent launch of a nuclear capable ballistic missile into the Pacific Ocean have raised concerns about a possible conflict.
- At home, Mr. Xi has made himself effectively leader for life by ending term limits and extending his power over key government and party bodies.
    - China allows no competitive elections and the party retains near total control over the media that informs its 1.4 billion people.

2.2 M23 - a rebel group

Context:

- Rebel group in Congo generates $300,000 monthly in seized mining area, UN official says
- In April, the M23 - a rebel group with alleged links to Rwanda - seized the Rubaya mining area in eastern Congo, which holds deposits of a key mineral used in the production of smartphones and computers

News:

- "A rebel group in Congo generates around $300,000 a month in revenue through its control of a mining area in the east of the country," a United Nations official said.

More on the news:

- "In April, the M23 - a rebel group with alleged links to Rwanda - seized the Rubaya mining area in eastern Congo, which holds deposits of a key mineral used in the production of smartphones and computers.
    - Over 15% of the world's supply of tantalum, a rare metal extracted from coltan, comes from Rubaya.
- Unless international sanctions are imposed on those benefiting from this criminal trade, peace will remain elusive and civilians will continue to suffer.
- Tantalum is among the minerals that were identified earlier this year in a letter from Congo's government questioning Apple about the tech company's knowledge of "blood minerals" being smuggled in its supply chain.

- The decades long conflict in eastern Congo has produced one of the world's worst humanitarian crises, with more than 120 armed groups fighting for power, land and valuable mineral resources while others try to defend their communities.
    - Some armed groups have been accused of mass killings, rapes and other human rights violations.
    - The violence has displaced some 6 million people in the country's east.
- M23, or the March 23 Movement, is a rebel military group mainly made up of ethnic Tutsis that broke away from the Congolese army just over a decade ago.
    - They staged a large offensive in 2012 and took over the provincial capital of Goma near the border with Rwanda, the same city they are threatening again.
- Congo alleges that Rwanda has been involved in war crimes in the east, and U.S. and U.N. experts accuse it of giving military backing to M23.

- Rwanda denies the claim, but in February admitted that it has troops and missile systems in eastern Congo to safeguard its security, pointing to a buildup of Congolese forces near the border.
- In July, U.N. experts estimated that between 3,000 and 4,000 Rwandan government forces are deployed in eastern Congo alongside M23, which has been making major advances.

- Last week, a regional court in East Africa opened proceedings in a case filed by Congo against Rwanda, accusing it of violating Congo's sovereignty and territorial integrity by sending troops to help rebels in the country's east.

2.3 Chagos Islands

Context:

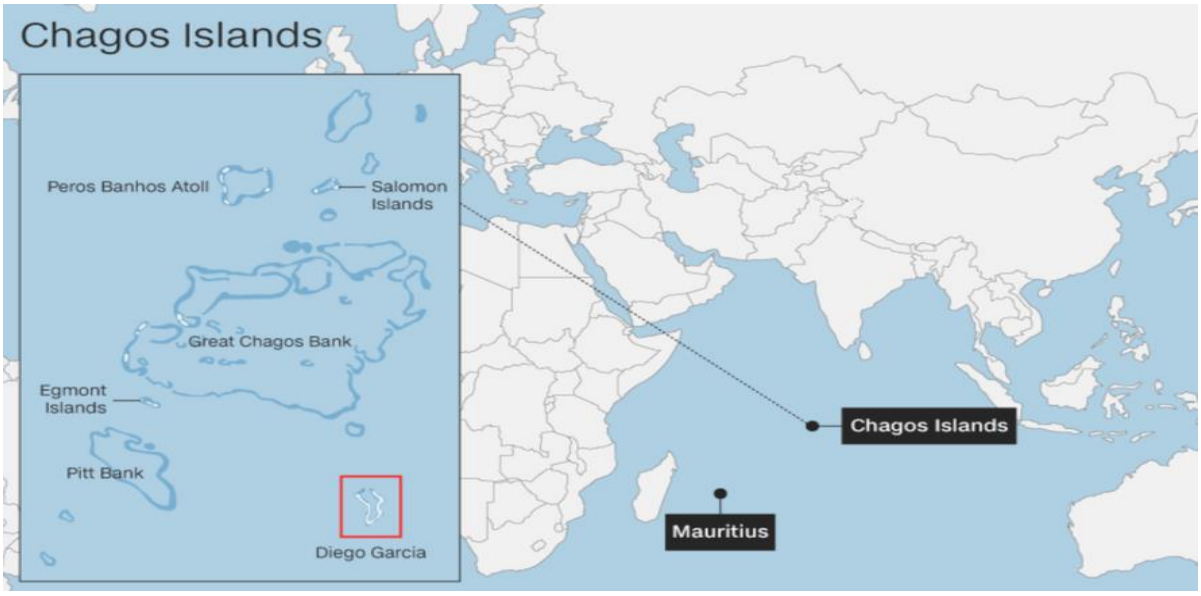
- U.K. hands over sovereignty of Chagos Islands to Mauritius in deal to secure U.S. base

News:

- Britain's government said that it agreed to hand sovereignty of the long-contested Chagos Islands, an archipelago of more than 60 islands in the Indian Ocean, to Mauritius, in a deal that secures the future of a strategically important U.K.-U.S. military base there.

More on the news:

- British Foreign Secretary said the agreement secures the vital military base at Diego Garcia, the largest in the chain of islands, for the future.
- The U.K. government said without the deal the secure operation of the military base would be under threat, with contested sovereignty and legal challenges, including through various international courts and tribunals.
  - As part of the deal, the U.K. will retain sovereignty of Diego Garcia for an initial period of 99 years.
- "It will strengthen our role in safeguarding global security, shut down any possibility of the Indian Ocean being used as a dangerous illegal migration route to the U.K., as well as guaranteeing our long-term relationship with Mauritius, a close Commonwealth partner," British Foreign Secretary said.
- The deal was strongly supported by international partners including the U.S., British officials said.
- The agreement will have to be signed off in a treaty and is dependent on legal processes being finalized.
  - Both sides have committed to complete this as quickly as possible.
- The Chagos Islands have been at the heart of what Britain calls the British Indian Ocean Territory since 1965 when they were siphoned away from Mauritius, a U.K. territory that gained independence three years later.
- The U.S. Navy base at Diego Garcia was built in the 1970s and provides what American authorities have described as "an all but indispensable platform" for security operations in the Middle East, South Asia and East Africa.
- Around 1,500 inhabitants from the Chagos Islands were displaced to make way for the U.S. base.
  - It's unclear immediately whether they and their descendants, who are mainly living in the U.K., Mauritius and the Seychelles, will have a right to return.
- In a statement, the White House said President Joe Biden applauded the "historic agreement" on the status of the Chagos Islands.
  - It called the Diego Garcia base vital in preserving "national, regional, and global security".
  - "The agreement secures the effective operation of the joint facility on Diego Garcia into the next century," the statement said.
- "This agreement affirms Mauritian sovereignty over the Chagos Archipelago, while granting the United Kingdom the authority to exercise the sovereign rights of Mauritius with respect to Diego Garcia."



2.4 International Medical Device Regulators Forum

Context:

- India becomes affiliate member of International Medical Device Regulators Forum (IMDRF)
- India joins IMDRF as an affiliate member, enhancing global collaboration and harmonisation in medical device regulations for public health

News:

- “India has become an affiliate member of the International Medical Device Regulators Forum (IMDRF), which will open doors to invaluable opportunities for reliance and collaboration with regulatory authorities worldwide,” the Union Health Ministry said.

About IMDRF:

- The IMDRF, which was established in 2011, is a group of global medical device regulators whose aim is to speed up the adoption of international medical device regulatory harmonisation and convergence.
- Its members include national regulatory authorities of the U.S., Australia, Canada, the European Union, Japan, the United Kingdom, Brazil, Russia, China, South Korea, Singapore and the World Health Organization (WHO).
- "To achieve global alignment in its medical device regulatory system, enhance the competitiveness of the domestic industry and boost transnational prominence, the Central Drugs Standard Control Organization (CDSCO), under the Ministry of Health and Family Welfare, applied for Affiliate Membership in the International Medical Device Regulators Forum (IMDRF) in 2024," the Health Ministry said in a statement.
    - "After review of India's application for affiliate membership and meeting discussions by the IMDRF Management Committee (MC) with the senior officers of CDSCO during the 26th Session of IMDRF held in September 2024 at Seattle, Washington, USA, the CDSCO has received approval from IMDRF as an affiliate member of the forum," it said.
    - “Becoming an affiliate member of the IMDRF will open doors to invaluable opportunities for reliance and collaboration with regulatory authorities worldwide,” it said.
- The membership helps to harmonise regulatory requirements across the globe, which reduces complexities for manufacturers and helps safeguard public health by promoting collaboration, harmonising regulations and promoting convergence.
- As an affiliate member, India will participate in IMDRF open sessions for information exchange on technical topics with other regulators, to discuss the latest medical device regulatory strategies and

trends, provide feedback on its experience and perspectives and use IMDRF documents in part or in whole as the basis for its regulatory framework for medical devices.

- "This will strengthen the CDSCO's medical device regulatory system, helping meet emerging technical challenges that are increasingly diverse, ensuring the protection of public health and safety, and continuing to maintain the goal of international recognition for its medical device regulation," the statement said.
- "This membership will also enable Indian medical device manufacturers to meet the regulatory requirements of IMDRF member countries, thereby strengthening "Brand India" in the global market," it said.

2.5 India, UAE investment promotion, protection treaty

Context:

- India, UAE investment promotion, protection treaty comes into effect from August 31: Finance ministry

News:

- The government said bilateral investment treaty (BIT) signed between India and the UAE has been enforced from August 31 this year.
  - The BIT was signed on February 13 this year at Abu Dhabi, UAE, and it entered into force with effect from August 31, 2024, the finance ministry said.

Key features of the pact:

- Enforcement of this pact with the UAE gives continuity of investment protection to investors of both the countries, as the earlier Bilateral Investment Promotion and Protection Agreement (BIPPA) between India and the UAE signed in December 2013 expired on September 12 this year.
- As per the treaty, the UAE investors must have to exhaust domestic remedies (for at least three years) before commencing arbitration under the BIT.
  - The time period earlier was five years.
- The other key features of the pact included provisions of closed asset-based definition of investment with coverage of portfolio investment; treatment of investment with obligation for no denial of justice, no fundamental breach of due process, no targeted discrimination and no manifestly abusive or arbitrary treatment.
- It also includes the scope carved out for measures such as those related to taxation, local government, government procurement, subsidies or grants and compulsory license; and no investor claim in case investments is involved with corruption, fraud, round tripping.
  - However, while providing investor and investment protection, balance has been maintained with regard to the state's right to regulate and, thereby providing adequate policy space.
- The treaty provides for protection to investments from expropriation, provides for transparency, transfers, and compensation for losses.

India-UAE economic relations:

- The UAE is the seventh largest with a share of 3 per cent in the total foreign direct investment (FDI) received in India, with cumulative investment of about USD 19 billion from April 2000-June 2024.
- India also made 5% of its total overseas direct investments in the UAE to the tune of USD 15.26 billion from April 2000-August 2024.
- India-UAE BIT is expected to increase the comfort level and boost the confidence of the investors by assuring minimum standard of treatment and non-discrimination while providing for an independent forum for dispute settlement by arbitration.

- The treaty is expected to pave the way for increased bilateral investments, benefiting businesses and economies in both countries.
- Both countries have also implemented a free trade agreement, which came into force on May 1, 2021.

2.6 Nile nations

Context:

- Nile nations agree on water-sharing without Egypt's nod

News:

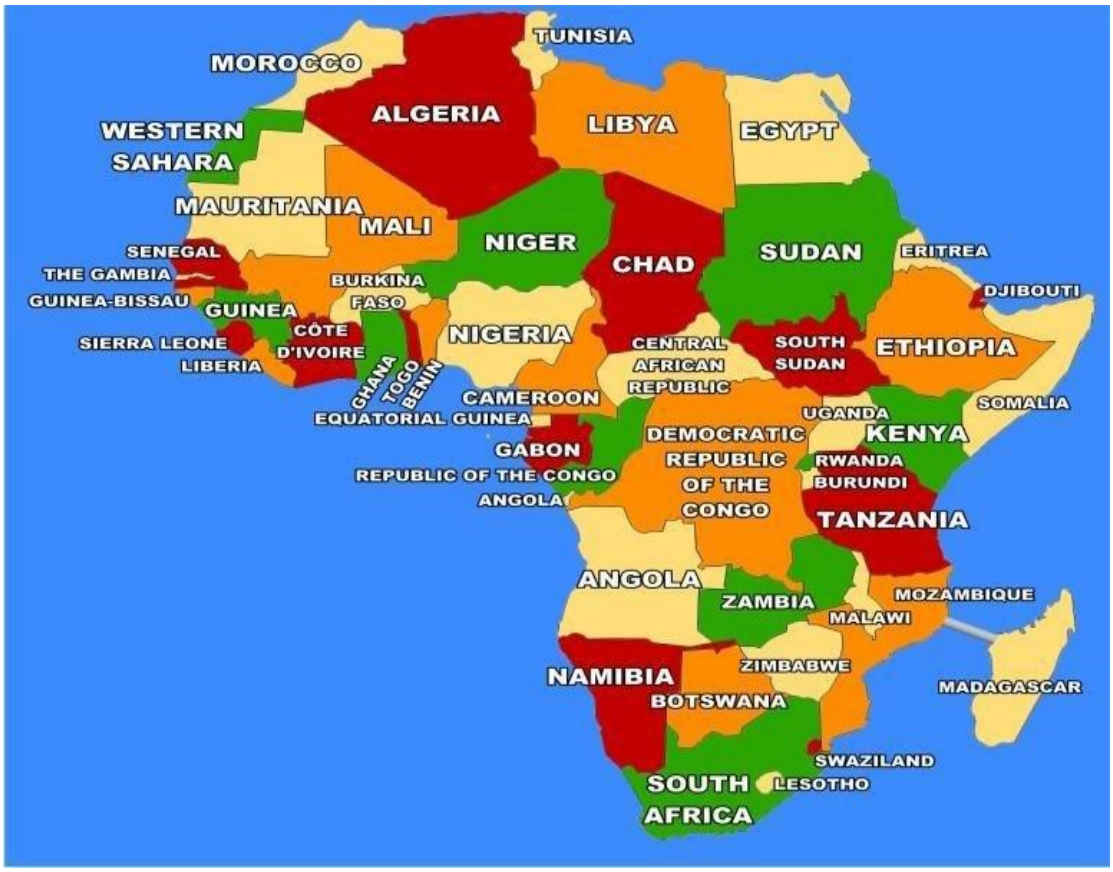
- A regional partnership of 10 countries said an agreement on the equitable use of water resources from the Nile River basin has come into force despite the notable opposition of Egypt.

More info:

- The legal status of the "cooperative framework" was formally confirmed by the African Union after South Sudan joined the treaty, the Nile Basin Initiative said in a statement.
- Ethiopia, Uganda, Rwanda, Burundi, and Tanzania have ratified the accord.
    - Egypt and Sudan declined to sign, while Congo abstained.
    - Kenya has not yet deposited its ratification documents with the African Union.
- The accord, which came into force, "is a testament to our collective determination to harness the Nile River for the benefit of all, ensuring its equitable and sustainable use for generations to come," the Nile Basin Initiative said in its statement.
- The lack of ratification by Egypt and Sudan - desert nations that have raised concern over any attempts to diminish their shares of Nile water - means the accord will prove controversial.
- Tensions in the region have increased, stemming in part from Ethiopia's construction of a $4 billion dam on the Blue Nile, a key tributary of the Nile River.
    - Egypt fears the dam will have a devastating effect on water and irrigation supplies downstream unless Ethiopia takes its needs into account.

About Nile river:

- It is the longest river in the world.
- It rises south of the Equator and flows northward through northeastern Africa to drain into the Mediterranean Sea.
- It has a length of about 6,650 kilometres.
- Its basin includes parts of Tanzania, Burundi, Rwanda, the Democratic Republic of the Congo, Kenya, Uganda, South Sudan, Ethiopia, Sudan, and the cultivated part of Egypt.
- Its most distant source is the Kagera River in Burundi.
- The Nile is formed by three principal streams: the Blue Nile,; the Atbara, which flow from the highlands of Ethiopia; and the White Nile, the headstreams of which flow into Lakes Victoria and Albert.
- The basin is bordered on the north by the Mediterranean; on the east by the Red Sea Hills and the Ethiopian Plateau; on the south by the East African Highlands, which include Lake Victoria, a Nile source; and on the west by the less well-defined watershed between the Nile, Chad, and Congo basins, extending northwest to include the Marrah Mountains of Sudan, the Al-Jilf al-Kabīr Plateau of Egypt, and the Libyan Desert (part of the Sahara).



2.7 International Solar Alliance (ISA)

Context:

- Seventh Session of ISA will be held in New Delhi

News:

- Leaders from 120 Member Countries to attend the Seventh Session of the International Solar Alliance Assembly in New Delhi.

About ISA Assembly:

- The Assembly is the apex decision-making body of ISA, representing each Member Country.
- This body makes decisions concerning the implementation of the ISA's Framework Agreement and coordinated actions to be taken to achieve its objective.
- The Assembly meets annually at the ministerial level at the ISA's seat.
- It assesses the aggregate effect of the programmes and other activities in terms of deployment of solar energy, performance, reliability, cost and scale of finance.
- 120 countries are signatories to the ISA Framework Agreement, of which 102 countries have submitted the necessary instruments of ratification to become full members of the ISA.
- The Republic of India holds the office of the President of the ISA Assembly, with the Government of the French Republic as the co-president.

About ISA:

- The International Solar Alliance is an international organisation with 120 Member & Signatory Countries.
- It works with governments to improve energy access and security worldwide and promote solar power as a sustainable way to transition to a carbon-neutral future.
- ISA's mission is to unlock US$ 1 trillion of investments in solar by 2030 while reducing the cost of the technology and its financing.
- It promotes the use of solar energy in the agriculture, health, transport and power generation sectors.
- ISA Member Countries are driving change by enacting policies and regulations, sharing best practices, agreeing on common standards, and mobilising investments.
    - Through this work, ISA has identified and designed and tested new business models for solar projects; supported governments to make their energy legislation and policies solar-friendly through Ease of Doing Solar analytics and advisory; pooled demand for solar technology from different countries, and drove down costs; improved access to finance by reducing the risks and making the sector more attractive to private investment; increased access to solar training, data and insights for solar engineers and energy policymakers.
- ISA was formed at the 21st Conference of Parties (COP21) to the United Nations Framework Convention on Climate Change (UNFCCC) held in Paris in 2015 and is partnering with multilateral development banks (MDBs), development financial institutions (DFIs), private and public sector organisations, civil society, and other international institutions to deploy cost-effective and transformational energy solutions powered by the sun, especially in the least Developed Countries (LDCs) and the Small Island Developing States (SIDS).

More info on ISA:

- ISA has evolved into a key platform for global solar cooperation, now encompassing 120 Member & Signatory Countries.
- Solar energy, available year-round and in abundance in some of the Member Countries, holds the potential to be the game-changer in the theatre of global climate action.
    - Its attributes of being clean, reliable, free and easily accessible to all make it central to achieving universal energy access.
- Efforts through the ISA focus on expanding solar infrastructure, creating green jobs, supporting livelihoods, and mitigating climate impacts.
- Global solar deployment presents its challenges: investments, infrastructure, and indigenisation.
    - To address these challenges through various programmes, initiatives, and collaborations with governments, private enterprises, and international organisations and by working with its Member Countries, ISA creates opportunities to diversify global supply chains and boost solar energy demand, contributing to manufacturing capacity growth.

- ISA proudly counts 120 Member & Signatory Countries, with 102 ratifying the ISA Framework Agreement, showcasing growing global influence.
- With the firm support of Member Countries, ISA has successfully launched initiatives to accelerate solar adoption, foster innovation, and enhance capacity-building efforts.
- The International Solar Alliance stands at the forefront of global efforts to achieve the Sustainable Development Goals, particularly SDGs 7 & 13 on affordable and clean energy and climate action respectively.
- ISA harmonises and aggregates demand for solar finance, technologies, innovation, research and development, and capacity building.
- Work at the ISA directly supports the implementation of the Paris Agreement and contributes to the broader UN framework for sustainable development.
- ISA is working with Member Countries to help shape conducive policies to bring in investments in solar energy, a sustainable pipeline of solar-powered projects, and help build skills to sustain solar projects in the long term.

2.8 BRICS+ group

Context:

- BRICS+ group's share in global goods exports can overtake G7 by 2026

News:

- The October edition of EY Economy Watch reveals a significant shift in global trade dynamics, with the BRICS+ group rapidly increasing its share in merchandise exports and imports.

More info:

- From 2000 to 2023, the BRICS+ group's share of global merchandise exports has risen from 10.7% to 23.3%, marking an impressive increase of 12.6 percentage points.
  - In contrast, the G7's share has seen a notable decline, dropping from 45.1% to 28.9%.
  - Meanwhile, the rest of the world has maintained a relatively stable share, increasing slightly from 44.2% to 47.9%.
  - This trend highlights the growing prominence of the BRICS+ group in the global trade arena, suggesting a potential shift towards a multipolar global economic landscape.
  - Given the present trends and the likelihood of several new members joining the BRICS+ group being strong, the share of BRICS+ in global merchandise exports can overtake that of the G7 group by 2026.
  - Central to this transformation are India and China, two key members of the BRICS+ alliance.
    - In 2023, they ranked third and first, respectively, globally in terms of purchasing power parity (PPP), both countries are projected to retain these positions by 2030.
  - China's contribution to BRICS+ exports has surged dramatically, increasing from 36.1% in 2000 to 62.5% in 2023.
  - India has also made significant strides, contributing 7.9% to BRICS+ exports in 2023.
- EY's analysis further underscores the increasing importance of high-tech exports from BRICS+ countries.
  - The group's share of global high-tech exports has risen significantly, from just 5% in 2000 to 32.8% in 2022.
  - This shift reflects a strategic move toward technology-intensive products, positioning BRICS+ nations as vital players in the global high-tech market, it added.
- In addition to trade dynamics, the currencies of BRICS+ nations are gaining traction in the global economy.
  - The Yuan has remained stable, with slight appreciation, while the Indian rupee has faced depreciation, particularly since 2018.

- Notably, the share of the U.S. dollar as a global reserve currency has declined from 71.5% in 2000 to 58.2% in 2024, signalling a potential shift toward a more multipolar currency framework.
    - As geopolitical tensions continue, the coordinated policies among BRICS+ members may challenge the established dominance of the G7 and the U.S. dollar, paving the way for a new multipolar global economic landscape.

About BRICS+ group:

- The BRICS+ group is establishing a platform for conducting international trade and investment transactions, which could become a low-cost alternative to the existing SWIFT platform.
- The group is also developing a trade and reserve currency, backed by gold and other select commodities.
- BRICS, consisting of Brazil, Russia, India, China and South Africa, has now expanded with five additional members - Egypt, Ethiopia, Iran, Saudi Arabia and the UAE.
- **Note:** G7 is a grouping of advanced economies - the United States, Canada, France, Germany, Italy, Japan, and the United Kingdom.

Mains

2.9 India's vision for Indo-Pacific

Context:

- India's vision for Indo-Pacific is based on fostering partnerships through sustainable development, economic growth & mutual security: Raksha Mantri at Indo-Pacific Regional Dialogue 2024

News:

- "India's vision for the Indo-Pacific is based on the idea of SAGAR (Security and Growth for All in the Region) as we believe in fostering partnerships that prioritise sustainable development, economic growth and mutual security," said Raksha Mantri Shri Rajnath Singh while addressing the Indo-Pacific Regional Dialogue (IPRD) 2024 in New Delhi.

India's vision for Indo-Pacific:

- India's engagement with its partners is guided by the understanding that true progress can only be achieved through collective action & synergy, and due to these efforts, it is now considered as a credible & preferred security partner and first responder in the region.
- India's unwavering resolve to a rule-based international order, respect for international law, and adherence to the principles enshrined in the UN Convention on the Law of the Sea, describing them as the cornerstones of foreign policy.
- India has consistently advocated for a peaceful resolution to disputes and has sought to promote cooperation among nations in the Indo-Pacific, with a strong emphasis on the centrality of ASEAN in fostering regional dialogue, stability & collective growth.
- India's commitment to ensuring the safety and security of the vital international maritime routes.
- The engagement with regional partners, including joint exercises and information-sharing initiatives, is aimed at strengthening the collective maritime security framework.
- Indian Armed Forces, especially Navy, has been at the forefront of cooperative endeavours with countries of the region, and are continuously working towards building their capacity and capabilities.
- While India's endeavour for maritime cooperation continues, its interests are not in conflict with any other country.
    - At the same time, interests of any other nation should not come in conflict with other nations. This is the spirit in which we must work together.

Evolving Indo-Pacific region:

- Rapidly evolving global maritime landscape is shaped by shifting power dynamics, resource competition & emerging security threats.
- Emergence of the Indo-Pacific theatre reflects a visible balancing of global power.
- The Indo-Pacific region has emerged as the world's most dynamic geopolitical zone and is the centre of gravity of the economic & strategic interests.
- It also carries a degree of pre-existing international tension, rivalry and conflict.
- While some challenges are of local nature, many challenges have global ramifications.
- With respect to marine resources, we are witnessing a significant increase in geopolitical competition.
    - As populations continue to grow, the demand for marine resources has surged, leading to heightened tensions and competition among nations.
- **Global Commons:** Natural resources such as the ocean, outer space, climate, clean air, etc., which is shared by all of humanity, these are essential to maintain a sustainable planet.
    - There is a need to create a balance of competing interests, which can offer numerous ecological, economic, and social benefits transcending national boundaries.
- **Tragedy of the commons:** A scenario where individuals, acting in their own self-interest, deplete shared resources, leading to collective ruin.
    - It as a looming threat, which can only be dealt with if the international community comes together and acts swiftly for sustainable management of shared global commons.

IPRD:

- The IPRD is an annual apex-level regional strategic dialogue of the Indian Navy which aims to sequentially flesh-out the seven spokes of the Indo-Pacific Oceans Initiative (IPOI).
- Through its central theme of 'Resource-Geopolitics and Security in the Indo-Pacific', this year's conference focuses on 'Marine Resources' and 'Maritime Security' pillars of IPOI.
- The IPRD-2024 is being organised by the Indian Navy in association with National Maritime Foundation (NMF) as its knowledge partner.
    - Established in 2005, the NMF is one of India's foremost maritime think-tanks that concentrates its research upon issues relevant to India's maritime interests, and has gained significant international traction for conduct of independent, original, and policy-relevant research on all 'matters maritime'.

2.10 Colombo Security Conclave as a much-needed security dimension

Context:

- The scope for cooperation between the Colombo Security Conclave member-states is aligned with the maritime security challenges prevalent in the Bay of Bengal region

Introduction:

- The Colombo Security Conclave (CSC) reached a milestone with India, Sri Lanka, the Maldives and Mauritius signing a Charter and a memorandum of understanding, for the establishment of the CSC secretariat.
    - Though Bangladesh, a newly inducted member to the grouping, was absent, no conclusive explanation has surfaced.
    - The Seychelles participated as an observer state.

Bay of Bengal as strategic theatre:

- This achievement, for the CSC, marks significant progress in a shared synergy and the commitment of the grouping since its inception.

- The shared geography between the member-states encompasses the Bay of Bengal and the western Indian Ocean.
- For India, the Bay of Bengal remains an important strategic theatre, and the CSC provides an opportunity to add a much-needed security dimension to its outlook towards the region.
- In the evolving context of global geopolitics, regional forums have emerged as important instruments of expanding influence and shaping broader architectures of regional security.
    - Importantly, such forums also serve as frameworks for the construction of a regional outlook towards issues of common concern.
    - For India, coalescing robust institutional frameworks for boosting synergy and cooperation on issues of security has remained a critical challenge.
- In the Bay of Bengal region, the Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (BIMSTEC) has remained an important forum for developing synergy and cooperation.
    - But the ambit of cooperation within the grouping has largely remained in the realm of economic cooperation and connectivity, with a marginal emphasis on security.
    - This has made it imperative for India to cultivate a forum for regional cooperation with a security-oriented agenda in the Bay of Bengal.
- In this context, the steady progress made by the CSC appears to provide an opportunity to India, and other member-states to enhance cooperation on issues of maritime security in the Bay of Bengal region.
    - With key pillars of cooperation that include maritime safety and security; countering terrorism and radicalisation; combating trafficking and transnational organised crime; cyber security and protection of critical infrastructure and technology; and humanitarian assistance and disaster relief, there is scope for cooperation under the CSC which suits the maritime security challenges prevalent in the Bay of Bengal region.

China's actions:

- Why is a security-oriented approach in the Bay of Bengal essential for India?
    - China's growing naval footprint and expanding political influence in the Indian Ocean have caused alarm in India's strategic circles.
    - Beijing continues to exhibit key interest in the Indian Ocean for the fulfilment of its energy security demands and expanding trade networks.
    - China's aggressive actions against the Philippines in the South China Sea have already demonstrated its desperation to resort to coercive mechanisms to seek control and project power in the Indo-Pacific.
    - With Chinese warships, research vessels, and submarines entering the Indian Ocean, it is evident that Beijing seeks to assume an active role and have a notable naval presence in the region.
    - The Bay of Bengal's geography sits as a bridge between the South China Sea and the wider Indian Ocean.
    - The region is also of significant importance to India with critical maritime interests.
    - Unlike the South China Sea region where China has demonstrated a coercive approach, its strategy in the Indian Ocean has been more nuanced.
    - Here, China has sought to expand its influence by developing partnerships with littoral states in the region, which has, in turn, facilitated its naval presence.
    - Additionally, the Bay of Bengal region remains vulnerable to climate change and natural disaster-induced security threats such as rising sea levels and cyclones as well as trafficking and other such transnational crimes.
    - These have formed the rationale for a security-oriented approach in the Bay of Bengal.

Revised outlook:

- Though the CSC was stagnant between 2014-20, ever since its revival, the grouping has taken strides in exhibiting a willingness to enhance cooperation, even resulting in the expansion of its membership.
- Mooted as a trilateral between India, Sri Lanka, and the Maldives, the grouping later inducted Bangladesh and Mauritius.
- Evidently, the Bay of Bengal geography prominently features in the spatial ambit of the grouping.
- Given the absence of any security-oriented forum for regional cooperation in the Bay of Bengal, and the vital security challenges posed by the evolving strategic dynamics in the region, the progress made by the CSC presents an opportunity to construct a forum sensitive to the urgent security concerns in the region.
- For India, the CSC appears to be directing a security-oriented outlook towards the Bay of Bengal - a region that is likely to continue posing critical maritime security challenges.

3. Economy

Prelims

3.1 Annual Survey of Industries

Context:

- Annual survey of industries shows growth in manufacturing sector

News:

- India's industrial sector is growing at a fast pace, said NITI Aayog CEO, while releasing the Annual Survey of Industries.
    - The report was released by the Ministry of Statistics and Programme Implementation for the financial year 2022-23.

More on the news:

- Contrary to the criticism against the Centre, the manufacturing sector is growing at fast pace and providing jobs, added 22 lakh jobs in 2022-23.
- The report said the Gross Value Added (GVA) grew by 7.3% in current prices in the year 2022-23 over 2021-22.
- "Increase in input was 24.4% while output grew by 21.5% in the sector in 2022-23 over 2021-22," the report said.
- 2022-23 witnessed a growth in industrial sector for majority of the important economic parameters like invested capital, input, output, GVA, employment and wages and even surpassed the pre-pandemic level in absolute value terms.
- When asked about the recent Periodic Labour Force Survey (PLFS) results that cited stagnation in labour force in manufacturing sector, Mr. Subrahmanyam said the PLFS also looks at the agriculture sector, including food processing sectors.
    - "PLFS is across the sectors. Contract labour is stagnant. This survey is not showing micro industries. This survey largely covers small and medium sectors," he said.
- According to the survey, the main drivers of this growth in 2022-23 were industries like manufacture of basic metal, coke & refined petroleum products, food products, chemical and chemical products and motor vehicles.
    - "These industries, taken together, contributed about 58% of the total output of the sector and showed output growth of 24.5% and GVA growth of 2.6% in comparison to 2021-22," the government said.
- The estimated number of persons engaged in this sector in 2022-23 has exceeded the pre-pandemic level (that is 2018-19) by more than 22.14 lakh.
    - "At the same time, average emoluments also registered an increase over previous year.
    - Also, average emoluments per persons engaged in this sector had gone up by 6.3% in 2022-23 in comparison to 2021-22," the report said.
- Among the major States, in terms of GVA, Maharashtra ranked first in 2022-23 followed by Gujarat, Tamil Nadu, Karnataka and Uttar Pradesh.
    - "The top five States, taken together contributed more than 54% of the total manufacturing GVA of the country in 2022-23.
- The top five States employing highest number of persons in this sector were Tamil Nadu, Maharashtra, Gujarat, Uttar Pradesh and Karnataka in ASI 2022-23.

- Taken together, these States contributed about 55% of total manufacturing employment in the year 2022-23," the report added.

3.2 Economics Nobel

Context:

- Three share Economics Nobel for research into differences in prosperity between nations

News:

- The Nobel memorial prize in economics has been awarded to Daron Acemoglu, Simon Johnson and James A. Robinson for research into differences in prosperity between nations.
  - The three economists have demonstrated the importance of societal institutions for a country's prosperity.
  - Societies with a poor rule of law and institutions that exploit the population do not generate growth or change for the better. The laureates' research helps us understand why.

About Economics Nobel:

- The economics prize is formally known as the Bank of Sweden Prize in Economic Sciences in Memory of Alfred Nobel.
- The central bank established it in 1968 as a memorial to Nobel, the 19th-century Swedish businessman and chemist who invented dynamite and established the five Nobel Prizes.
- Though economics prize is technically not a Nobel Prize, it is always presented together with the others on December 10, the anniversary of Nobel's death in 1896.

Nobel Prize 2024:

- The economics prize wraps up this year's Nobel season, which honoured achievements in artificial intelligence for the physics and chemistry prizes, while the Peace Prize went to Japanese group Nihon Hidankyo, committed to fighting nuclear weapons.
- The 2024 Nobel Prize in physics went to John Hopfield and Geoffrey Hinton "for foundational discoveries and inventions that enable machine learning with artificial neural networks."
- The 2024 Nobel Prize for chemistry was shared by David Baker "for computational protein design" along with Demis Hassabis and John Jumper "for protein structure prediction."
- South Korea's Han Kan won the literature prize - the only woman laureate so far this year - while the medicine prize lauded discoveries in understanding gene regulation.
- The Nobel Prizes consist of a diploma, a gold medal and a one-million-dollar lump sum.
- They will be presented at ceremonies in Stockholm and Oslo on December 10, the anniversary of the 1896 death of scientist and prize creator Alfred Nobel.

3.3 PM Internship Scheme

Context:

- More than 1.55 lakh candidates have applied for the Prime Minister Internship Scheme

About PM Internship Scheme:

- India is actively recognizing the critical need to equip its youth with the skills necessary to excel in today's fast-paced economy.
  - In line with this vision, the Prime Minister's Internship Scheme was launched.
- This ambitious initiative implemented through an online portal aims to provide one crore young individuals with valuable internship opportunities over the next five years, allowing them to immerse themselves in diverse business environments and explore a variety of professions.

- The internship opportunities span 24 sectors, including oil, gas, energy, travel, hospitality, automotive, and banking and financial services, etc.
- The companies selected for this pilot were identified based on their corporate social responsibility (CSR) expenditure over the past three years, ensuring that participants are placed in organizations that are committed to social and ethical practices.
- By focusing solely on internships, the Prime Minister's Internship Scheme seeks to create a tailored experience that enhances employability and provides young people with real-world exposure.

Eligibility:

- The Pilot Project offers a 12-month internship program designed for youth aged 21 to 24 years, specifically for Indian nationals who are not employed full-time or engaged in full-time education.
- Candidates enrolled in online or distance learning programs are eligible to apply.
- Internships can be applied through the PM Internship Portal.
- The Project aims 1.25 lakh internships for the Financial Year 2024-25.
- Candidates who have passed High School or Higher Secondary School, have a certificate from an ITI, have a diploma from a polytechnic institute, Graduated with degrees such as BA, B.Sc, B.Com, BCA, BBA, B.Pharma, etc.

Ineligibility:

- Graduates from IITs, IIMs, National Law Universities, IISER, NIDs, and IIITs
- Holders of qualifications such as CA, CMA, CS, MBBS, BDS, MBA, or any master's or higher degree.
- Those undergoing skill, apprenticeships, internships, or student training under Central or State government schemes.
- Individuals who have completed apprenticeships under National Apprenticeship Training Scheme (NATS) or National Apprenticeship Promotion Scheme (NAPS).
- If the income of any of the family members of the candidate exceeds Rs 8 Lakh for FY 2023-24.
- Family members of permanent or regular government employees.

Criteria for Partner Companies:

- The Ministry has identified top 500 companies based on their average CSR expenditure over the last three years.
- Other companies, banks, or financial institutions can also participate with approval from the Ministry of Corporate Affairs (MCA).

Financial Assistance:

- Interns will receive a monthly stipend of ₹5,000 throughout the internship duration.
- Additionally, a one-time grant of ₹6,000 will be disbursed after joining the internship.

Insurance Coverage:

- All interns will be covered under the government's insurance schemes: Pradhan Mantri Jeevan Jyoti Bima Yojana and Pradhan Mantri Suraksha Bima Yojana, with the premium paid by the government.

PM Internship Portal:

- The Prime Minister's Internship Scheme is implemented through a centralized online portal.

Conclusion:

- The internship scheme presents a valuable opportunity for youth to gain real-world experience while benefiting from financial support and comprehensive training.
- By partnering with leading companies across diverse sectors, the initiative aims to enhance employability and skills among participants.

- With clear eligibility criteria and structured support through Direct Benefit Transfers, this program not only fosters professional growth but also encourages active participation from businesses committed to corporate social responsibility.

3.4 Over 77 per cent of India's children lack WHO-suggested diversity in diet, study finds

Context:

- About 77 per cent of children in India aged 6-23 months lack diversity in diet as suggested by the World Health Organization, with the country's central region showing the highest prevalence of minimum dietary failure, a study has found.

More info:

- The states of Uttar Pradesh, Rajasthan, Gujarat, Maharashtra and Madhya Pradesh reported the highest levels of inadequate diversity in children's diets -- all above 80 per cent -- while Sikkim and Meghalaya were the only two to report an under-50 per cent prevalence.
- The WHO suggests using the Minimum Dietary Diversity (MDD) score to evaluate the quality of a child's diet -- it is considered to be diverse if it contains five or more food groups, including breastmilk, eggs, legumes and nuts, and fruits and vegetables.
- Analysing National Family and Health Survey data from 2019-21 (NFHS-5), researchers found that the country's overall rate of minimum dietary diversity failure has dropped from 87.4 per cent, which was calculated using data from 2005-06 (NFHS-3).
    - However, "our study shows that the prevalence of minimum dietary diversity failure remains high (above 75 per cent) in India," the authors wrote in the study.
- The team also looked at children's dietary habits across various food groups like proteins and vitamins, comparing data from 2019-21 with that from 2005-06.
    - The consumption of eggs registered an "impressive" rise, from around 5 per cent in NFHS-3 to over 17 per cent in NFHS-5 while that of legumes and nuts increased from nearly 14 per cent during 2005-06 to over 17 per cent during 2019-21.
    - "The consumption of vitamin A-rich fruits and vegetables increased by 7.3 percentage points, whereas the consumption of fruits and vegetables increased by 13 percentage points over the same time.
    - For flesh foods, the consumption increased by 4 percentage points," the authors wrote.
    - However, the consumption of breastmilk and dairy products was found to drop from 87 per cent in NFHS-3 to 85 per cent in NFHS-5 and 54 per cent to 52 per cent, respectively.
- The authors also found that the children of illiterate and rural-residing mothers with no exposure to mass media, those born first and not exposed to counselling and health check-ups at Anganwadi or Integrated Child Development Services (ICDS) centres were more likely to be consuming diets deficient in diversity.
- Anaemic children and those with a low birth weight were also found to have a higher chance of consuming a non-diverse diet.
- To tackle the issue of inadequate diversity in children's diets, the authors called for a holistic approach from the government, including an improved public distribution system, intensified ICDS programme, use of social media and nutrition counselling through local self-governance.

3.5 Critical minerals

Context:

- India remains highly dependent on imports for minerals critical to accelerating its energy transition, with a full reliance on shipping in lithium, cobalt and nickel, according to a report released.

More info:

- The report, published by the Institute for Energy Economics and Financial Analysis (IEEFA), said that India's demand for critical minerals is expected to more than double by 2030, while domestic mining operations may take over a decade to start producing.
- It stresses that India needs a carefully crafted import strategy to mitigate potential trade risks while balancing international relationships to secure these essential minerals.
- IEEFA's report examines five critical minerals (and their compounds) - cobalt, copper, graphite, lithium and nickel - from the perspectives of import dependency, trade dynamics, domestic availability, and global price fluctuations.
- The findings show that India remains largely import-dependent for these minerals and their compounds, with 100% import reliance for minerals like lithium, cobalt, and nickel.
- India should strive to de-risk its critical mineral sourcing by identifying new international resources and expediting domestic production.
    - A concerted effort to partner with and foster bilateral relations with mineral-rich nations should be a priority for India.
- The country can also explore investment opportunities in resource-rich, friendly nations, such as Australia and Chile, as well as African countries like Ghana and South Africa.
- The report said India depends heavily on China for synthetic graphite and natural graphite, and it should explore cooperation initiatives with countries like Mozambique, Madagascar, Brazil and Tanzania, which are some of the highest graphite producing-countries.
    - "As part of the Global South cooperation initiatives, these countries could be favourable partners for India for graphite trading," said the report.
- India is also highly import-dependent for copper cathodes and nickel sulphates from just two countries - Japan and Belgium.
    - The report suggests India could look at the US, the fifth largest producer of copper in the world, to diversify its suppliers and enhance supply security.
- For minerals like lithium oxide and nickel oxide, the dependency is low on one country, but overall imports largely come from Russia and China, both countries with potential trade risks.
    - Developing domestic lithium refining capacity will help India integrate with the global lithium supply chain.
- The report also notes the significant efforts that the Indian Government is making to improve domestic production of critical minerals with the auctions by the Ministry of Mines and the planned Critical Minerals Mission.
    - The critical minerals mining block auctions can serve as an opportunity for India to focus on building refining and processing capabilities to emerge as a global value-adding hub.
    - Government support in the form of viability gap funding and technology development will help promote such auctions and ultimately the domestic production of critical minerals.
- A stable supply of critical minerals is imperative for India to achieve its renewable energy goals.
- India has committed to achieving 500 gigawatts (GW) of non-fossil fuel-based electricity installed capacity by 2030.
    - Currently, the country's renewable energy installed capacity stands at 201 GW, with solar energy accounting for 91 GW.
- According to another study, the fast-developing South Asian nation needs to install around 7,000 GW of renewable energy capacity to achieve net-zero emissions by 2070.

Mains

3.6 Why is the textile industry struggling to perform better?

What caused the slump in the Indian textile sector in the last two financial years?

Introduction:

- Union Minister for Textiles recently said that the Indian textile and apparel sector is aiming for a total business of $350 billion annually by 2030, which is to generate 3.5 crore jobs.
    - However, the industry went through a tumultuous phase during the last two financial years, casting a shadow on the possibility for 10% CAGR.

Present status:

- The size of the Indian textile and apparel industry was estimated to be $153 billion in 2021, with almost $110 billion contributed by domestic business.
- In FY22, India was the third largest textile exporter globally, enjoying a 5.4% share.
- India is also said to have the second largest manufacturing capacity, with a robust capability across the value chain.
- The sector's contribution to GDP is close to 2.3% (FY21) and 10.6% of total manufacturing Gross Value Added (GVA) in FY23.
- About 105 million people are employed by the textile and garment units, directly and indirectly.
- For an industry that has 80% of its capacity spread across MSMEs and is sensitive to international developments as it is strongly linked to global markets, FY2021-2022 saw tremendous growth with $43.4 billion exports.
    - However, slowdown in demand that started in 2022-2023 only worsened in FY24 with a slump in exports and domestic demand.
    - This impacted manufacturing clusters severely.
        - For instance, Tamil Nadu, which has the largest spinning capacity in the country, saw the closure of nearly 500 textile mills in the last two years.
        - In Tiruppur, which is a knitwear production destination, many units saw a 40% drop in business in FY23.

Reasons for exports slump:

- Geopolitical developments and a slump in demand in buying countries hit the exporting units.
    - This was exacerbated by high raw material prices of both, cotton and Man Made Fibres (MMF), and the growing import of fabrics and garments.
- The imposition of a 10% import duty on cotton has made Indian cotton more expensive compared to international prices.
- In the case of MMF, introduction of quality control orders has disturbed raw material availability and price stability.
- The industry is repeatedly demanding removal of the import duty on cotton at least during the off-season months of April to October.
- This is an industry in which the stakeholders compete in the international market with countries that heavily support their domestic production capabilities.
    - So, India needs schemes that run for at least five years and boost investments.
    - Raw material should be available for the domestic industry at internationally competitive prices.

Other challenges:

- Apart from policy issues, the industry is also staring at disruptions in its traditional business systems.

- Direct retailing to customers through e-commerce is a trend that is catching on among garment and home textile manufacturers, with more startups entering this space.
    - A report notes that "(Foreign) brands are fast-tracking the adoption of ESG sustainability across the supply chain."
    - They are defining their sustainability targets and want to source from vendors who will meet these targets.
- Further, there is a rise in comfort wear, loungewear, and athleisure as the emphasis on comfortable clothing has increased among consumers.
    - Even in the domestic market, much has changed in the way business is done.
        - Customers in rural and semi-urban areas prefer to shop in multi-brand outlets or hyper markets. They do not want to step into outlets of less known brands.

Way forward:

- The industry is looking at a $100 billion investment across various segments of the value chain by 2030 to augment production capacities and meet the $350 billion target.
- Labour constitutes roughly 10% of the production cost in the textile sector.
    - The industry has no option but to look at technology and skilling of its workforce to improve productivity and reduce wastages.

3.7 India space strategy

- India has a plan to carve out a beachhead in the battle for commercial space, officials say: crunching space data, building small satellites and launching them cheaply into orbit rather than challenging heavyweights such as SpaceX head-on.
- In particular, it is taking aim at providing cost-effective services and hardware to sectors such as communications, agriculture and commodities, where high-quality data is a precious resource.
- This is a sector that India can win, instead of challenging heavy launches where Elon Musk has dominance.
    - The country already has an historical advantage in data mining and interpretation.
- Since February, India has opened its space sector to private players and created Rs 10 billion venture funds to support space startups.
    - It has also unveiled plans for crewed space exploration and a mission to Venus, but the focus is on developing commercial ventures.
- In many ways it will be an uphill fight.
    - Other countries such as Japan and China have advanced space industries, and designs on cheap launches.
    - Spaceflight itself is difficult; the startup landscape globally is littered with failed boosters and satellite designs.
    - For India, the tech is there and the ability is there... but space is tricky and very competitive, and while private companies have shown that they can create a niche for themselves, we need more proof of concept.
    - Indian government must be an "anchor customer" for private industry.
- Most of the revenue growth is expected to come from so-called downstream data applications.
- Those involve crunching data from orbit to help improve crop yields on earth, build more accurate navigation systems, bolster telecommunications, tighten border security and fight climate change.
- Indian companies such as Bellatrix Aerospace, Pixxel, Agnikul Cosmos, Dhruva Space and others are already building or have launched small satellites or satellite components.
- India's space agency, ISRO, last month completed the third and final developmental flight for its Small Satellite Launch Vehicle.

- The design will then be handed to private companies.
- The end uses of Earth observation are vast.
  - Bengaluru-based company has been providing near real-time satellite data to the Airports Authority of India to enhance air traffic management and safety, helping airlines save fuel costs by improved flight planning.
    - The project is expected to save 37.5 billion rupees ($446 million) in fuel costs for airlines annually by 2025 and result in a roughly 70% reduction in airport process planning timelines.
  - Earth observation (EO) satellites - orbiting cameras and sensors - can unlock similar savings in other areas.
  - EO is solving problems that span across utilities, navigation, trading, industries, helping save millions of dollars.

Government push:

- Since the government opened up the market, companies big and small have jumped in, with legacy IT firms like Infosys investing in satellite imaging company GalaxEye Space Solutions, Google-backed Pixxel signing contracts with NASA, and Baring- and Promus-backed SatSure taking on clients such as HDFC Bank and global seed company Syngenta.
- Dhruva Space became one of the first to be handed a permit to operate satellite communication centres on earth - to date the dominion of ISRO.
- India is a software powerhouse and produces some of the best minds in the world in data science, machine learning, and artificial intelligence.
  - The space downstream market is, at the end of the day, a software play.
- The consultancy Euroconsult forecasts that between 2023 and 2032, about 26,104 small satellites - weighing less than 500 kilogrammes (1,100 lb) - will be put in orbit, averaging 1.5 tons of daily launch mass. The firm expects the overall small satellite industry to be worth $110.5 billion in the next decade.
- Indian space companies have already seen an influx of funding - $126 million in 2023, a 7% increase from the $118 million raised in 2022 and an increase of 235% from the $37.6 million raised in 2021, according to Tracxn data.
  - But India has only about 2% of market share in commercial space activities, demand is still largely dependent on global clients, and well-established U.S., Russian and Chinese companies are formidable rivals.
- To truly make a dent, (Indian) solutions have to scale to the rest of south Asia and then to the rest of the world.

3.8 India's SDG focus and its human development issues

Introduction:

- G-20 Summit 2023 in New Delhi resolved to accelerate the full and effective implementation of the UN Agenda 2030 for Sustainable Development.
- An "SDG Summit" 2023 was convened at the United Nations headquarters to follow up and review the implementation of the Agenda and the progress of the 17 Sustainable Development Goals (SDGs).
- A "Summit of the Future", took place in 2024, at the UN headquarters to build upon the SDG Summit 2023 and its commitments by member nations.
- In this context, examining India's progress in human development since 1990, based on the UNDP's latest Human Development Report (HDR), is valid.
- As said by Nobel laureate Amartya Sen in his book, Development as Freedom, 'development is a process of expanding the real freedoms that people enjoy'.

- In his 'capability approach', the basic concern of human development is 'our capability to lead the kind of lives we have reason to value'.
- Freedom from hunger and ill-health on the one hand and gender and income equality, and access to quality education on the other hand lead to the achievement of human development, and, consequently, to sustainable development.

Development and the SDGs:

- The Human Development Index (HDI) developed by the UNDP has three dimensions: long and healthy life (measured by life expectancy at birth); knowledge (expected years of schooling and mean years of schooling), and a decent standard of living (income per capita).
  - All the three dimensions are much related to some of the key SDGs: SDG-3 (good health); SDG-4 (quality education); SDG-5 (gender equality); SDG-8 (decent work) and SDG-10 (reduced inequality).
- Clearly, countries aspiring to achieve sustainable development need to take appropriate measures to boost human development.
- The HDR 2023-24 places India in the 'medium human development category' with a human development index (HDI) value of 0.644.
  - India ranks 134 out of 193 countries.
  - The HDI value was stagnant in 2019-20, at 0.638, and fell to 0.633 in 2021.
  - It improved to 0.644 in 2022.
  - In this report, some of India's neighbouring countries have better HDI ranks - Malaysia (63); Thailand (66); China (75); Sri Lanka (78); Indonesia (112); Bhutan (125), and Bangladesh (129).
- The HDR also presents interpolated consistent data which can be used to compare HDI values across years and countries.
- India saw its HDI value increase by 48.4%, from 0.434 in 1990 to 0.644 in 2022.
- As per HDI rankings, during 2015-2022, India improved by four ranks, while neighbouring countries such as Bangladesh and Bhutan improved by 12 and 10 ranks, respectively.
  - China improved by 18 ranks.
  - India's human development initiatives lagged behind during 2015-22.
  - One of the reasons for the slow growth is the COVID-19 pandemic and its impact on dimensions of human development such as education and income.

Gender gaps:

- The HDR also presents the Gender Development Index (GDI) for 193 countries.
  - It measures disparities in human development by gender.
  - The report contains HDI values estimated separately for women and men, the ratio of which is the GDI value.
  - The closer the ratio is to one, the lesser the gap there is between women and men.
- Among the 42 'medium human development countries' to which India belongs, there are only seven with low equality in HDI achievements between women and men.
  - These countries, with absolute deviation from gender parity of more than 10%, are India, Bangladesh, Nepal, Uganda, Morocco, the Syrian Arab Republic, and Kiribati.
- India has one of the largest gender gaps in the Labour Force Participation Rate (LFPR) a 47.8 percent points difference between women (28.3%) and men (76.1%).
  - Female labour force participation rate in India is very low when compared to many countries, more so when one compares it with India's neighbouring countries where in China it is 53.6 %, Bhutan 53.5 %, and Bangladesh 39.2%.

- In the latest Periodic Labour Force Survey (PLFS) -2022-23, published by the Ministry of Statistics and Program Implementation, around 37% females of working age (15 years and above) were in the labour force in 2022-23; it was 23.3% in 2017-18.
    - However, there is a huge gap in female labour force participation in rural and urban areas.
        - While the female labour force participation rate in rural areas increased from 24.6% in 2017-18 to 41.5% in 2022-23, there is only a marginal increase in urban areas (from 20.4% to 25.4%).
        - This is a matter of concern that requires further research and in-depth study aimed at feasible policy initiatives.

Income inequality:

- In addition to the gender gap in income, inequality of incomes is also on the rise.
- India is one of the countries where income shares held by the richest 1% is very high (21.7%) compared to Bangladesh (11.6%), China (15.7%), Bhutan (18.1%), and Nepal (9.7%).
- Income inequality in India is also higher than the world average of 17.5% and the South Asia average of 19.6%.
    - Most importantly, income inequality is also higher than other regional groups such as East Asia and the Pacific (16.5%) and Europe and Central Asia (15.7%).

Conclusion:

- India needs to address these gender development issues and increasing inequality in order to achieve the SDGs.

3.9 Stress factors for Indian Railways

Why has there been a spate of accidents across railway zones? Will 'Kavach' coverage and overhauling of signalling systems help? Is it earning enough from passenger and freight services to plough back profits for upgradation, maintenance and paying salaries?

Introduction:

- Indian trains have been involved in multiple accidents of late.
    - The Balasore accident in 2023, had the greatest death toll, more than 275, yet pressure on the Railways to improve safety competes with pressures straining its subsistence.

Number of accidents:

- The number of railway accidents dropped from 1,390 per year in the 1960s to 80 per year in the last decade.
    - There were still 34 consequential accidents in 2021-2022, 48 in 2022-23, and 40 in 2023-2024.
    - A consequential accident injures and/or kills people, damages railway infrastructure, and disrupts rail traffic.
- According to public records, 55.8% of all accidents involving trains have been due to the failure of Railway staff and another 28.4% due to failures on the part of non-staff people.
    - Equipment failure accounted for 6.2%.
- In both the Balasore and the Kavaraipettai accidents, officials blamed the signalling system.

Kavach:

- The 'Kavach' automatic train protection system is designed to prevent collisions using devices that allow pilots to track the relative location of their vehicles and which can actuate alarms and automated braking protocols.
- By February 2024, the Railways had installed 'Kavach' on 1,465 route km, or 2% of its total route length.

- After the Balasore accident, Union Railway Minister said 'Kavach' would be implemented in "mission mode".
- An analysis found the all-inclusive cost of implementation over a decade to be less than 2% of the Railways' annual capex.
- When faced with criticism of the slow implementation, officials have deferred to declines in accident incidence and mortality over the years.
    - But experts have said comparing current and past accident rates is misguided because advanced safety technologies didn't exist earlier and that the government has the means today to eliminate collisions.
- Since 1990-1991, the Railways has classified nearly 70% of all major accidents as derailments, but only 2% of them were due to collisions.
- 'Kavach' also may not have prevented the Kavaraipettai accident because the relevant error happened beyond the minimum margins 'Kavach' requires to assist.

Operating ratio:

- The operating ratio (OR) - the amount the Railways spends to earn ₹100 - in 2024-2025 is estimated to be ₹98.2, a small improvement from 2023-2024 (₹98.7) but a decline from ₹97.8 in 2016.
- A higher OR leaves less for capex and the Railways more dependent on budgetary support and Extra-Budgetary Resources (EBRs).
- In 2016-2017, the government brought the railway budget under the regular budget after nine decades of separation.
    - One outcome was easier access for the Railways to gross budgetary support.
- As for EBRs: the Railways' dues have ballooned to 17% of its revenue receipts today from 10% in 2015-2016.

Freight services:

- The Railways' two main internal revenue sources are passenger services and freight.
    - The latter accounts for 65%.
    - While revenue from both sources is increasing, freight rates increased more than thrice as fast as passenger rates in 2009-2019, NITI Aayog has estimated.
- According to the draft National Rail Plan, nearly 30% of the railway network is utilised to more than 100% capacity.
    - This has translated to slow freight movement - around 26 km/hr in 2016 - and slower revenue growth.
- Of the Dedicated Freight Corridors (DFCs) the government mooted in 2005, only the eastern DFC is fully operational.
    - The western DFC is partly ready; the east coast, east-west sub-corridor, and north-south sub-corridor DFCs, are still in planning.
- Freight revenue also depends on the freight basket.
    - Coal accounted for half of the freight revenue and 45% of volume in the 2024-2025 budget estimates.
    - However, the government has been adding more renewable energy sources while pushing industries to reduce their dependence on fossil fuels, including coal.
- The Railways also needs to keep up existing equipment, including replacing tracks and wagons and maintaining trackside infrastructure.
    - But in the 2023-2024 budget, capital outlay for track renewal dropped to 7.2%.
    - Appropriations to the Depreciation Reserve Fund also fell 96% in the BJP's first term; the government had moved these resources to the Rashtriya Rail Sanraksha Kosh safety fund created in 2017-2018.
        - The Standing Committee on Railways said then the latter wouldn't be able to pay to repair or replace depreciating assets.

Passenger services' revenue:

- The Railways' freight profit is offset significantly by passenger losses.
- In 2019-2020, the revenue from passenger services was a little over ₹50,000 crore and loss, ₹63,364 crore.
- In 2021-2022 - a pandemic year in which many trains had to be cancelled - passenger services incurred a loss of ₹68,269 crore.
- In a July 2024 analysis, PRL Legislative Research estimated the revenue from passenger services was ₹80,000 crore in 2024-2025.
    - PRL also estimated the Railways had a passenger traffic of 11 lakh passenger km, expected to increase to 12.4 lakh in 2024-2025 thanks to the addition of new trains - including the Vande Bharats - on high-traffic routes.
- The Railways has also replaced many of the more affordably ticketed sleeper and second-class coaches with the more expensive AC coaches, all to increase passenger revenue.
    - However, it last rationalised passenger fares in 2020.

Safety:

- For a long time now, the Railways has been caught between two aspirations: providing an affordable travelling option to the Indian people versus being a profitable business.
- The Railways' losses are compounded by growing wage and pension bills and fuel costs.
- Locomotive pilots have also reported stressful working conditions, including 12-hour shifts, especially in zones with large freight volumes, and shifting standard operating procedures.
- The high network congestion is likewise exemplified by the limited utility of 'Kavach' as well as the failure of a homegrown system, based on walkie-talkies, to alert trackside workers to oncoming trains.
    - The system does not work fully … where a number of trains ply in a single block section at close intervals and signals are placed 1 km apart.
- In sum, the Railways' inability to generate revenue to plug gaps in the gross budgetary support, burgeoning demands on its revenue receipts, and growing pressure to ease congestion and improve physical capacity mean it's constantly playing catch-up.

3.10 Tourism Expansion in India

Introduction:

- With its rich heritage, cultural diversity, and breathtaking destinations offering a wealth of possibilities, India's tourism industry is emerging as a global favourite.
- As a key driver of economic growth, the tourism sector not only promotes development but also improves the quality of life by creating various job opportunities.
    - Acknowledging the potential of this sector, the government has allocated ₹2,479 crore for the tourism sector for FY25.

Global Perspective: Tourism Travel & Tourism Development Index 2024

- According to the latest Travel and Tourism Development Index 2024 (TTDI), international tourist arrivals (ITAs) have been projected to increase globally after COVID-19.
- India has been ranked 39th among 119 countries in the latest TTDI 2024 report published by the World Economic Forum.
    - India's score has improved in three areas:
        - Prioritisation of Travel & Tourism
        - Safety & Security
        - Health & Hygiene

- The Government of India promotes tourism as a vehicle for social inclusion, employment and economic progress.
    - Committed efforts are being made to transform India into a desirable tourist destination, and the tourism sector is becoming a key driver to making India a developed country by 2047.

Foreign Tourist Arrival in India:

- In 2023, India recorded 9.24 million foreign tourist arrivals (FTAs), a growth of 43.5% compared to 6.44 million in 2022.
    - FTAs contributed Foreign Exchange Earnings (FEEs) of Rs 2.3 lakh crores (Provisional estimates), a growth of around 65% in the same period compared to Rs. 1.39 lakh crores in 2022.
- FTAs during January-June 2024 were 47,78,374 (Provisional).
    - FEEs during January-June 2024 (Provisional estimate) were Rs. 1.27 lakh crores.
- To increase the number of FTAs, various steps have been taken, such as promoting adventure and niche tourism, making easy the availability of e-visas, and launching a 24X7 multilingual helpline for tourists.
    - Also, on World Tourism Day 2024, 'Paryatan Didi and Paryatan Mitra' were launched to create a hospitable and memorable experience for tourists in India.

Rise in Domestic Tourism:

- Domestic tourism plays a crucial role in the overall growth of India's tourism sector.
- The Government of India has taken various initiatives to promote domestic tourism, such as Dekho Apna Desh, PRASHAD, Vibrant Village Programme, SWADESH 2.0, and Regional Connectivity Scheme – Udaan.
    - These efforts focus on raising awareness about key tourist destinations and products within the country and facilitating growth in tourism-related activities.
    - Due to these continuous efforts, India has shown a positive trajectory in domestic tourism.
    - In 2023, 2509.63 million Domestic Tourist Visits (DTVs) were recorded (provisionally) compared to 1731.01 Million DTVs in 2022.
- Further, in 2022-23, 76.17 million direct and indirect jobs were created due to tourism in India, compared to 70.04 million direct and indirect jobs created in 2021-22.
- Over the last few years, India has built extensive tourism infrastructure worth approximately $1 billion (Rs. 7,000 Crores) to improve the tourist experience.
- To make India a global travel destination, the country's tourism products are being promoted holistically within the country and overseas markets.

Conclusion:

- Tourism in India has grown remarkably over the past two decades, with government initiatives, infrastructure development, and global branding contributing to this success.
- To boost tourism in India, schemes like Swadesh Darshan 2.0, Vibrant Village Programme, PRASHAD (Pilgrimage Rejuvenation and Spiritual Augmentation Drive), and Paryatan Mitra have been started.
    - At the same time, the government is taking key steps to develop adventure and sustainable tourism.
    - Technological integration and diversification into niche markets will help the tourism industry increase its growth.

3.11 Semiconductor ecosystem of India

How to make 85,000 jobs in semiconductors a reality?

Introduction:

- India's dream is that every device in the world will have an Indian-made chip.

- India needs highly qualified trainers with strong domain knowledge and experience to create the talent base for semiconductors.
- To create a strong semiconductor industry, the supply side of critical minerals such as rare earths must be stabilized and dependence on imports reduced significantly.

Countries dominating the semiconductor industry:

- Taiwan produces approximately 50% of the world's semiconductors, while South Korea is home to a vast network of over 20,000 semiconductor-related companies.
- Despite possessing only 12% of the global manufacturing capacity, U.S. semiconductor manufacturing companies hold 40% of the global IC design market share.
- The U.S. leads in providing crucial design automation software and core intellectual property (IP) for chip development.
    - U.S. companies also own and operate the largest wafer fabrication plants, and supply 44% of the global wafer fab equipment.
- Japan, ranked third behind South Korea and Taiwan in the semiconductor manufacturing supply chain, accounts for more than 50% of the semiconductor material production market, and around 30% of the equipment-production market.
- China has made significant strides in catching up but continues to rely on foreign suppliers for its most advanced semiconductor needs.
- Rare earths, the key input for semiconductors, and the discovery is startling: China dominates global production of the vast majority of the 17 different rare earth elements, followed by USA, Myanmar, Australia and Thailand.
    - India ranks 6th, with rare earths mine production of 2,900 metric tons.

Lagging behind in rare-earth extraction:

- India accounts for 0.83% of global rare earths production, China leads with 68.57%, and the United States ranks a distant second with 12.29%.
    - If India must progress towards a greener future, and accelerate energy transition to mitigate climate change, the supply side of critical minerals such as rare earths must be stabilized and dependence on imports reduced significantly.
    - In this context, the 2023-24 Economic Survey tabled in the Indian Parliament has identified India's critical mineral dependence on China as a major concern.
- The alternative is to focus on domestic exploration and production.
    - Despite the increased focus on critical mineral exploration, the government is unable to find takers for most of the mineral blocks it is offering for exploration.
    - The lack of response from the domestic mining industry primarily due to the unavailability of extraction and processing technologies within India, which turns the focus on skill development and technology upgradation which will help reduce dependence on imports from China.

Thirst for water:

- According to the World Economic Forum, the semiconductor manufacturing process calls for use of ultrapure water to rinse residue from silicon chips during fabrication.
    - Ultrapure water, which is thousands of times cleaner than drinking water, is treated through processes such as deionization and reverse osmosis to remove pollutants, minerals and other impurities that can damage chips.
    - The downside is it takes around 1,400 to 1,600 gallons of municipal water to make 1,000 gallons of water.
    - An average chip manufacturing facility today can use 10 million gallons of ultrapure water per day.

Creating a training ground for semiconductors:

- The scale, size and power rating of the chips can vary from low to high current.
- Materials inside the chips - titanium, gold, aluminum, copper or gold - are used in such minuscule quantity they can be seen only in a microscope.
- India's current dependency on import of chips indicates that the shortage is not just about materials that we require to manufacture a semiconductor.
    - Rare earths is only a start point, we also need composite electronic materials, chemicals and gases.
- Safety protocols must be in place for cylinder pressure, mixtures, piping and labeling.
    - In addition, sustained critical super-purified (de-ionized) water supply, along with high degree surge-protected 24 x 7 power supply and hi-precision overload protection units across the spectrum of chip manufacturing equipment are among fundamentally necessary features.
- This brings us back to the need for training of personnel by trainers with excellent domain knowledge and experience.
- A tremendous opportunity exists in India for skilling, upskilling and reskilling.
- Companies, domestic and foreign, can express satisfaction with infrastructure available in India, and will appreciate the Production Linked Incentive schemes being rolled out by state governments.
- All this will succeed only when we have trained manpower for the semiconductor industry.
- India currently accounts for 20% of global semiconductor design talent.
- The central government has introduced the Chips to Startup (C2S) programme, aimed to train 85,000 engineers qualified in Electronic System Design and Manufacturing (ESDM) over five years.
- Even more encouraging is the government's setting up of 'India Semiconductor Mission' and its commitment of Rs. 2,30,000 crores to position India as a global hub for electronics manufacturing with semiconductors as the foundational building block.

A shift to productizing technology:

- To emerge as a nation with tangible products, to keep pace or to stay ahead of the global race for semiconductors, India must work on the following: International certifications are essential to be able to access lucrative overseas markets.
    - Currently, Indian companies must reach out to international agencies for product certification.
    - Empowering Indian agencies such as Standardisation Testing and Quality Certification (STQC) Directorate and encouraging private players in this area would open doors to domestic certification.
- Design-Linked and Production-Linked Incentive Schemes can be enhanced with projects with a larger outlay.
    - Seamless procedures will make the schemes even more effective.
- On the usage side, India must encourage domestic Electronics Manufacturing Services manufacturers to use locally sourced chips.
    - This could take the form of subsidies and negative import lists.

Conclusion:

- The vibrant semiconductor ecosystem, a bouquet of incentives, and the prevailing impetus to 'Make in India' augur well for a niche vertical that can help achieve our collective goal of swifter communications, lower vehicular emissions, cleaner factories, and a healthier populace.
    - A speedy rollout of steps can take us towards that.

3.12 Indian fertilizer imports

Introduction:

- With the crisis continuing in Ukraine and Gaza, experts and policymakers are concerned about further increases in the prices of the components used for making petroleum-based chemical fertilizers.
- India has to increase its own fertilizer production capacity.
- The Agriculture Minister of the country's largest foodgrains producing Uttar Pradesh recently complained that the State has the stock of fertilizers for only 10 more days.
- The sowing of winter rabi crops has started in almost all the wheat-growing States and fertilizers such as Diammonium phosphate (DAP) and NPK [Nitrogen, Phosphorus, and Potassium] are essential for its growth.

Current fertilizer import scenario:

- The Standing Committee of Parliament on Chemicals and Fertilizers, in August 2023, tabled a report on 'Planning for Fertilizers Production and Import Policy on Fertilizers Including GST and Import Duty Thereon' in both the Houses.
    - It expressed concern that the "production capacity of fertilizers does not commensurate with its demand/requirement and, therefore, the gap between demand and supply is met through imports.
    - According to the report, about 20% of the domestic requirement of urea, 50-60% of the domestic requirement of DAP, and 100% of the domestic requirement of Muriate of Potassium (MOP, or Potash) is met through imports.

India's fertilizer production:

- In 2020-21, the total consumption of fertilizers was about 629.83 LMT.
- The country produced 435.95 LMT of chemical fertilizers in 2021-22, resulting in a shortfall of 143.72 LMT relative to demand.

Situation in Ukraine and Gaza:

- We do not see any stability in fertilizer markets now due to the situations in Ukraine and Gaza.
- The impact of the crisis on the oil prices, which will spill over to the by-products such as fertilizers.
- According to an answer provided in Lok Sabha, in 2018-19, 2019-20, and 2020-21, India's fertilizer imports were mostly from countries such as China, Russia, Saudi Arabia, UAE, Oman, Iran and Egypt.
    - The worsening situation in West Asia and the ongoing conflict in Russia and Ukraine could impact imports from these regions.

India's options:

- India has to enhance its fertilizer production capacity and to shift its farming systems to reduce dependence on imported fertilizers while making better use of the existing fertilizers.
- Suggestions such as using nano urea, shifting to natural farming, and enhancing the capacity of fertilizer factories have also been made to the government.
- The Standing Committee of Parliament also pointed out the need for policy initiatives aimed at creating an environment that would facilitate investments in the public, co-operatives, and private sectors engaged in the manufacturing and marketing of fertilizers.

4. Science and Tech

Prelims

4.1 INCOIS, NCPOR to launch a glider to study Antarctic Ocean

Context:

- The gliders are deployed to study the sea temperatures, salinity and geochemical process in the ice cold region

News:

- Indian National Centre for Ocean Information Services (INCOIS) together with the National Centre for Polar and Ocean Research (NCPOR) will be launching a glider near the country's research station 'Bharati' at Antarctica to study the sea temperatures, salinity and geochemical process in the ice cold region.

More on the news:

- Gliders are autonomous underwater vehicles operated remotely to study the sea or ocean temperatures, salinity and geochemical process.
- The plan is to launch the glider sometime next year when the next Indian scientific research team embarks on the expedition to the cold continent.
    - It is part of the new-age ocean observing platforms 'Gliders', as part of the Ministry of Earth Sciences (MoES) 'Deep Ocean Mission – Ocean Climate Change Advisory Services'.
- The data generated from the gliders along with the information coming from the tide gauges, argo floats, buoys and other ocean observing systems are meant to understand the impact of climate change on sea level, cyclonic storms, waves, swell surges and even ocean ecosystems.

Gliders:

- These gliders can travel up to 15 km a day, dive to a depth of 1,000-2,000 metres and are operated remotely from the command centre by maneuvreing it both vertically and horizontally at eight centimetres per second.
- They surface every 10 days while measuring state of sea parameters like chlorophyll, dissolved oxygen, salinity, temperatures and others with help of the latest biogeochemical sensors.
    - While the basic data is transmitted in real time when the gliders surface four-five times a day, the more exhaustive information can be obtained when the battery has to be replaced after nine months.
- We go by our research ship to physically bring back the gliders here for 'ballasting' to retrieve data.
    - 'Ballasting' is to retrofit gliders suitable for the waters - considering parameters such as salinity and others - in which they are to be deployed," said Head of Ocean Observations and Data Management.

INCOIS's real time data monitoring facility:

- INCOIS's real time data monitoring facility 'SynOPS' or Synergetic Ocean Observation Prediction Services, is quite special.
    - The newly launched 10,000 sq.ft lab is for visualising ocean data, satellite remote sensing and model products including 3D visualisation area with a 1.8 metre digital globe.
    - The satellite data acquisition and processing facility has an Oceansat3 and X/L band ground station.
- We can do a visualisation of any kind of ocean information or simulations about sea temperatures, ocean currents, clouds formation, rainfall patterns and others globally, real time or go back in time with the help of data sets from satellites and models.

4.2 India launches BharatGen project for generative AI in local languages

Context:

- India on Sept. 30 launched BharatGen, an initiative to make generative AI available to citizens in different Indian languages, with Science and Technology Minister Jitendra Singh asserting that it was the world's first State-funded project of its kind.
    - Spearheaded by IIT Bombay under the National Mission on Interdisciplinary Cyber-Physical Systems (NM-ICPS), the initiative will create generative AI systems that can generate high-quality text and multimodal content in various Indian languages.

About BharatGen initiative:

- BharatGen initiative was the world's first government-funded multimodal large language model project focused on creating efficient and inclusive AI in Indian languages.
- A key element of BharatGen is its open-source foundational models, which will help democratise AI across India.
- By making AI more accessible, a collaborative ecosystem would be created, where researchers and developers can work together to build innovative solutions.
- The project is expected to be completed in two years along with plans to benefit several government, private, educational, and research institutions.
- A core feature of BharatGen is its focus on data-efficient learning, particularly for Indian languages with limited digital presence.
- Through fundamental research and collaboration with academic institutions, the initiative will develop models that are effective with minimal data, a critical need for languages under served by global AI initiatives.

More info:

- Along with BharatGen initiative, officials also launched the four thematic hubs (T-Hubs) for Quantum Computing, Quantum Communication, Quantum Sensing and Metrology, and Quantum Materials and Devices, under the National Quantum Mission (NQM).
    - The hubs will be at the forefront of research and innovation, setting the stage for India's leadership in quantum computing, communication, sensing, and materials.
    - Each T-Hub will operate under the Hub-Spoke-Spike model, supporting a cluster-based network of research projects (Spokes) and individual research groups (Spikes) alongside these central hubs to enhance coordination among research institutions, enabling them to pool resources and expertise.

4.3 Rectangular solar cells

Context:

- Firm to produce ‘rectangular’ solar cells that require less land

News:

- With land for solar energy parks increasingly becoming a constraint, Solex Energy Limited, a Surat-based solar-instruments manufacturer, announced that it plans to manufacture India’s first “rectangular” solar cells.
    - The solar cells commonly used in Indian panels are square but cut down in the middle (effectively making them rectangular).

More info:

- Solex’s cells would be made rectangular.

- This would increase the effective power produced by 7%, improve the structural efficiency of the cells, require no significant changes in associated installation costs, and, crucially, require less space for a similar power output.
- Normally, to produce 1 MW, a panel needs 2,000 solar cells. With this technology, we will need only 1,700.
  - If three acres were required before, now you will need 2.5.
- The standard cells in vogue are squares of 182 mm length. The new cells that Solex hopes to locally manufacture by 2026 will be 182 mm wide and 210 mm long.
- The company has sourced this technology from China and the early batch of cells being deployed in India will be imported.

India aims for 280 GW:

- India has the world's fifth-largest installed solar power capacity of 84 GW and aims to ramp up to 280 GW by 2030.
  - A MW of solar power requires about 3-5 acres of land.
  - This translates to 75,000 square kilometres of land.
  - Finding land for solar parks has been a challenge and a source of fractious litigation.
  - About 80% of India's installed solar capacity is in solar parks, chiefly in Rajasthan and Gujarat.
  - In addition to this, the wide range in temperatures and climate means that solar cells operate at varying degrees of efficiency.
- Over the years, solar cells in India have evolved, and different technologies are being tested.
  - In the international markets, a category called N Type TOPCON (Tunnel Oxide Passivated Contact) cells is becoming popular, and they seem more suited for India in terms of climate and efficiency.
  - While a few Indian firms are sourcing N-Type TOPCON, Solex's variation is the N-Type TOPCON-R (for rectangular).
  - The 'Tapi-R' series, as the company calls it - in a nod to the Tapi river in Surat - with its rectangular dimensions, comprises 132 half cut cells and delivers up to 625 Wp (the maximum power in ideal conditions in a cell) of power with a 23.14% module efficiency, the company claimed.
    - It is particularly suited for large-scale solar projects in challenging environments, such as deserts, and barren land, according to a company statement.

4.4 Solar eclipse

Context:

- Solar eclipse to create rare 'ring of fire' over South America
- The Moon will be further from the Earth than usual, so those in parts of Chile and Argentina will be able to witness a kind of ring of light coming from the Sun

News:

- An annual solar eclipse will create a rare "ring of fire" phenomenon visible in parts of South America on Wednesday, October 2, 2024.

More info:

- A "ring of fire" occurs when the Moon lines up between the Sun and the Earth to create a solar eclipse but does not block out the Sun's light entirely.
- This year, the Moon will be further from the Earth than usual, so those in parts of Chile and Argentina will be able to witness "a kind of ring of light coming from the Sun.
- A "crescent sun" will be visible before and after the ring, as the Moon passes in front of the Sun.
- The solar eclipse's path will begin in the North Pacific, pass over the Andes and Patagonia regions of Latin America, and finish in the Atlantic.

- “The eclipse will last more than three hours, from 1700 to around 2030 GMT,” according to NASA.
- “But the “ring of fire” phenomenon is expected to last just a few minutes, occurring around 1845 GMT,” according to the IMCCE institute of France’s Paris Observatory.
- “A partial eclipse will be visible from Bolivia, Peru, Paraguay, Uruguay, parts of Brazil, Mexico, New Zealand, and several islands in the Pacific and Atlantic oceans,” NASA said.
- Space agencies and institutes have warned against observing an eclipse with the naked eye, saying it can cause irreversible damage to the retina. Ordinary sunglasses offer insufficient protection.
    - The only safe methods, according to NASA and the IMCCE, are using certified special eclipse glasses, or watching indirectly through a pinhole in a cardboard sheet projecting the image of the eclipsed Sun onto a second cardboard sheet.
- The next partial solar eclipse will take place on March 29, 2025, visible mainly from western North America, Europe and northwest Africa.

4.5 Small rocky planet detected in orbit about nearby Barnard's star

Context:

- Scientists eager to study nearby potentially habitable worlds are excited by the discovery of the first confirmed planet orbiting Barnard's star, a rocky one with a mass about 40% that of Earth.

More info:

- Barnard's star is a red dwarf, the smallest type of regular star and much smaller and less luminous than our sun.
    - At about 6 light years away, it is the closest single star - one not orbiting with other stars - to our solar system.
    - It is, in cosmic terms, in our neighbourhood.
- Because of this, scientists eager to study nearby potentially habitable worlds are excited by the discovery of the first confirmed planet orbiting Barnard's star, a rocky one with a mass about 40% that of Earth.
- While this planet, orbiting very close to Barnard's star, has a surface temperature too high to be suitable for life, the researchers found what they called "strong hints" of three other planets around Barnard's star that might be better candidates.
- The confirmed planet, called Barnard b, has a predicted diameter about three-quarters that of Earth, so about 6,000 miles (9,700 km).
- "It is one of the least massive planets ever found," beyond our solar system.
- Among planets in our solar system, only Mars and Mercury are smaller.
- Barnard b, with a surface temperature around 275 degrees Fahrenheit (125 degrees Celsius), orbits Barnard's star in just three Earth days at a distance 20 times closer than our solar system's innermost planet Mercury is to the sun.
- Planets beyond the solar system are called exoplanets.
    - Scientists searching for exoplanets that possibly could harbor life look at those residing in the "habitable zone" around a star, where it is not too hot and not too cold, and liquid water can exist on the planetary surface.
- The researchers used an instrument called ESPRESSO on the European Southern Observatory's Chile-based Very Large Telescope to detect this planet.
- The three other potential planets orbiting Barnard's star all apparently are rocky and smaller than Earth, ranging from 20-30% of Earth's mass.
    - The hope is that at least one of these may be in the vicinity of the habitable zone.
- If confirmed, this would be the only known star with a multi-planet system entirely comprised of planets smaller than Earth.

- Barnard's star, in the constellation Ophiuchus, has a mass about 16% of the sun's, a diameter 19% of it and is far less hot.
    - It also is estimated to be more than twice as old as the sun.
- Being so cold and small, it is quite faint, making its habitable zone much closer to the star than in the case of the sun.
- It also is a very quiet star. While some red dwarfs have been found to flare very frequently, Barnard's star doesn't do it.
- The closer that exoplanets are to us, the easier they are to study.
    - It is easier to detect low-mass rocky planets orbiting red dwarfs, the most common type of star in our Milky Way galaxy, than around larger stars.
- Only the three stars in the Alpha Centauri system, about 4 light-years away, are closer to our solar system than Barnard's star.
    - A light-year is the distance light travels in a year, 5.9 trillion miles (9.5 trillion km).
    - Two exoplanets have been detected in the Alpha Centauri system, both orbiting the red dwarf Proxima Centauri.
    - One has a mass about equal to Earth's. The other is about 25% Earth's mass.
- In science fiction, light speed travel is commonplace.
    - In reality, it is far beyond human capabilities, though research projects such as Breakthrough Starshot are exploring the feasibility of interstellar travel.
    - Barnard's star and Alpha Centauri might be on wish lists of future destinations.
    - While they are very close in astronomical terms, they are out of reach for any kind of human technology. However, if projects such as the Breakthrough Starshot are successful, it is likely that these will be some of the first targets.

4.6 Ancient human DNA

Context:

- Ancient human DNA from a South African rock shelter sheds light on 10,000 years of history

Introduction:

- Oakhurst rock shelter is an archaeological site near the town of George on the southern coast of South Africa.
    - It is set into a sandstone cliff above a stream in a valley forested by towering old yellowwood trees.
- What makes the site special is the record of human occupation there, which spans 12,000 years.
- Not only have rock art, stone tools and ceramic fragments been found there, but also the remains of 46 people.
    - That’s rare: most very old burials found in South Africa (from the last 40,000 years) have been of single individuals.
- New technology is making it possible to keep learning more from previously discovered archaeological material.
    - Oakhurst offered an opportunity to reconstruct the genomes of the site’s inhabitants through time, and to assess their genetic relationships to people living in the region today.
- A genome is the genetic information about a living organism.
    - This information gets passed down from one generation to the next, forming a record of the past.
- Studying ancient genomes – a field known as archaeogenetics – helps us understand the history of living people and the movements of populations.
- Scientists were able to generate 13 ancient genomes from skeletal human remains at Oakhurst.

- They included the oldest ancient DNA from the region to date, from two individuals who lived around 10,000 years ago.
- The findings show that the population history of southernmost Africa is different from other regions of the world.
  - People didn't arrive here in waves, replacing other populations and mixing with them.
  - Instead there was long-lasting genetic continuity throughout the entire span for these 13 individuals, from 10,000 until as recently as 1,300 years ago.

Human genetic diversity and history:

- Archaeogenetics has revealed much about human history in Asia and Europe.
  - There has been less success in Africa, because of the environmental conditions.
  - Ancient DNA isn't well preserved when average temperatures are high.
  - So far, fewer than two dozen genomes from South Africa, Botswana and Zambia have been published.
- But Africa is interesting as it is the continent with the greatest human genetic diversity.
  - All of the remaining world's human genetic diversity is just a subset of Africa's.
  - So human history cannot be understood without understanding African history.
- Oakhurst study started in 2017, with a team of biological anthropologists, archaeologists, and archaeogeneticists.
  - They sampled 13 individuals from the site.
  - Two samples were 9,000-10,000 years old, four were 5,000-6,000, five 4,000-5,000 and two 1,000-1,500 years old.
  - Their ages were established by radiocarbon dating of bone or tooth collagen.
  - All individuals were adults, five were women and eight were men.
- The genetics work required several attempts due to technical challenges caused by poor DNA preservation.
  - They extracted DNA from powdered skeletal material and performed a series of laboratory steps to extract DNA molecules and multiply them often enough so that they could be sequenced.
- All of the genomes turned out to be relatively similar to those of contemporary San and Khoekhoe people, who live in the region today, including the ǂKhomani San.
  - We could show that between 10,000 and 1,300 years ago, no ancestry from outside present-day South Africa arrived at Oakhurst rock shelter.
- This genetic continuity over a long time is remarkable.
  - In comparison, in Europe and Asia, we see more of a change in the ancient DNA record as major population movements occurred.
- But it is not as if there was no change in southern Africa.
  - We do see that these people had cultural innovations over time.
  - Several stone technological shifts are preserved at the Oakhurst site, and around the same time, are similarly found across archaeological sites in South Africa.
- Around 2,000 years ago, newcomers arrived in the region, introducing herding, farming and new languages.
  - They began interacting with local hunter-gatherer groups.
  - Still, even the individual we studied who lived 1,300 years ago was genetically similar to the older genomes.
- We hope that these new results may open doors for further studies into one of the most culturally, linguistically and genetically diverse regions of the world.

4.7 World Health Organization approves first mpox diagnostic test

Context:

- The United Nations health agency approves first diagnostic test for mpox, crucial for countries facing outbreaks

News:

- The United Nations health agency said that it had approved the use of the first diagnostic test for mpox, a key tool in countries battling outbreaks.

More info:

- "The approval for emergency use" of the test "will be pivotal in expanding diagnostic capacity in countries facing mpox outbreaks, where the need for quick and accurate testing has risen sharply", the World Health Organization said.
- The test, called the Alinity m MPXV assay enables the detection of the mpox virus from swabs taken from human lesions.
- By detecting DNA from pustular or vesicular rash samples, laboratory and health workers can confirm suspected mpox cases efficiently and effectively.
- Limited testing capacity and delays in confirming mpox cases persist in Africa, contributing to the continued spread of the virus.
- The approval of the test represents a significant milestone in expanding testing availability in affected countries.
- Increasing access to quality-assured medical products is central to our efforts in assisting countries to contain the spread of the virus and protect their people, especially in underserved regions.

About mpox:

- Mpox, previously known as monkeypox, is caused by a virus transmitted to humans by infected animals but can also be passed from human to human through close physical contact.
- It causes fever, muscular aches and large boil-like skin lesions, and can be deadly.

4.8 Cruise Bharat Mission

Context:

- The Union Minister for Ports, Shipping, and Waterways Launches 'Cruise Bharat Mission,' to Double Cruise Calls and Passengers within Five years
- Cruise circuits to be designed to celebrate and promote globally the cultural, historical and natural heritage of Bharat
- Mission to be implemented in Three Phases & cover three key segments - Ocean & Harbour cruise, River & Island cruise, Island cruise

About Cruise Bharat Mission:

- Aimed at the boosting the tremendous potential of cruise tourism in the country, the programme by the Ministry of Ports, Shipping & Waterways aims to propel country's cruise tourism industry by doubling cruise passenger traffic within five years; i.e. by 2029
- The initiative aims to excel India's vision to become a global hub for cruise tourism and promote the country as the leading global cruise destination.
- The Cruise India Mission will be implemented in three phases, beginning from 1 October 2024 up to 31 March 2029.
    - The Phase 1 (01.10.2024 – 30.09.2025) will focus on conducting studies, master planning, and forming cruise alliances with neighbouring countries.

        - It will also modernise existing cruise terminals, marinas, and destinations to enhance the potential of cruise circuits.
    - The Phase 2 (01.10.2025 – 31.03.2027) will concentrate on developing new cruise terminals, marinas, and destinations to activate high-potential cruise locations and circuits.
    - Phase 3 (01.04.2027 – 31.03.2029) will focus on integrating all cruise circuits across the Indian Subcontinent, marking the maturity of the cruise ecosystem while continuing the development of cruise terminals, marinas, and destinations.
- Key performance targets across the phases include increasing sea cruise passengers from 0.5 million in Phase 1 to 1 million by Phase 3, with corresponding increases in sea cruise calls from 125 to 500.
    - River cruise passengers will grow from 0.5 million in Phase 1 to 1.5 million by Phase 3.
    - The number of international cruise terminals will expand from 2 in Phase 1 to 10 by Phase 3, while river cruise terminals will increase from 50 to 100. Similarly, marinas will grow from 1 to 5, and employment generated will rise from 0.1 million to 0.4 million by the final phase.
- The mission aims to continuously work towards the development of world-class infrastructure and destinations while leveraging technology to provide a seamless experience for embarkation, disembarkation, and destination visits.
    - It will promote the cultural, historical, and natural circuits of the Indian Subcontinent, ensuring inclusive and equitable growth for all stakeholders, including ports, cruise lines, vessel operators, tour operators, service providers, and local communities.
    - Additionally, the mission will enable the responsible involvement of all regulatory agencies such as Customs, Immigration, CISF, State Tourism Departments, State Maritime Agencies, District Administrations, and local police.
- The government has been taking measures that witnessed a remarkable increase of 400% passenger footfall in cruise since 2014.
    - The 'Cruise Bharat Mission' will further build on this as it aims to double volume of cruise calls from 254 in 2024 to 500 by 2030 and 1,100 by 2047.
    - We are expecting rise in passengers from 4.6 lakh in 2024 to 5 million by 2047.
    - The mission also aims to create 4 lakhs employment in the cruise sector during this period.
- The Cruise India Mission targets three key cruise segments.
    - First, the Ocean & Harbour Cruise segment encompasses ocean cruises, including deep-sea and coastal cruises, along with harbour-based yachting and sailing cruises.
    - Second, the River & Inland Cruise segment focuses on river and inland cruises on canals, backwaters, creeks, and lakes.
    - Lastly, the Island Cruise segment highlights inter-island cruises, lighthouse tours, live-aboard experiences, expedition cruises, and boutique cruises to lesser-known destinations.
- This mission aims at creating sustainable and vibrant ecosystem which will be beneficial for cruise operators, tourists and communities.
    - This visionary mission will power India's maritime sector which will open new vistas in tourism and harnessing the Blue Economy.
- The mission has identified key initiatives across five strategic pillars.
    - The Sustainable Infrastructure & Capital pillar addresses infrastructure gaps, focusing on developing world-class terminals, marinas, water aerodromes, and heliports, alongside digitalisation (e.g., facial recognition) and decarbonisation (e.g., shore power).
        - It includes creating a National Cruise Infrastructure Masterplan 2047, setting up a cruise-focused SPV under Indian Ports Association (IPA), and establishing a cruise development fund.

- The Operations Including Technology Enabled pillar aims to streamline operations, ensuring smooth embarkation, disembarkation, and destination visits with a focus on digital solutions such as e-clearance systems and e-visa facilities.
- The Cruise Promotion & Circuit Integration pillar focuses on international marketing and investment promotion, including linking cruise circuits, hosting events like the "Cruise India Summit," and forming alliances with neighbouring countries.
- The Regulatory, Fiscal & Financial Policy pillar is centred on creating tailored fiscal and financial policies, with a focus on tax scenarios, cruise regulations, and the launch of a National Cruise Tourism Policy.
- Lastly, the Capacity Building and Economic Research pillar emphasizes skill development, creating a Centre of Excellence for cruise-related economic research, and formulating National Occupational Standards to promote youth employment in the cruise industry.

- The Cruise Bharat Mission will not only elevate India's cruise tourism sector but also create lasting opportunities for generations to come.

4.9 Road Safety Sensor

Context:

- Novel polymer nanocomposite creates base for road safety sensor for accident prone turnings

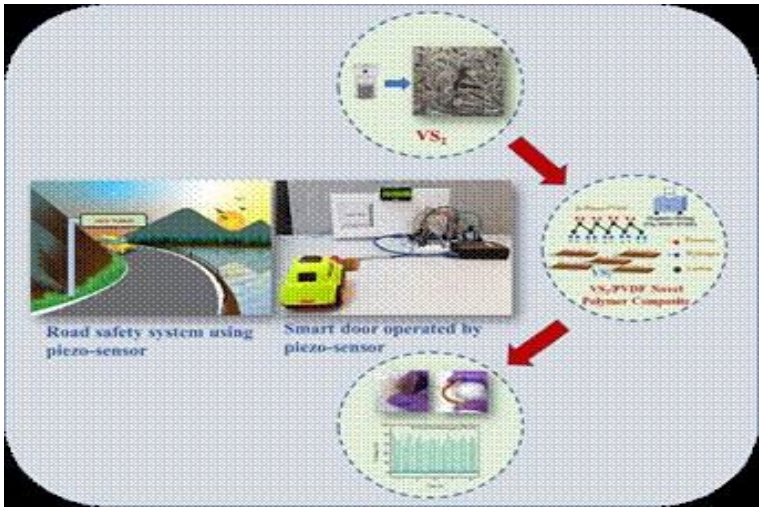
News:

- A prototype of a road safety sensor that can be implanted at high-risk turning points where accidents are frequent, has been developed from a new polymer nanocomposite with pressure sensing and energy harvesting properties.

More info:

- Scientists are constantly trying to develop new materials for self-powered energy generating and pressure sensing devices and using them for several applications.
  - Flexible, portable, long-lasting, and wearable sensors and energy harvesting devices can play an essential part in today's artificial intelligence era.
  - Polymers and nanoparticles serve critical roles in today's flexible electronic systems.
- Researchers from Centre for Nano and Soft matter Sciences (CeNS), Bengluru have developed a polymer nanocomposite for pressure sensing and energy harvesting applications and used it to invent a prototype of a road safety sensor.
  - The prototype may be implanted in the movable ramp and secured to the road just 100 meters before acute and fatal turning points.
  - Thus, any vehicle approaching from the opposite side will see the signal on a screen and be alerted.
  - This prototype works on the principle of piezoelectric effect so it can generate energy that can be stored and used further to power electronic gadgets as well.
- The novel polymer nanocomposite, from which the prototype has been crafted, has been made of transition metal dichalcogenide.
- The scientists synthesized vanadium disulfide (VS2) with a very high surface charge which has the capacity of improving the piezoelectric characteristics of polymers.
- Polymer nanocomposite films were prepared by integrating these nanoparticles at various concentrations into a well-known piezoelectric polymer, poly (vinylidene difluoride) (PVDF).
- Further they investigated how the surface charge of nanoparticles will affect the piezoelectric properties of polymer nanocomposite.

- In addition, a laboratory-scale demonstration of a road safety sensor and smart door was established, with the prototype as a pressure sensor.
- This study demonstrates that PVDF-VS2 nanocomposites will provide significant value to flexible, long-term energy generating and pressure sensing applications.
- This study is part of an ongoing project "Materials for self-powered energy generating and pressure sensing devices" funded by Department of Science and Technology under INSPIRE –faculty fellowship programme.



4.10 Gold

Context:

- Each of the Nobel Prizes to be awarded from October 7 will include a medal of electrum, an alloy of gold and silver, plated with 24 carat gold.

About Gold:

- Gold is a precious metal famed for its use in jewellery and as a form of investment.
- Its atomic number is 79 and its Latin name is 'aurum', thus its symbol on the periodic table, Au.
- Some 10% of all the gold produced around the world is used every year in industry thanks to the metal's many desirable properties.
    - For example, gold doesn't dissolve in strong nitric acid whereas most metals do; this is why the term 'acid test' is used to refer to a test of someone's character.
    - Among the Nobel metals, only platinum is less reactive.
    - Gold does dissolve in a solution of nitric acid and hydrochloric acid that alchemists called aqua regia, or "royal water".
        - It also dissolves in some alkaline solutions and in mercury, and is malleable, ductile, corrosion-resistant, and a good conductor of electricity.
        - It is commonly used in industry to form connectors in computers.
- South Africa has produced most of the world's gold since the late 19th century, but today the largest producer is China (no. 6 on this list is the small country of Ghana).
- The cost of extracting and refining gold depends on where it is found, although gold nuggets are typically found in mountainous areas that also have quartz veins.

4.11 The discovery that led to an explosion in planet hunting

Context:

- On October 6, 1995, astronomers announced the discovery of 51 Pegasi b.
    - This exoplanet, also known by the names Bellerophon and Dimidium, was the first planet discovered orbiting a distant sun-like star.

More about this discovery and how it changed in a big way our understanding of our place in the universe:

- The 51 Pegasi b is the first exoplanet discovered orbiting a sun-like star.
    - Exoplanets are planets that orbit a star outside of our own solar system.

- In the nearly three decades since the discovery of 51 Pegasi b, the number of exoplanets discovered has ballooned to over 5,000, altering our understanding of ourselves.
- This exoplanet wasn't the first to be discovered, but it was the first discovered to be orbiting a sun-like star.
- The first exoplanets of any type were discovered in 1992. Astronomers detected two planets orbiting a pulsar star.
    - Pulsars are rapidly rotating neutron stars emitting beams of radiation in regular phases, are very unlike stars like our own sun.

Hot Jupiter:

- As far as 51 Pegasi b is concerned, it is a "hot Jupiter," meaning it is a gas giant exoplanet.
- Located 51 light-years from Earth, this exoplanet is 47% less massive than Jupiter, while being 50% larger than Jupiter.
- It's a star-hugging planet, meaning it circles just 7 million km away from its host star, taking just four days to complete an orbit (a year for 51 Pegasi b is therefore just four days!).
- According to nomenclature, 51 Pegasi corresponds to the parent star, and the b denotes that it is the first planet discovered in the star system.
    - If more planets are discovered (not the case with 51 Pegasi), they are denoted with c, d, e, and so on.
- Before 51 Pegasi b's discovery, Earth was one of just eight known planets (or nine until 2006, since Pluto's reclassification as a dwarf planet only took place that year).
    - In the span of 29 years since then, Earth has gone on to become one of over 5,000 known planets.
- There's reason to believe that every star in the Milky Way hosts at least a planet on average.
    - There are suggestions that one out of every five sun-like stars harbour a potentially habitable, relatively Earth-like planet.
    - This would mean that Earth is one of trillions of planets. And yet, it is the only one (we know of) that harbours life.

Techniques employed in planet hunting:

- There are five techniques currently used to find a planet: radial velocity, transit, direct imaging, gravitational microlensing, and astrometry.
    - In the radial velocity method, also called the Doppler wobble method, exoplanets are detected by measuring the reflex motion of a star.

4.12 Medicine Nobel 2024 awarded for discovery of microRNA

Context:

- The Nobel Prize for 2024 in Medicine or Physiology has been awarded to Victor Ambros and Gary Ruvkun

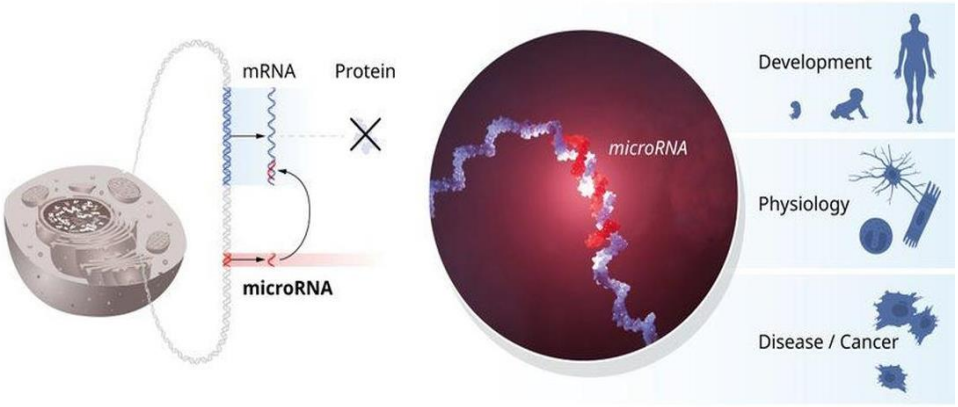
News:

- Victor Ambros and Gary Ruvkun have been jointly awarded the Nobel Prize for Physiology 2024.
    - They were awarded the prestigious prize for the discovery of microRNA and its role in post-transcriptional gene regulation.

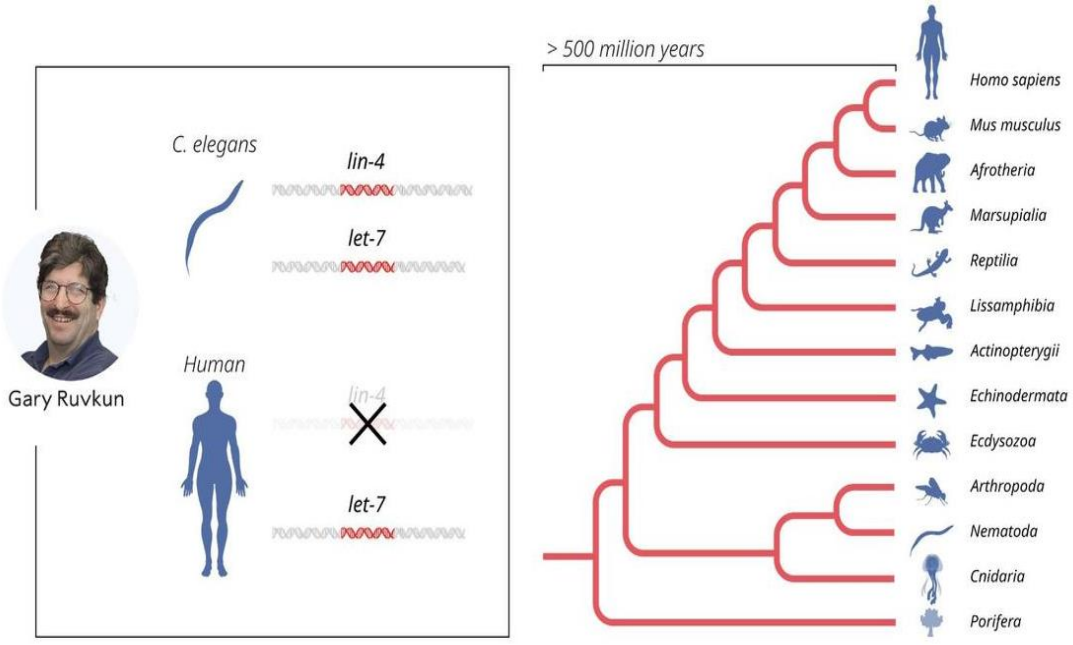
More info:

- Victor Ambros and Gary Ruvkun were interested in how different cell types develop.
    - They discovered microRNA, a new class of tiny RNA molecules that play a crucial role in gene regulation.
- Ambros and Ruvkun's groundbreaking discovery, revealed a completely new principle of gene regulation that turned out to be essential for multicellular organisms, including humans.

- It is now known that the human genome codes for over one thousand microRNAs.



- **Note:** Understanding the regulation of gene activity has been an important goal for many decades. If gene regulation goes awry, it can lead to serious diseases such as cancer, diabetes, or autoimmunity.
- Their surprising discovery revealed an entirely new dimension to gene regulation.
  - MicroRNAs are proving to be fundamentally important for how organisms develop and function.
- This year's Nobel Prize focuses on the discovery of a vital regulatory mechanism used in cells to control gene activity.
  - Genetic information flows from DNA to messenger RNA (mRNA), via a process called transcription, and then on to the cellular machinery for protein production.
  - There, mRNAs are translated so that proteins are made according to the genetic instructions stored in DNA.
  - Since the mid-20th century, several of the most fundamental scientific discoveries have explained how these processes work.
- Victor Ambros and Gary Ruvkun were studied a relatively unassuming 1 mm long roundworm, C. elegans.
  - Despite its small size, C. elegans possesses many specialized cell types such as nerve and muscle cells also found in larger, more complex animals, making it a useful model for investigating how tissues develop and mature in multicellular organisms.
  - Ambros and Ruvkun were interested in genes that control the timing of activation of different genetic programs, ensuring that various cell types develop at the right time.



- **Note:** MicroRNA genes have evolved and expanded within the genomes of multicellular organisms for over 500 million years.

- Today, we know that there are more than a thousand genes for different microRNAs in humans, and that gene regulation by microRNA – discovered by this year's medicine laureates – is universal among multicellular organisms.

About Nobel Prize:

- The Nobel Prize was created by wealthy Swedish inventor Alfred Nobel, who in his will dictated that his estate should be used to fund "prizes to those who, during the preceding year, have conferred the greatest benefit to humankind".
- The prizes carry a cash award of 10 million Swedish kronor (nearly $900,000) and will be awarded on December 10.
- The Prize for Physiology or Medicine kicks off a week of Nobel Prize announcements.
- Last year the Nobel Prize for Physiology was jointly awarded to Katalin Karikó and Drew Weissman for their "discoveries concerning nucleoside base modification that enabled the development of effective mRNA vaccines against COVID-19".

4.13 Nobel Prize in Physics 2024

Context:

- John J. Hopfield, Geoffrey E. Hinton awarded for work on machine learning with artificial neural network
  - The Nobel Prizes for 2024 in Physics has been awarded to duo for their inventions that helped in machine learning

News:

- The 2024 Nobel Prize in Physics has been awarded to John J. Hopfield and Geoffrey E. Hinton "for foundational discoveries and inventions that enable machine learning with artificial neural networks," The Royal Swedish Academy of Science announced.

More info:

- This year's two Nobel Laureates in Physics have used tools from physics to develop methods that are the foundation of today's powerful machine learning.
- John J. Hopfield invented a network that uses a method for saving and recreating patterns.
  - The Hopfield network utilises physics that describes a material's characteristics due to its atomic spin – a property that makes each atom a tiny magnet.
- When the Hopfield network is fed a distorted or incomplete image, it methodically works through the nodes and updates their values so the network's energy falls.
  - The network thus works stepwise to find the saved image that is most like the imperfect one it was fed with.
- Geoffrey Hinton used the Hopfield network as the foundation for a new network that uses a different method: the Boltzmann machine.
  - This can learn to recognise characteristic elements in a given type of data.
  - Professor Hinton used tools from statistical physics, the science of systems built from many similar components.
- The Boltzmann machine can be used to classify images or create new examples of the type of pattern on which it was trained.
  - Mr. Hinton has built upon this work, helping initiate the current explosive development of machine learning.
- The laureates' work has already been of the greatest benefit.
  - In physics we use artificial neural networks in a vast range of areas, such as developing new materials with specific properties.

- Last year, The Nobel Prize in Physics was awarded to Pierre Agostini, Ferenc Krausz, and Anne L'Huillier for experimental methods that generate attosecond pulses of light for the study of electro dynamics in matter.

4.14 Upper stage of PSLV-37 mission re-enters Earth's atmosphere

Context:

- Upper stage of historic PSLV-37 mission re-enters Earth's atmosphere eight years after launch: ISRO

News:

- The Indian Space Research Organisation (ISRO) informed that the upper stage of the Polar Satellite Launch Vehicle C-37 (PSLV C-37 mission) re-entered the Earth's atmosphere on October 6.

About PSLV-C37 mission:

- The PSLV-C37 mission was launched in 2017 with Cartosat-2D as the main payload along with another 103 satellites as co-passengers, namely INS-1A, INS- 1B, Al-Farabi 1, BGUSAT, DIDO-2, Nayif 1, PEASS, 88 Flock-3p satellites, and 8 Lemur-2 satellites.
    - The space agency created history as it was the first mission to launch 104 satellites with a single vehicle.

More info on the upper stage re-entry:

- After injecting the satellites and passivation, the upper stage (PS4) was left at an orbit of approximately 470x494 km.
- It was regularly tracked by US Space Command (USSPACECOM) as an object with NORAD id 42052.
    - Its orbital altitude slowly decayed, primarily due to atmospheric drag effects.
- Since September 2024, ISRO System for Safe and Sustainable Space Operations Management (IS4OM) regularly monitored the orbital decay as part of its regular activities and predicted re-entry into the atmosphere in the first week of October 2024.
- The orbit had decayed to a size of 134x148 km, as of October 6, 2024 12:45 UTC.
- As per USSPACECOM prediction published in Space Track, the re-entry took place on October 6 at 15:49 UTC (+/-1 minute of uncertainty) while IS4OM prediction also showed that re-entry would occur on October 6 at 15:48:25 UTC.
- The corresponding impact point is in the North Atlantic Ocean, ISRO informed.
- The atmospheric re-entry of the rocket body within eight years of its launch is fully compliant with the international debris mitigation guidelines, in particular, the guideline of Inter-Agency Space Debris Coordination Committee (IADC) that recommends limiting the post-mission orbital life of a defunct object in Low-Earth orbit (LEO) to 25 years.
- According to ISRO, this requirement was met by properly designing a passivation sequence, which lowered the orbit of PS4 after injection of the payloads.
    - At present, special initiatives are undertaken to ensure that the residual orbital lifetime of the PSLV upper stages is reduced to 5 years, or even less, by actively de-orbiting them to lower altitude orbits through engine re-starts, as in PSLV-C38, PSLV-40, PSLV-C43, PSLV-C56, and PSLV-C58 missions.
- Controlled re-entry of the upper stage is also envisaged for the disposal of the upper stage in future PSLV missions.
- As part of its longstanding commitment to preserve long term sustainability of outer space activities, ISRO will continue to implement proactive measures to meet the objectives of Debris Free Space Mission (DFSM) by the year 2030, the ISRO stated.

4.15 Hidden pandemic of AMR poses challenge for modern medicine

Context:

- A simmering silent pandemic of superbugs that is going on for decades, is causing more havoc than most people realise.

About AMR:

- Quarter of antibiotics consumed in the world are in India, and there are annually 300,000 direct deaths attributable to AMR, and superbugs are a factor in 10 lakh additional deaths each year.
  - Even a single scar can get dangerous as it can develop into a deadly wound if the body does not respond to antibiotics.
- We haven't had any innovative antibiotics developed since the last few decades and we are finding more and more patients with seemingly minor infections going for complicated treatments and surgery; even new born babies are facing infections at a very high rate for which there is no cure.
  - How did we reach this situation? A lot of early antibiotics were easier to isolate from soil and they have already been found.
  - Also largely, populations have become resistant to these antibiotics.
  - Also, pharmaceutical companies are now investing more in research and development related to anti-cancer medication as compared to antibiotics.
    - There are only 27 drug candidates in clinical development for priority bacteria across the world meant for tackling AMR.
    - Most of these will fail along the way and not get approved in comparison to 1,600 in cancer treatment.
  - Also there are only 3,000 active researchers who focus on AMR resistance worldwide while there are 46,000 dedicated to cancer research.
- There is a complete market distortion with how antibiotics are developed and how we value them.
  - That's why the pipeline is dry.
  - The government can do more to provide incentives as there is going to be a public benefit to have more of these drugs.
- There is more focus on R&D for cancer drugs compared to antibiotics because as a society we put less value on antibiotics as drugs, even if they are expensive and save your life compared to cancer which might just likely extend your life by a few months.
  - This is because, if a pharma company invests a lot of money in antibiotics - say, it takes 10 years to develop that antibiotic - they normally have a set amount of time before it falls off the patent cliff.
  - Then generics are available as an alternative so they have to recoup R&D expenses within a decade.
  - So, the problem is that you have to price it very high and it is available for limited people, and the economics of it does not make sense at all.
- Even when people suffer from a small sniffle, they prescribe antibiotics themselves, or have a neighbourhood doctor to write a prescription and there should be more stringent enforcement by the government to restrict this.
  - During COVID for instance, seven out of 10 people were given Azithromycin without basis even when they did not have a bacterial co-infection.

4.16 Major Atmospheric Cherenkov Experiment (MACE) Observatory

Context:

- DAE Inaugurates MACE, Asia's Largest and World's Highest Imaging Cherenkov Observatory, at Hanle, Ladakh

About MACE Observatory:

- MACE is the largest imaging Cherenkov telescope in Asia.
- Located at an altitude of ~4,300 m, it is also the highest of its kind in the world.
- The telescope is indigenously built by BARC with support from ECIL and other Indian industry partners.
- MACE Observatory is a monumental achievement for India, and it places our nation at the forefront of cosmic-ray research globally.
- This telescope will allow us to study high-energy gamma rays, paving the way for deeper understanding of the universe's most energetic events.
- The significant role that MACE project plays not only in advancing scientific research but also in supporting the socio-economic development of Ladakh.
- MACE project would inspire future generations of Indian astronomers, scientists, and engineers.
- The inauguration of the MACE telescope marks a significant step forward for Indian astrophysics and cosmic-ray research.
- Situated at an altitude of ~4,300 m, the MACE telescope will observe high-energy gamma rays, contributing to global efforts to understand the most energetic phenomena in the universe, such as supernovae, black holes, and gamma-ray bursts.
- This facility will also complement global observatories, strengthening India's position in the field of multi messenger astronomy.
- Looking ahead, the MACE project aims to foster international collaborations, advancing India's contributions to space research and bolstering India's position in the global scientific community.
- The observatory will also serve as a beacon of inspiration for future generations of Indian scientists, encouraging them to explore new frontiers in astrophysics.

4.17 Trachoma

Context:

- India has eliminated trachoma as a public health problem: WHO

News:

- The World Health Organization (WHO) has now recognised that India has successfully eliminated trachoma, a bacterial infection that affects the eyes, as a public health problem.
- The UN health body announced that India is the third country in South-East Asia Region to reach this important public health milestone.

About Trachoma:

- Trachoma is a bacterial infection that affects the eyes.
- It is caused by the bacterium Chlamydia Trachomatis.
- Trachoma is contagious, spreading through contact with the eyes, eyelids, nose or throat secretions of infected people, if left untreated it causes irreversible blindness.
- WHO has termed Trachoma as a neglected tropical disease.
- Trachoma is found in underprivileged communities living in poor environmental conditions.
- Trachoma was amongst the leading cause of blindness in the country during 1950-60.
- The Government of India launched the National Trachoma Control Program in 1963 and later on Trachoma control efforts were integrated into India's National Program for Control of Blindness (NPCB).
- In 1971, blindness due to Trachoma was 5% and today, owing to the various interventions under the National Programme for Control of Blindness & Visual Impairment (NPCBVI), it has come down to less than 1%.

- WHO SAFE strategy was implemented throughout the country wherein SAFE stands for adoption of surgery, antibiotics, facial hygiene, environmental cleanliness etc.
    - As a result, in 2017, India was declared free from infective Trachoma.
    - However, surveillance continued for trachoma cases in all the districts of India from 2019 onwards till 2024.
- The National Trachomatous Trichiasis (TT only) Survey was also carried out in 200 endemic districts of the country under NPCBVI from 2021-24, which was a mandate set by WHO in order to declare that India has eliminated Trachoma as a public health problem.
    - All the reports were compiled in a specific dossier format by the NPCBVI team and were shared with the WHO country office for final scrutiny.
    - Finally, after years of fighting against Trachoma, WHO declared that India has eliminated Trachoma as a public health problem.

4.18 MicroRNAs

Context:

- The 2024 Nobel Prize in Physiology or Medicine was awarded to Victor Ambros and Gary Ruvkun
    - The scientists won the esteemed prize for the discovery of microRNA and its role in post-transcriptional gene regulation

About microRNAs:

- MicroRNAs, or miRNAs, are small, non-coding molecules of RNA.
- They are typically around 19-24 nucleotides long and play an important role in determining how much messenger RNA (mRNA), which carries genetic information, eventually gets translated into protein.
- The body makes proteins in a complex process with two broad steps.
    - In the transcription step, a cell copies a DNA sequence into messenger RNA (mRNA) in the nucleus.
    - The mRNA moves from the nucleus, through the cell fluid, and attaches itself to the ribosome.
    - In the translation step, another type of RNA called transfer RNA (tRNA) brings specific amino acids to the ribosome, where they are linked together in the order specified by the mRNA to make the protein.
- Micro RNA, or miRNA, regulates the production of proteins by bonding with and subsequently silencing the mRNA at an appropriate juncture.
    - The process is called post-transcriptional gene regulation.

Applications:

- A single micro-RNA can regulate the expression of many genes, and alternatively a single gene can also be controlled by multiple micro-RNAs.
    - This leads to fine tuning of different types of cells despite similar genetic information.
- Abnormal regulation by microRNA can contribute to cancer, and mutations in genes coding for microRNAs have been found in humans, causing conditions such as congenital hearing loss, eye and skeletal disorders.
    - However, there are no clear applications of miRNAs yet. Understanding them is the first step towards further research.

4.19 Advanced Glycation End products (AGEs)

Context:

- Consumption of ultra-processed and fast foods leading cause of diabetes in India, reveals new study

More info:

- A diet rich in advanced glycation end products (AGEs) – which includes ultra-processed and fast foods – is among the leading cause of India being the world's diabetic capital notes a first-of-its-kind clinical trial finding.
- The study found that low-AGE diets exhibited improvement in the insulin-sensitivity and reduction in the inflammatory levels compared to high-AGE diets.
- The study for the first time in India revealed that low AGE diets could be a potential strategy to reduce diabetes risk.
- **AGEs:** Harmful compounds that are formed when sugars react with fats or proteins during high-temperature cooking, like frying or roasting - are directly linked to inflammation, a key factor behind diabetes.
- Studies on the subject, earlier studies from the west demonstrated an increased risk for chronic diseases due to the consumption of highly processed foods that are high in fat, sugar, salt, and potentially toxic compounds known as AGEs.
- This current study has shown that consumption of AGE-rich foods leads to inflammation in the body, an underlying cause of diabetes.
    - This is because glycation - a non-enzymatic chemical process in which a sugar molecule binds to a protein or lipid molecule - can result in harmful reactions in the body.
- It recommends that by following low-AGE diet (fruits, vegetables, whole grains, and low-fat milk) overweight and obese individuals can reduce oxidative stress in their bodies, which refers to the imbalance of free radicals and antioxidants that result in inflammation and cell damage.
- The high-AGE foods included those prepared by roasting, deep-frying, and shallow-frying, while the low-AGE foods included those cooked by boiling and steaming, in a short span of time.
- The low-AGE diet can also lower risk of future type 2 diabetes.
- By adopting healthier diets such as green leafy non starchy vegetables, fruits, boiled foods rather than fried ones and cutting down on bakery foods and sugary foods one can have diets which are low in dietary AGE's and thus lower the risk of type 2 diabetes.
    - It means going back to the healthier diets that our forefathers ate.

4.20 Aortic Aneurysm

- An aortic aneurysm is a swelling or a bulge that occurs in the aorta when part of its wall weakens.
    - Aorta is the main blood vessel leaving the heart.

About Aortic Aneurysm:

- The aorta is a critical blood vessel through which oxygen-rich blood travels from the heart to the rest of the body.
- The aorta begins in the left ventricle, goes up towards head, curves down, goes through chest and abdominal cavities and ends at pelvis.
- An aneurysm is a swelling or a bulge that occurs in a blood vessel when part of its wall weakens.
- An abdominal aortic aneurysm, occurs in the abdominal aorta - the section of the blood vessel that goes through abdomen.
- Usually, the walls of aorta are thick enough to handle the force of the blood pressure from the heart.
    - But if this is not the case due to certain health issues perhaps, the walls of the aorta may weaken, causing a widening or ballooning.
    - This bulge can be at risk of tearing.

Possible factors for the wall of the aorta get damaged:

- High blood pressure, smoking, atherosclerosis, injury, some infections, such as untreated syphilis, some genetic conditions, such as Marfan syndrome and aging.

Treatment:

- Abdominal aortic aneurysms can be treated through endovascular repair, a minimally invasive procedure.
  - In this procedure, an incision is made through an artery, usually in the groin.
  - A thin catheter is threaded through the artery to the site of the swelling.
  - A stent is then sent along the catheter to where the aneurysm is located.
    - A stent is a tiny tube that helps keep blood vessels open, usually used in weak or narrow vessels.
  - The stent is opened inside the aorta and then stays in place, protecting that part of the blood vessel and allowing blood to flow through.

4.21 IAF World Space Award

Context:

- ISRO Chairman S. Somanath receives IAF World Space Award for Chandrayaan-3's remarkable achievement

News:

- ISRO said that its Chairman S. Somanath has received the International Astronautical Federation's (IAF) prestigious World Space Award for Chandrayaan-3's remarkable achievement.

More info:

- This recognition celebrates India's contributions to space exploration.
- According to the IAF, Chandrayaan-3 mission by ISRO exemplifies the synergy of scientific curiosity and cost-effective engineering, symbolising India's commitment to excellence and the vast potential that space exploration offers humanity.
- "Rapidly unveiling previously undiscovered facets of the Moon's composition and geology, the mission stands as a global testament to innovation.
  - Achieving a historic milestone, Chandrayaan-3 becomes the first to touch down near the lunar South Pole, showcasing both aspiration and technological prowess on an international scale," the IAF said in a statement.

4.22 Swell waves

Context:

- The Indian National Centre for Ocean Information Services (INCOIS) in Hyderabad, an autonomous body under the Union Ministry of Earth Sciences, has issued extensive advisories for swell waves for Andaman and Nicobar and Lakshadweep islands as well as parts of coastal areas in Andhra Pradesh, Goa, Gujarat, Kerala, Maharashtra, Odisha, Tamil Nadu, West Bengal, Daman and Diu, and Puducherry.

About swell waves:

- Swell waves are long-wavelength ocean waves that travel away from their places of origin.
- They are usually created by windstorms or other weather systems.
  - Sea waves otherwise are usually generated due to local winds.
- Windstorms and other powerful air current systems transfer energy from the air to water, making swell waves more powerful than locally generated waves.
- Because of their high energy, swell waves are able to travel large distances and strike shores with considerably high power.

- According to INCOIS, swell waves organise themselves into groups of similar heights and periods, and then travel long distances without much change.
- Wave period is the time one wavelength takes to pass a specific point.
    - Longer wavelengths, therefore, result in longer wave periods, and these characteristics are associated with faster and more powerful waves.
- A wave is essentially a transfer of energy from one point to another.
    - Shorter waves dissipate more energy due to frequent movement, which is why they also lose energy quickly.
    - Longer wavelengths are more powerful, and this is also why swells continue to persist days after they are formed.
- Direction is also important characteristics associated with swells.
    - Meteorologists forecast swell directions in degrees that indicate the direction where the swell is coming from.

Forecasting swells in India:

- INCOIS Hyderabad launched its swell surge forecast system in 2020 to provide warnings for coastal populations in case of anticipated swell waves.
- Swell waves are also called Kallakkadal waves in India, which is a colloquial term used by Kerala fishermen to denote sudden waves that cause flash floods.
    - The term has now been approved for scientific use by UNESCO.

Swell surges and tsunami waves:

- Kallakkadal waves inundate large areas of land when the sudden waves surge.
- These waves are also sometimes confused with tsunami waves given their stealthy nature, but both are different.
- Kallakkadal waves are caused due to weather phenomenon, while tsunamis are mostly caused due to earthquakes or tectonic activity.
- A 2016 study by INCOIS found that meteorlogical conditions in the Southern Indian Ocean, including strong and long duration surface winds, generate favourable conditions for long-period swells.
- High-waves in the Southern Indian Ocean can also propagate to the north as swells, causing Kallakkadal events along the North Indian Ocean coastal regions.

4.23 Kala-Azar

Context:

- Kala-Azar cases under control for two years: India gears to apply for elimination certificate

News:

- India could be at the threshold of eliminating Kala-Azar as a public health problem with the country having managed to keep the number of cases under one in 10,000 as per the World Health Organization (WHO) parameters for elimination certification for two consecutive years now.
    - Kala-Azar is the second deadliest parasitic disease after malaria in India.

More info:

- If India can maintain the figures for another year India will become eligible to seek the elimination certificate from WHO making it the second country in the world after Bangladesh which in October became the only country to have eliminated Kala-Azar, also known as visceral leishmaniasis, as a public health problem.

- A disease is certified as eliminated as a public health issue when a country can prove that local transmission has been interrupted for a set period, and that there is a system to prevent the disease from re-emerging.
    - WHO assesses countries' submissions to determine if they meet the criteria for elimination.
- India's Kala-Azar programme focuses on active case detection, effective vector control, and raising community awareness.
- Achieving a low case of Kala-Azar to less than one case per 10,000 population at the sub-district (block PHCs) for two straight years puts India on track to earn WHO certification for eliminating Kala-Azar as a public health problem.
- Historically, Bihar, Jharkhand, West Bengal, and parts of Uttar Pradesh have seen the highest number of Kala-Azar cases, with Bihar alone accounting for over 70% of India's cases.
    - These areas offer ideal sandfly breeding conditions due to poor sanitation and climate factors.
    - Despite this, these regions have made huge progress in recent years by increasing awareness, controlling vectors, and ensuring quick diagnosis and treatment.
- India is moving closer to Kala-Azar elimination.
    - It's also important to address the root causes, like poverty and inadequate sanitation that allow diseases like Kala-Azar to spread.
    - India must keep improving surveillance, expanding access to rapid diagnostic tools, and making treatments readily available to sustain these gains.
    - For a long-term solution, we should focus on better vector control, address social and economic conditions, and invest in research for vaccines and new treatments.
- For elimination of Kala-Azar, the Health Ministry had adopted strategies including – early diagnosis and complete case management, integrated vector management and vector surveillance, supervision, monitoring, surveillance, evaluation, and advocacy, communication and social mobilisation for behavioural impact and inter-sectoral convergence.

About Kala-Azar:

- Kala-Azar is a disease caused by a protozoa parasite that is transmitted by the bite of an infected female sandfly.
- Symptoms include - irregular fevers, weight loss, enlarged spleen and liver, and anaemia.
- Kala-Azar is fatal if left untreated in more than 95% of cases.
- India's National Health Policy (2002) initially set a target of eliminating Kala-Azar by 2010, but this was later revised to 2015, 2017, and then 2020.
- The WHO's Neglected Tropical Disease roadmap set a goal of eliminating Kala-Azar by 2020, but the target was not achieved.
    - The WHO is now accelerating work to achieve the target by 2030.

4.24 Tea

- Tea plants came to India from China and Southeastern Asia about three centuries ago, brought here by the British colonialists.
    - While experimenting to introduce tea in India, they noticed that tea plants with thicker leaves also grew in Assam, and these, when planted in India, responded very well.
    - Tea is also grown in some areas in Karnataka, Kerala, and Tamil Nadu, though not in amounts comparable to that in the Northeast.
    - Recently, Uttarakhand and U.P. have also started growing tea.
- Today, India has the largest total consumption of tea.
    - And India is the world's fourth largest exporter of tea.

Chemical components:

- Tea leaves are rich in aroma, which gives tea its fragrance.
- Tea leaves are also rich in vitamins, and protective compounds that help in improving blood pressure, and cardiovascular health, reducing diabetes risk, improving gut health, alleviating stress and anxiety, improving attention and focus.
- When compared to coffee, tea has less caffeine, which is a nervous system stimulant.
  - This is also why children are not advised to drink either of these.
  - Tea has more antioxidants than coffee beans, but some scientists claim that coffee is better against diabetes than tea.
- The aroma of tea leaves is due to the presence volatile compounds called carotenoids such as lycopene, lutein, and Jasmonate.
  - On the other hand, the taste of food is due to non-volatile compounds such as sugar, salt, iron, and calcium.
- In daily food cooked and made at home, these flavours come by using iron, salt, calcium, and sugar on one hand, and vegetables such as carrots, sweet potatoes, and fresh vegetables on the other.
- In India, the Central Food Technology and Research Institute (CSIR-CFTRI), is involved in studying antioxidants, polyphenols, and other health-promoting molecules in Indian food.

4.25 Candy leaf has Potential beyond its Natural Sweetening properties

- Candy Leaf (Stevia rebaudiana (Bertoni) Bertoni) a plant recognized for its natural non-caloric sweetening characteristics, also has therapeutic properties for diseases like endocrine, metabolic, immune, and cardiovascular diseases, because of its effect on cellular signalling systems according to a new study.
- Assam exports Stevia worldwide.
  - The North Eastern Council also highlighted stevia cultivation's potential to help the northeast Indian economy due to high demand and use.
- Scientists did pioneering research on Stevia's medicinal properties, effects on cellular signalling mechanisms to prove the Assam's Stevia's therapeutic qualities.
  - Their multimodal strategy integrated network pharmacology with in vitro and in vivo techniques, showing that the plant used phosphorylation of Protein Kinase C (PKC) to inhibit a crucial cellular signalling route.
    - PKC is connected to inflammatory, autoimmune, endocrine, and cardiovascular illnesses.
  - Stevia suppresses PKC phosphorylation, which alters downstream pathways that cause inflammation, a significant cause of endocrine metabolic and cardiovascular issues.
  - The study shows Stevia's promise in this field for the first time.
  - The study also found that active stevia molecules strongly interact with AMPK, highlighting the need for additional research.
- This work revealed Stevia's potential and identified new targets for immunological endocrine and cardiovascular problems.
  - It could have therapeutic effect on diabetes, type 1, type 2, autoimmune diabetes, pre-diabetes, chronic inflammation related auto immune disease - rheumatoid arthritis; chronic kidney diseases and cardiovascular diseases like hypertension; vasculopathy and so on.
- The study illuminates an undiscovered facet of Stevia, underlining the necessity of creative tactics and scientific data to support traditional therapeutic practices.

4.26 Connections established between Volcanic Eruption & Ionospheric Disturbances

Context:

- A new study has revealed a previously unexplored ionospheric connection between the massive eruption of the Tonga volcano, a submarine volcano in the South Pacific, in January 2022 and the formation of Equatorial Plasma Bubbles (EPBs) or an ionospheric phenomenon near the Earth's geomagnetic equator at night time over the Indian subcontinent.
    - It highlights how volcanic eruptions can trigger ionospheric disturbances and space weather that affect satellite communication and navigation systems.
- In today's world, satellite-based communication and navigation systems are critical for numerous sectors.
    - Understanding how natural disasters, like volcanic eruptions, can impact the ionosphere is essential for predicting and mitigating disruptions in these systems.
    - While previous studies have established that EPBs can disrupt satellite signals, the role of terrestrial events in shaping space weather has not been explored.
- In January, 2022, the Tonga volcano located 65 km (40 mi) north of Tongatapu, Tonga's main island in Polynesia, erupted with extraordinary force sending shock waves through the atmosphere.
    - Scientists were intrigued by the subsequent formation of EPBs in the evening hours over the Indian region.
- Scientists at Indian Institute of Geomagnetism (IIG), an autonomous institute of Department of Science and Technology explored the connection between the Tonga volcanic eruption and the EPBs.
    - They found that the eruption produced strong atmospheric gravity waves that propagated into the upper atmosphere, triggering ionospheric conditions favorable to trigger EPBs.
    - They used ionosonde observations from Tirunelveli and Prayagraj to detect spread-F traces --a phenomenon in the ionosphere where electron density become irregular causing spread in radio signals and leading to fading or disruptions in communications.
    - Concurrently, satellite data from Swarm B and C confirmed significant electron density depletions, directly linked to the formation of EPBs.
- The scientists analyzed various atmospheric and ionospheric data to understand how disturbances triggered by the eruption led to the generation of EPBs.
- Observations from NASA’s Ionospheric Connection Explorer (ICON) (wind, ion density, and temperature) and Swarm satellites provided a comprehensive view of the ionospheric changes during the event, confirming that the eruption-induced gravity waves played a crucial role in initiating these plasma instabilities.
- Plasma blobs, as well as enhanced Pre- Reversal Enhancement (PRE) --sharp increase in the ionospheric eastward electric field in the dusk sector before it turns to westward in the late-night hours, triggered by atmospheric disturbances were also detected.
- Further analysis of iso-frequency and Total Electron Content (TEC) data from Global Navigation Satellite System (GNSS) measurements across the Indian region revealed gravity wave-like oscillations/Traveling Ionospheric Disturbances (TIDs) moving across Indian longitudes in the equatorial ionosphere.
    - This indicated that the volcanic eruption had a widespread impact on the ionosphere and acted as seeding mechanisms for EPB generation.
    - This comprehensive utilization of data from multiple sources gave the researchers a multi-dimensional view of the ionospheric disturbances.
- By combining ground-based and satellite data, the study offers new insights into how natural disasters like volcanic eruptions can significantly influence space weather, affecting satellite communication and navigation systems.

- The Tonga Volcano identified as a cause for these ionospheric disturbances is a real-world example showing the need for monitoring space weather conditions in the aftermath of major geological events, adding to existing knowledge of ionospheric dynamics.
- The research by the team underscores the role of terrestrial events in shaping space weather, adding to existing knowledge of ionospheric dynamics.
- The connection established between geological events and ionospheric dynamics is important for satellite communication and relevant for sectors like defense, agriculture, aviation, disaster management, and any other areas that rely on Global Positioning Systems (GPS) and satellite-based technologies.
- The study can help improve forecasting of ionospheric disturbances leading to better early warning systems that involve satellite signal interference, benefiting fields like navigation, aviation, and military operations.
    - This will allow governments and industries to better prepare for and mitigate disruptions in essential services like GPS, air traffic control, and satellite communications.

4.27 Gaucher Disease

Context:

- Petition sent to Union Health Minister seeking sustainable treatment support for Gaucher Disease

News:

- The Lysosomal Storage Disorders Support Society of India has written to Minister J.P. Nadda stating that only 25% of eligible Gaucher patients are currently receiving treatment, and requesting his urgent intervention to ensure all patients with this rare disease can begin treatment.

About Gaucher disease:

- Gaucher disease is a rare genetic disorder, one of the lysosomal storage disorders.
    - Lysosomal Storage Disorders are categorised under Group 3 (a) in the National Policy for Rare Diseases 2021.
- Patients with Gaucher disease have low levels of an enzyme that breaks down lipids (fatty substances).
    - This results in these lipids building up in organs such as the spleen and liver, and causing a host of symptoms.
- October is observed as Gaucher month.
- In India, the treatment of Gaucher disease through Enzyme Replacement Therapy (ERT) began 25 years ago.
    - Thanks to early diagnosis and timely treatment, a substantial number of Gaucher patients in India are now leading normal lives.

4.28 Space rocks

Context:

- New research shows most space rocks crashing into Earth come from a single source

Introduction:

- Each year, roughly 17,000 fireballs from space enter Earth's atmosphere.
- Scientists know that while some of these meteorites come from the Moon and Mars, the majority come from asteroids.

Meteorite:

- Only when a fireball reaches Earth's surface is it called a meteorite.

- Meteorites are commonly designated as three types: stony meteorites, iron meteorites, and stony-iron meteorites.
- Stony meteorites come in two types.
    - The most common are the chondrites, which have round objects inside that appear to have formed as melt droplets.
        - These comprise 85% of all meteorites found on Earth.
        - Most are known as “ordinary chondrites”.
        - They are then divided into three broad classes – H, L and LL – based on the iron content of the meteorites and the distribution of iron and magnesium in the major minerals olivine and pyroxene.
            - These silicate minerals are the mineral building blocks of our Solar System and are common on Earth, being present in basalt.
        - “Carbonaceous chondrites” are a distinct group.
            - They contain high amounts of water in clay minerals, and organic materials such as amino acids.
    - Chondrites have never been melted and are direct samples of the dust that originally formed the solar system.
    - The less common of the two types of stony meteorites are the so-called “achondrites”.
        - These do not have the distinctive round particles of chondrites, because they experienced melting on planetary bodies.

Asteroid belt:

- Asteroids are the primary sources of meteorites.
- Most asteroids reside in a dense belt between Mars and Jupiter.
- The asteroid belt itself consists of millions of asteroids swept around and marshalled by the gravitational force of Jupiter.
- The interactions with Jupiter can perturb asteroid orbits and cause collisions.
    - This results in debris, which can aggregate into rubble pile asteroids.
        - These then take on lives of their own.
- It is asteroids of this type which the recent Hayabusa and Osiris-REx missions visited and returned samples from.
    - These missions established the connection between distinct asteroid types and the meteorites that fall to Earth.
- S-class asteroids (akin to stony meteorites) are found on the inner regions of the belt, while C-class carbonaceous asteroids (akin to carbonaceous chondrites) are more commonly found in the outer regions of the belt.
    - But, as the studies show, we can relate a specific meteorite type to its specific source asteroid in the main belt.

One family of asteroids:

- The two new studies place the sources of ordinary chondrite types into specific asteroid families – and most likely specific asteroids.
    - This work requires painstaking back-tracking of meteoroid trajectories, observations of individual asteroids, and detailed modelling of the orbital evolution of parent bodies.
- One of the study reports that ordinary chondrites originate from collisions between asteroids larger than 30 kilometres in diameter that occurred less than 30 million years ago.
- The Koronis and Massalia asteroid families provide appropriate body sizes and are in a position that leads to material falling to Earth, based on detailed computer modelling.
    - Of these families, asteroids Koronis and Karin are likely the dominant sources of H chondrites.
    - Massalia (L) and Flora (LL) families are by far the main sources of L- and LL-like meteorites.

- The above study further documents the origin of L chondrite meteorites from Massalia.
  - It compiled spectroscopic data – that is, characteristic light intensities which can be fingerprints of different molecules – of asteroids in the belt between Mars and Jupiter.
    - This showed that the composition of L chondrite meteorites on Earth is very similar to that of the Massalia family of asteroids.
  - The scientists then used computer modelling to show an asteroid collision that occurred roughly 470 million years ago formed the Massalia family.
    - Serendipitously, this collision also resulted in abundant fossil meteorites in Ordovician limestones in Sweden.
- In determining the source asteroid body, these reports provide the foundations for missions to visit the asteroids responsible for the most common outerspace visitors to Earth.
  - In understanding these source asteroids, we can view the events that shaped our planetary system.

4.29 Private 5G network

Introduction:

- Even to this day, communication from a disaster site or a mine field remains a problem despite advancements in technology as public mobile networks are weak in remote areas.
  - To address this problem, a startup has come up with 'Private 5G Box', a tailor-made portable solution for enterprises seeking to deploy secure and private 5G networks.

About Private 5G network:

- The customisable Private 5G Box works similar to a public mobile network and can be accessed by inserting private sim cards into mobile sets.
- When set up, Private 5G Box provides network coverage up to 500 meters.
- It also allows users to make cross network calls.
- When a disaster strikes and network is completely down, this box can be taken to the disaster site to set up network and manage the disaster.
- Both voice and video calls can be made with this network.
- The box will have similar applications in mines where workers often have no facilities to make calls due to network issues.
- The start-up has developed base stations (network orchestrators) to facilitate this private communication.
- The compact, portable box integrates a 5G core and radio access network (RAN), which can provide instant 5G connectivity by using the base stations.
- It can support 5G usage in various forms, including video streaming, IoT applications, public safety, and smart industries.
- Micro base stations (5G box) have small access points, like WiFi.
  - They can be installed on any campus, industry, or mine, and used in healthcare and logistics sector too.
- Any organisation which purchases the Private 5G Box will have complete control over the data that passes through the network.
- They can decide where they would like to store the data.
- The defense sector always needs a trusted network.
  - If the base station is from another country, then we cannot be sure about its security.
  - Since this network has been developed indigenously, it can also be used in the defence sector.

4.30 ISRO-DBT ink deal to conduct biotechnology experiments in space station

News:

- The Indian Space Research Organisation (ISRO) and the Department of Biotechnology (DBT) have inked an agreement to design and conduct experiments, which will then be integrated into the forthcoming Bharatiya Antariksh Station (BAS), India's proposed indigenous space station.

More info:

- Some of the experiments being mooted include:
  - How weightlessness can influence muscle loss on those in space
  - What kind of algae may be suitable as nutrients or to preserve food for longer
  - How some algae may be processed to make jet fuel
  - Impact of radiation on the health of those aboard space stations
- Some of the biology missions could be included in the uncrewed test missions of Gaganyaan.
- In some of the test flights (uncrewed) prior to the main Gaganyaan mission, ISRO said, it may consider including some of these experiments.
  - Based on the learning, it could consider some experiments in Gaganyaan.
  - However, the primary plan is for the BAS.
- The ISRO-DBT collaboration stems from another initiative this year called the BIOE3 (Biotechnology for Economy, Environment and Employment) policy by the Department of Biotechnology (DBT) that aims to stimulate 'bio-manufacturing' in India.
- The bio-economy would be worth $300 billion by 2030.
  - The space bio-manufacturing sector is part of this.
- This agreement will spur innovation and developments in human health research, novel pharmaceuticals, biotherapeutics, regenerative medicine, bio-based technologies for waste management as well as support multiple start-ups.

About International Space Station (ISS) and other space stations:

- ISS is a collaborative venture involving the United States, Canada, Russia, Japan, has been operational, in its complete form, since 1998.
  - But with changing geo-politics and costs, the ISS is expected to be decommissioned by 2030.
  - Some countries are moving to build their own space stations.
  - China launched the base module of its station, Tiangong, in 2021 and has completed the tri-modular station as of November 2022.
    - The station hosts regular crewed missions.

Importance of Bharatiya Antariksh Station (BAS):

- The vision for space in the Amrit kaal envisages including other things, creation of an operational Bharatiya Antariksh Station by 2035.
- A national space-based facility such as the Bharatiya Antariksh Station will boost microgravity based scientific research & technology development activities.
  - This will lead to technological spin-offs and encourage innovations in key areas of research and development.
- Enhanced industrial participation and economic activity in human space programme will result in increased employment generation, especially in niche high technology areas in space and allied sectors.

4.31 CERT-In releases advisory on online scams

News:

- Cyber-security agency Computer Emergency Response Team of India (CERT-In) shared a list of ways in which online scams are being perpetrated by fraudsters in the country, including "digital arrest".
- The public advisory talks about more than a dozen ways fraudsters use to dupe people and steal their money and private data.
    - It came on a day when Prime Minister Narendra Modi too cautioned people against such frauds in his monthly 'Mann ki Baat' radio broadcast.

More info:

- The CERT-In advisory said "digital arrest" is an online scam as "government agencies do not use platforms like WhatsApp or Skype for official communication". "Verify their identity by directly contacting the relevant agency," it recommended.
- In a case of "digital arrest", victims receive a phone call, e-mail, or message claiming that they are under investigation for illegal activities, such as identity theft or money laundering, the advisory said.
    - The scammer threatens the victim with arrest or legal consequences unless he or she takes immediate action.
    - They often create a sense of panic to prevent rational thinking, the advisory said.
    - Under the guise of "clearing their name", "assisting with the investigation" ,or "refundable security deposit/escrow account", individuals are coerced into transferring large sums of money to specified bank accounts or UPI IDs, it added.
- The advisory also spoke about other online cons like "phishing scams", in which scammers create e-mails or messages that appear legitimate, often using logos and branding from trusted organisations.
- "Emotional manipulation scams" are perpetrated on online dating communication apps where scammers build emotional connections and then solicit money for emergencies like medical treatment and request that funds be sent via crypto currency.
- "Job scams" are meant to con fresh graduates by posting about fake work listings on legitimate hiring portals or social media.
- As part of "tech-support scams", cyber criminals take advantage of a user's lack of technical knowledge and stealthily gain access to his computer by warning about a virus and then steal sensitive personal data.
- "Investment scams" cash on a person's desire to earn quick money as they promise "unrealistic" returns via Ponzi or pyramid schemes and in "cash-on-delivery scams", criminals set up fake online stores accepting CoD orders. When the product is delivered, it is either counterfeit or completely different from what was advertised.
- To con people using "fake charity appeal scams", scammers create convincing websites or social media profiles asking for donations for fake causes like disaster relief or health initiatives and use such images or stories that provoke sympathy or urgency.
- "Mistaken money-transfer scams" are those in which fraudsters contact a victim via e-mail or social media, claiming that money has been mistakenly sent to his account as they use fake transaction receipts to ask the person to return the funds immediately to avoid legal issues.
- "Phone scams" are those where victims receive calls or messages under the fake name of a telecom regulatory body, saying there is an "issue" in their service as they urgently seek one-time passwords (OTPs) and banking information for identity verification.
- "Parcel scams" are like "digital arrest" where victims are informed over a call or message that they are under probe as their 'drugs-laden parcel' has been seized and they will be arrested or may have to face legal consequences if they do not pay a fine.

- As part of the "loan or cards scam", fraudsters offer loans with low interest rates, coupled with quick approval, and "disappear" after the victim transfers an upfront fee for securing the loan.

4.32 Leptospirosis

Context:

- Scientists at the National Institute of Animal Biotechnology (NIAB) are working on the next generation vaccine against 'Leptospirosis'.

About Leptospirosis:

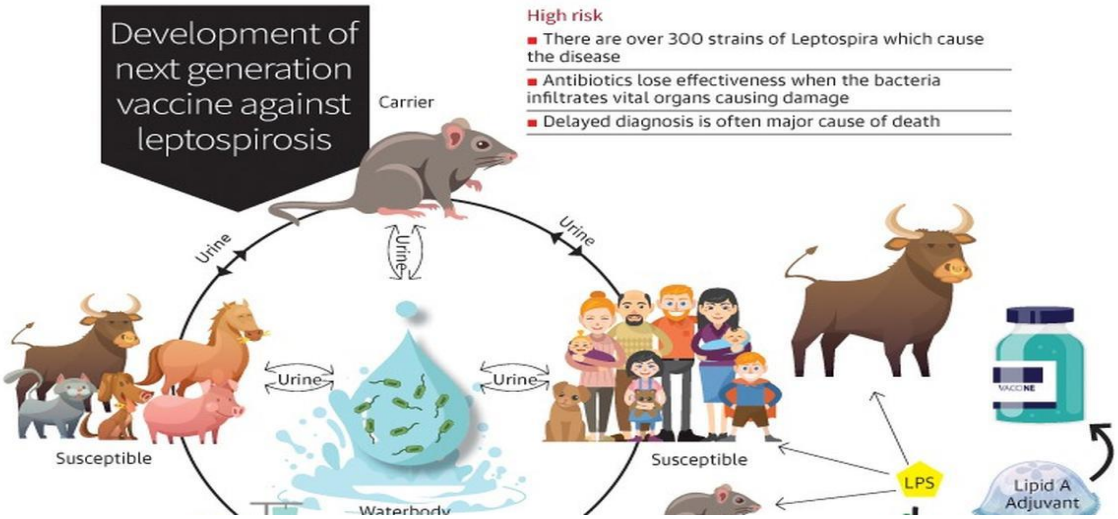
- It is a serious disease affecting both animals and people - caused by bacteria called 'Leptospira', which has over 300 different types of strains.
- This zoonotic (affecting humans and animals) disease remains a public health concern as it has become more of a threat having escalated prevalence due to the impacts of climate change and global warming.

Efficacy of antibiotics:

- One million cases of human leptospirosis are reported every year resulting in an estimated 60,000 deaths.
  - Despite the availability of a good number of antibiotics, their effectiveness becomes less when the bacteria infiltrates vital organs causing damage, often due to delayed diagnosis.
- While vaccination is a cost-effective and secure preventive measure to combat this disease, the current killed vaccine only provides short-term immunity specific to certain strains of the zoonotic disease and fails to prevent bacterial shedding through urine.
- At present, there's a vaccine for animals only but it doesn't protect against all strains of these bacteria and there is no vaccine for humans.
  - The existing vaccines, despite inducing robust cross-protection, do not provide sterilizing immunity or a long-lasting protective response.

A next-gen vaccine:

- The NIAB focused on developing the next generation vaccine against this important zoonotic infection against multiple strains, have already characterized a Lipopolysaccharide (LPS) which is one the most important protective antigen and defines the strains specificity.
- The NIAB has also demonstrated that the initial immune response against LPS may decide whether the host will develop mild infection or succumb to severe infection associated with multi-organ dysfunction.
  - This work has further highlighted that a component of LPS, called Lipid A, is less toxic, can boost the immune response and make vaccines more effective, a significant step in developing a new type of vaccine.
- Various antigens, such as leptospira immunoglobulin-like proteins called 'LigA and LigB', have been identified as potential subunit vaccine candidates.
  - These antigens require potent adjuvants for effectiveness.
  - Experiments conducted on mice and hamsters showed these proteins combined with alum and Leptospira Lipid A as adjuvant exhibited significantly higher levels of cellular immune responses and provided sterilizing immunity against Leptospirosis.
- Overall, this research study, supported by Department of Science & Technology (DST) sheds light on the adjuvant properties of Leptospira Lipid A and offers promising avenues for developing LPS-based vaccines against this devastating zoonotic disease.
  - The potent adjuvant activates the innate immune system enhancing a sustained, antigen-specific protective immune response.



4.33 Graphene supercapacitors

Graphene supercapacitors fuel next-gen wearables

Context:

- Graphene supercapacitors are expected to experience rapid growth, driven by increasing investments in renewable energy and electric mobility apart from the flexible electronics market

More info:

- Flexible and wearable electronics are being touted as the next-generation technology, showing a wide variety of uses including diagnostics.
    - But, researchers say these devices will reach their full potential only when the energy systems powering them are just as adaptable.
- The future of wearable and portable devices depends on energy storage that can bend, stretch, and conform without limits.
    - In this context, the potential of graphene-based supercapacitors is attracting attention from major tech hubs worldwide.
    - Key applications for such devices are for portable, miniaturised energy storage for wearables, medical implants, environmental sensors, consumer applications, and low-power electronics.
- Graphene supercapacitors could soon become a cornerstone in the future of sustainable energy storage as demand for greener and faster energy solutions grows.
- One of the research team has developed an energy storage solution using flexible, laser-induced nanographene supercapacitors, poised to revolutionise low-power applications.
    - Using laser engraving techniques, the research team has fabricated supercapacitors on flexible substrates or underlying surfaces like ‘polyamide’ (LIG or laser-induced graphene) and paper substrate (‘LIrGO’ or laser-induced graphene dioxide).
        - These materials offer significant advantages: LIG exhibits a highly porous structure, ideal for ion transport, while paper-based LIrGO is recyclable and environmentally friendly.
- The supercapacitors have demonstrated remarkable electrochemical performance, with those made from polyamide showing superior capacitance and energy density compared to those made from paper.
    - They also exhibited behaviour characteristic of Electrical Double-Layer Capacitors.
- Graphene supercapacitors are expected to experience rapid growth, driven by increasing investments in renewable energy and electric mobility apart from the flexible electronics market.
- Material properties of both were examined using electron microscopy and spectroscopy.

4.34 Union Health Ministry comes up with new draft guidelines on passive euthanasia

Context:

- The guidelines state that doctors should take considered decisions on withdrawal of life support, and on not starting life supporting measures in terminally ill patients that are unlikely to benefit the patient

News:

- Doctors should take a "considered decision" on withdrawal of life support in terminally ill patients on the basis of certain conditions including a documented informed refusal by the patient or their kin, according to draft guidelines released by the Union Health Ministry.

More on the news:

- The guidelines laid out four conditions for passive euthanasia to take a "considered decision in a patient's best interests, to stop or discontinue ongoing life support in a terminally ill disease that is no longer likely to benefit the patient or is likely to harm in terms of causing suffering and loss of dignity."
- **The conditions are:**
  - The individual has been declared to have had a brainstem death
  - There is medical prognostication and a considered opinion that the patient's disease condition is advanced and not likely to benefit from aggressive therapeutic interventions,
  - A patient/surrogate documented informed refusal, following prognostic awareness, to continue life support
  - Compliance with procedures prescribed by the Supreme Court.
- The 'Draft Guidelines for Withdrawal of Life Support in Terminally Ill Patients,' also state that doctors should take a considered decision to not start a life supporting measure in a terminally ill patient that is unlikely to benefit the patient and is likely to lead to suffering and loss of dignity.
  - In such a case, three conditions - on whether the individual has been declared to have a brainstem death, if there is a medical prognostication and considered opinion that the patient's disease condition is advanced and not likely to benefit from aggressive therapeutic interventions, patient/surrogate documented informed refusal, following prognostic awareness - has to be taken into account.
- Terminal illness in the draft guidelines has been defined as an irreversible or incurable condition from which death is inevitable in the foreseeable future.
  - Severe traumatic brain injury which shows no recovery after 72 hours or more is also included.
- The draft calls for taking considered decisions on not performing cardiopulmonary resuscitation in the event of anticipated cardiac arrests if there is no realistic possibility of survival or meaningful recovery.
- According to the document, the legal principles outlined by the Supreme Court state an adult patient capable of taking healthcare decisions may refuse life sustaining treatments (LST) even if it results in death.
- Further, according to principals, LST may be withheld or withdrawn lawfully under certain conditions from people who no longer retain decision-making capacity, based on the fundamental Right to Autonomy, Privacy and Dignity.
- Advance Medical Directives, or AMDs that meets specified requirements are legally valid documents.
  - An AMD is a written declaration made by a person with decision-making capacity documenting how they would like to be medically treated or not treated, should they lose capacity.
- For a patient without capacity, Foregoing of Life Support proposals should be made by a consensus among a group of at least three physicians who form the Primary Medical Board (PMB).
  - The PMB must explain the illness, the medical treatment available, alternative forms of treatment, and the consequences of remaining treated and untreated to fully inform the surrogate.

- A Secondary Medical Board of three physicians with one appointee by the Chief Medical Officer of the district must validate the decision by the PMB.
- "Active Euthanasia is the intentional act of killing a terminally ill patient on voluntary request, by the direct intervention of a doctor for the purpose of the good of the patient. It is illegal in India," the draft document said.

4.35 How AI is transforming learning

Context:

- Open AI's ChatGPT AI chatbot revolutionizes education, sparking debate on its integration and impact on students and educators.

Introduction:

- Open AI dropped its revolutionary generative artificial intelligence (AI) chatbot, ChatGPT, at the end of November 2022.
  - Within months one in five teenagers living in the US started using ChatGPT to help with their school and homework.
  - Indian students have not been lagging too far behind.
- ChatGPT's ability to answer queries and produce 5-page essays in no time has become a nightmare for many educators who have sought to block the chatbot and banned its use for schoolwork.
- While the fears around using ChatGPT in education still linger in the air, some institutions have opened their doors to the new technology and integrated it into their teaching and learning frameworks.
  - Indian institutions and educators including the University Grants Commission are seeking to get a grip on AI's inevitable use in education; a few such as IIM Sambalpur are seriously considering integrating AI into their learning methods.
- AI helps the students to quickly access and analyse vast amounts of data, allowing them to communicate with one another.
- Generative AI is not just a tool for getting answers, but a powerful interface for computing.
- Students are going to need these tools to be competitive in the future workforce, and by denying them access, we risk putting them at a disadvantage.

Using ChatGPT as a new skill:

- The problem isn't in the tool but in the way it is being used.
  - The fear that students might use it as a shortcut to avoid deeper exploration is valid.
  - With moderation and guidance from teachers, students will be able to leverage the computing power of generative AI as a tool for exploration not a replacement for their critical thinking.
- Generative AI demands a change in how teaching is approached in a classroom.
  - Educators need to play a more facilitative role, helping students how to apply, interpret, verify and gain perspective from the information generated by AI.
  - Teachers can no longer be postmasters taking the delivery content from the book and writing on the board.
- AI in education can be seen as a coin with two distinct but interconnected sides.
  - One is knowledge enrichment which includes generating content such as audio-visual media, quizzes or simulations – resources that can augment the existing lecture sessions and make them more interactive.
  - The other is personalized learning which takes into account the student's learning ability and prior knowledge.
- Teaching ethical AI is useful to both educators and learners.

- There is a need for national regulations, especially with the rise of AI-assisted self-learning courses.

India and ChatGPT-assisted teaching:

- The Indian Institute of Management (IIM), Sambalpur has announced the introduction of AI-enabled teaching for their MBA courses.
- The problem in the traditional class was that we were not able to ensure that every student came prepared.
  - This can be taken care of by AI-enabled learning management platform.
- The platform which IIM, Sambalpur using registers both students and professors who can then access case studies and articles, participate in quizzes based on their course material and participate in discussions with their peers from home.
  - The AI then evaluates the preparedness of individuals, and the overall performance of the class professor present and provides feedback to the professor, thus helping them prepare a lecture that can build on the existing knowledge of the classroom.

Mainstreaming AI-assisted teaching:

- AI-assisted teaching ventures, both in India and internationally, are being explored in the higher education sector.
- Improvements in learning outcomes in the case of young children largely depend on strong human facilitation from teachers and mentors, rather than on the technology itself.
  - The question is, how well set up are our teachers to facilitate? What is their level of tech savviness? The requirement doesn't end there.
    - They actually need to be domain experts.
    - Within the public education system and even within the private education system, our teachers are not really at that level of expertise.

From the policy front, three major concerns:

- **Data privacy:** Where is the student/teacher data collected for AI-assisted platforms stored and who controls it, when it is largely not localized within Indian servers?
- **Misuse:** What if there is a misuse of the information that's being generated on AI? This opens up the scope for cheating by students and educators relying heavily on generative AI and not interacting with students enough.
- **Equity:** Can it be used in areas without a powerful internet connection? Does the student using the paid version of ChatGPT have access to better outputs versus those using the free versions? And how it might impact their academic performance and evaluation.

Conclusion:

- The problem with ChatGPT is there are many mistakes in the answers they give to questions. Unless students can recognize their mistakes, they will blindly use them for assignments and projects...The database for ChatGPT is limited and only inputs fed in (by humans) are what they have to rely on. Students can get confused.

4.36 Liquid Biopsy

Introduction:

- Liquid biopsy is rapidly emerging as a revolutionary approach in modern diagnostics, offering an innovative and non-invasive alternative to traditional tissue biopsies.
- By analyzing bodily fluids such as blood, urine, or saliva, liquid biopsy provides a new window into disease detection, monitoring, and personalized treatment planning.

- Its most well-known application is in cancer diagnostics, but the potential of liquid biopsy extends across a wide array of medical fields, including prenatal screening, infectious disease detection, and monitoring of chronic conditions.

Liquid Biopsy:

- Liquid biopsy refers to the use of body fluids - predominantly blood - to detect disease-related biomarkers such as circulating tumour DNA (ctDNA), circulating tumor cells (CTCs), or RNA.
    - These biomarkers are often shed by tumors, infected cells, or other diseased tissues into the bloodstream or other bodily fluids.
- Unlike traditional biopsies, which require an invasive procedure to collect tissue samples, liquid biopsy is minimally invasive, providing an easier and more accessible alternative for disease detection and monitoring.

Key Biomarkers in Liquid Biopsy:

Liquid biopsy predominantly focuses on two key biomarkers:

- **Circulating Tumour DNA (ctDNA):** This is fragmented DNA that is released into the bloodstream from tumour cells.
    - ctDNA often carries genetic mutations, epigenetic alterations, and other molecular signatures that reflect the genetic makeup of the tumour, allowing for a non-invasive way to assess the presence and nature of cancer.
- **Circulating Tumor Cells (CTCs):** These are intact cancer cells that break away from a primary tumour and enter the bloodstream, potentially leading to metastasis (spread of cancer).
    - By detecting and analyzing CTCs, clinicians can gain insights into the progression of the disease and its potential for spreading to other organs.
- Other biomarkers such as extracellular vesicles (e.g., exosomes) and microRNAs are also emerging as promising candidates in liquid biopsy research, each offering a different set of insights into disease processes.

Advantages of Liquid Biopsy:

- **Non-Invasive and Safe:** One of the most significant advantages of liquid biopsy is its non-invasive nature.
    - Unlike traditional biopsies, which require surgery or the insertion of needles into the body to obtain tissue samples, liquid biopsy simply requires a blood draw or collection of another bodily fluid.
    - This makes it a safer and less painful option for patients, particularly for those who require repeated testing.
- **Early Detection:** Liquid biopsy has the potential to detect diseases, especially cancers, at their earliest stages.
    - By identifying genetic mutations, epigenetic alterations, or other molecular markers in the blood before the disease progresses, liquid biopsy offers the possibility for earlier intervention, which is critical for improving patient outcomes.
- **Real-Time Monitoring:** Liquid biopsy provides the advantage of continuous monitoring.
    - As it analyzes biomarkers circulating in the bloodstream, it allows clinicians to assess how a disease is evolving over time and how a patient is responding to treatment.
        - This dynamic form of monitoring is particularly useful in cancer therapy, where the response to treatment can vary rapidly.
- **Personalized Medicine:** Liquid biopsy enables personalized treatment strategies.
    - By identifying specific mutations or genetic profiles associated with a disease, clinicians can choose therapies that are more likely to be effective for individual patients.
        - This approach not only enhances the efficacy of treatments but also minimizes the side effects that can result from less targeted therapies.

- **Minimal Risk and Inconvenience:** Because it uses body fluids like blood or urine, liquid biopsy is much less risky than traditional biopsy methods, which may involve surgical procedures or significant discomfort.
    - This makes it an excellent tool for monitoring patients with chronic diseases or those who require frequent follow-up tests.

Applications of Liquid Biopsy:

Cancer Diagnosis and Monitoring:

- Cancer is the area where liquid biopsy has shown the most promise. The ability to detect ctDNA or CTCs in the blood allows for:
    - **Early Cancer Detection:** Liquid biopsy can potentially identify cancers before they are visible on imaging scans or detectable through other means.
        - This early detection opens the door for more effective treatments and improved survival rates.
    - **Monitoring Treatment Response:** Liquid biopsy provides real-time insights into how well a patient is responding to a particular cancer treatment.
        - By analyzing changes in ctDNA or CTC levels, doctors can quickly adapt treatment strategies based on how the tumor is evolving or whether it's becoming resistant to therapy.
    - **Detecting Minimal Residual Disease (MRD):** After a patient has undergone surgery or chemotherapy and is in remission, liquid biopsy can help identify small numbers of cancer cells that may remain in the body, allowing for earlier intervention if the cancer returns.

Prenatal Testing:

- Liquid biopsy is increasingly being used for non-invasive prenatal testing (NIPT).
    - By analyzing cell-free fetal DNA (cfDNA) in the mother's blood, doctors can screen for genetic conditions such as Down syndrome, trisomy 18, and trisomy 13, as well as other chromosomal abnormalities.
        - This method avoids the risks associated with invasive procedures like amniocentesis, making it a safer option for pregnant women.

Infectious Diseases and Monitoring:

- Infectious diseases such as viral infections (e.g., HIV, COVID-19) and bacterial infections can also be monitored using liquid biopsy.
    - By identifying pathogen-specific DNA or RNA in the bloodstream, liquid biopsy can provide real-time insights into the presence and progression of infections, as well as help monitor the effectiveness of treatment.

Autoimmune Diseases:

- Emerging research suggests that liquid biopsy could be used to monitor autoimmune diseases by analyzing biomarkers that reflect immune system dysfunction.
    - This approach could help in diagnosing autoimmune diseases, monitoring disease activity, and tracking the response to immunosuppressive therapies.

Conclusion:

- Liquid biopsy represents a significant leap forward in medical diagnostics, offering a non-invasive, real-time, and highly personalized approach to disease detection and management.
    - While challenges remain, its potential to revolutionize early detection, monitoring, and treatment - particularly in oncology - holds great promise.
    - As technology improves and the applications of liquid biopsy expand, it is set to become a cornerstone of modern, patient-centered healthcare.

4.37 INDIA IN SPACE

Context:

- Building on the moon landing, ISRO is now planning a Venus mission and further moon exploration, a new launcher is being developed as the private sector also begins to take a hand in the space effort.
    - A green propulsion system and low earth orbit satellite developed in the private sector will be seen in action soon.

News:

- The Indian government recently signed off on numerous new projects, including work on a new rocket and new moon and Venus mission.
- India is also preparing to launch the NISAR and Proba-3 satellites, and has received some good news from Astrosat.
- The private sector is also working on satellite projects of its own.

Recent approvals:

- The union cabinet approved ISRO's development of the Next Generation Launch Vehicle (NGLV).
    - ISRO is expected to develop the vehicle in collaboration with industry.
- The Cabinet has also approved a scientific mission to Venus and the next Chandrayaan mission to the Moon.
    - The Venus Orbiter Mission is expected to be launched in a window available in March 2028.
    - With the mission, scientists hope to study the planet's acerbic surface and atmosphere to understand how different planets of the Solar System evolved.

Chandrayaan-4 and LUPEX:

- Chandrayaan-4 will be a sample-return mission.
    - Its components will be launched on two separate LVM-3 launch vehicles; they will dock in earth orbit before going to the moon, and land on the surface near the location of Chandrayaan 3.
    - There the mission will scoop up some samples of moon soil and rock and send them back to the earth onboard a bespoke canister.
    - The mission is expected to be launched by 2027.
- The Space Commission also approved a joint moon mission with Japan called the Lunar Polar Exploration Mission (LUPEX).
    - For LUPEX, ISRO is developing a different moon lander than the one it used for Chandrayaan-3, and which it hopes can be used in crewed lunar missions in future.
- The Commission also signed off on the development of a third launch pad at Sriharikota, which ISRO will need to test and launch the NGLV (Next Generation Launch Vehicle).

SBS and Axiom-4:

- The Cabinet Committee on Security approved the third phase of the Space Based Surveillance (SBS) missions.
    - For this, ISRO will build 21 satellites and private companies will build another 31.
    - This is a significant improvement over the four satellites ISRO built for SBS-1 in 2001 and six for SBS-2 in 2013.
- India's astronaut-designate Sudhanshu Shukla had his space suit measured and also underwent pressurisation tests at the SpaceX headquarters.
    - The event marks the official start of his 10-day training programme before he will fly to the International Space Station aboard the Axiom-4 mission next year.

Satellites en route to India:

- The NASA-ISRO Synthetic Aperture Radar (NISAR) is an earth-observation satellite whose radar antenna reflector recently landed in India from the Jet Propulsion Lab in California.
- ISRO is expected to launch NISAR in early 2025 on board a Geosynchronous Satellite Launch Vehicle.
- The other mission, Proba-3 from Europe, will study the Sun's corona.
    - It will have two satellites flying in formation: one will gaze at the Sun while the other will block the first satellite's view of the Sun's central area, like creating an eclipse, leaving only light from the corona to hit the cameras.
    - The European Space Agency has said Proba 3 is expected to launch on board a PSLV-XL vehicle on November 29.
    - India previously launched Proba-1 on the PSLV-C3 mission, in 2001.

From the private sector:

- Manastu Space signed an agreement with Dhruva Space to test its green propulsion technology to power the latter's Launching Expeditions for Aspiring Payloads (LEAP-3) mission.
    - LEAP-3 will carry payloads from different companies in 2025.
- Manastu is developing a green propulsion system using a hydrogen-peroxide-based fuel.
    - It first tested LEAP on the PSLV-C58 mission on January 1 this year.
- Bellatrix Aerospace unveiled 'Project 200', a prototype for a satellite that can fly at an altitude of 200 km. a.k.a. the ultra-low earth orbit.
- Ananth Technologies became the first private Indian company to assemble, integrate, and test two Space Docking Experiment (SpaDEx) satellites for ISRO.

Space science:

- Scientists have found that the crater where Chandrayaan-3 landed is older than the South Pole Aitken Basin, itself 4.2-4.3 billion years old.
    - This was based on data from the Optical High-Resolution Camera onboard the Chandrayaan-2 orbiter and navigational cameras on board Pragyaan, the Chandrayaan-3 rover.
- Astrosat, India's first multi-wavelength space observatory, was built with a mission life of five years but has now operated for nine.
    - Based on fuel readings, it is expected to last for another two years.
    - The data collected by the observatory has been the basis of more than 400 published papers.

4.38 Malaria elimination

Egypt's success and a roadmap for India's WHO certification

Context:

- India has made remarkable strides in reducing malaria, with reported cases dropping over the years; however, there is a long journey ahead, with climate change raising the potential for malaria transmission in areas that have already achieved elimination

Introduction:

- Malaria is as old as the Egyptian civilization, and the fight against it spans nearly 100 years in Egypt.
- Egypt recently achieved a monumental feat by receiving WHO certification for eliminating the disease on October 20, 2024.
- Egypt is the third country in the WHO Eastern Mediterranean region and the 44th overall to be awarded the malaria elimination certification.

- The WHO certification confirms not only the interruption of local transmission, but also Egypt's preparedness to prevent the reintroduction of the disease.
- Meanwhile, India is on its journey toward malaria elimination, aiming for zero indigenous cases by 2027 and full certification by 2030.

Process for WHO certification:

- The Sustainable Development Goal (SDG) Target 3.3 aims to end malaria and other epidemics by 2030, a global commitment India has aligned with through its policies.
- India's aims to eliminate malaria by 2030, emphasising universal access to healthcare and disease prevention.
- The WHO certification for malaria elimination is an extensive process designed to ensure that malaria transmission has been interrupted within a country for a sustained period, and that systems are in place to prevent reintroduction.
- A country begins the certification process after reporting zero indigenous cases for at least three consecutive years, supported by a robust national surveillance system that can detect and respond to any imported cases.
- The process starts with a formal request to WHO through the country's Ministry of Health.
    - Following this, the country prepares a National Elimination Report that outlines detailed evidence of its success in eliminating malaria.
    - The report includes surveillance data, vector control activities, healthcare facility capabilities, and measures for preventing re-establishment.
    - WHO's Malaria Elimination Certification Panel (MECP) reviews the report and conducts field visits to verify its findings.
    - If the panel is satisfied, it submits a recommendation to the WHO Director-General, who decides whether to grant the country malaria-free certification.

Egypt's journey to malaria-free certification:

- By 2001, Egypt had malaria under control, and aimed for elimination through targeted measures.
- In 2014, a small outbreak in Aswan was successfully managed through early detection, treatment, vector control, and public education.
- Over the last decade, Egypt expanded access to health services, with 95% of the population living near primary care facilities and offered free malaria treatment.
- In 2016, Egypt formed a High Committee for Integrated Vector Management to address vector-borne diseases.
- The country also strengthened cross-border partnerships, especially with Sudan, to prevent the re-establishment of malaria and provided essential services to migrants, including those affected by the 2023 conflict.

India's strategy for malaria elimination:

- India's approach to eliminating malaria is rooted in several coordinated strategies aimed at controlling and ultimately eradicating the disease.
- A key focus is on strengthening surveillance systems, transforming them into an essential part of malaria control by improving data reporting and response mechanisms.
- Another crucial aspect is ensuring that every suspected case of malaria is tested, treated, and tracked to prevent further transmission.
- Vector control remains central to these efforts, with the widespread use of insecticide-treated bed nets and indoor residual spraying.

- The government has placed special emphasis on high-transmission areas such as tribal regions, forested zones, and border areas, where malaria remains a challenge.
- Additionally, India encourages research and innovation to adapt its strategies and prevent the re-establishment of malaria, while also fostering cross-border cooperation to tackle imported cases.
- India has made remarkable strides in reducing malaria, with reported cases dropping over the years.
- As of 2022, India has made significant progress in malaria elimination across its districts.
    - A total of 128 districts are in Category 0 (prevention of re-establishment) with zero indigenous malaria cases; 603 districts are in Category 1 (elimination phase) with an Annual Parasite Incidence (API) of less than 1 per 1,000 population.
    - Under Category 2 (pre-elimination phase), where the API is between 1 and 2, there are 9 districts.
    - Finally, 18 districts remain in Category 3 (intensified control phase), with an API exceeding 2 per 1,000 population.
    - This reflects a substantial reduction in malaria transmission compared to previous years.

India's preparation for the WHO certification:

- For larger countries like India, which have varying levels of malaria transmission across regions, subnational verification is crucial.
    - In such cases, parts of the country that have successfully interrupted malaria transmission can undergo subnational verification.
    - This allows countries to assess regional targets and reinforce efforts in high-transmission areas.
- Subnational verification follows the same rigorous criteria as national certification, with independent national and international experts reviewing reports and conducting field visits.
    - This process helps India drive progress toward its national elimination goals by encouraging healthy competition between States and districts.
    - Districts that achieve zero cases for three consecutive years can apply for subnational verification, which includes field visits, document reviews, and validation by independent national and international experts.
    - After districts or states pass the verification process, they must continue implementing robust surveillance and vector control measures to prevent reintroduction.
- According to the National Strategic Plan for Malaria Elimination (NSPME) 2023-2027, the process for WHO certification requires proof that local malaria transmission has been interrupted nationwide for at least three consecutive years.
    - In addition, India must have a fully functional surveillance and response system capable of preventing re-establishment of malaria.
- The certification process involves close collaboration with WHO's Malaria Elimination Certification Panel (MECP) and comprehensive documentation, including a national elimination report, epidemiological data, and detailed plans for ongoing surveillance.

Journey ahead:

- Despite significant reductions in malaria-related mortality, India still has a long journey ahead in reducing the number of cases.
    - The country's diverse landscape presents unique challenges, requiring tailored strategies to combat malaria in urban areas, forest regions, tribal communities, and among migrant populations.
    - Additionally, during and after the elimination process, India must remain vigilant against the potential impact of climate change, which could facilitate the resurgence of Plasmodium parasites and create favourable conditions for mosquito vectors.

- As climate change alters environmental patterns, it threatens malaria elimination programmes, underscoring the need for robust, long-term surveillance and adaptive vector control strategies to ensure continued progress in India's fight against malaria.
- However, India has made substantial progress in reducing malaria mortality, with the number of deaths falling to 83 in 2022 (NSPME).
- Egypt, along with other countries that have eliminated malaria, must also remain vigilant as climate change could increase the risk of malaria re-emergence.
- Changes in temperature and rainfall patterns may create favourable conditions for mosquito breeding, raising the potential for malaria transmission even in areas that have achieved elimination.
- As a global phenomenon, climate change can heighten the risk of imported cases and local outbreaks.
- Therefore, Egypt and other malaria-free nations need to continuously strengthen surveillance systems and vector control efforts to prevent the re-establishment of malaria, ensuring long-term disease elimination despite these environmental challenges.

5. Environment and Ecology

Prelims

5.1 Coal Power

Context:

- Britain to become first G7 country to end coal power as last plant closes
  - This is in line with the U.K. long term plan as part of wider measures to reach its climate targets

News:

- Britain will become the first G7 country to end coal-fired power production with the closure of its last plant, Uniper's Ratcliffe-on-Soar in England's Midlands.
  - It will end over 140 years of coal power in Britain.

More on the news:

- In 2015 Britain announced plans to close coal plants within the next decade as part of wider measures to reach its climate targets.
  - At that time almost 30% of the country's electricity came from coal but this had fallen to just over 1% last year.
- The U.K. has proven that it is possible to phase out coal power at unprecedented speed.
- The drop in coal power has helped cut Britain's greenhouse gas emissions, which have more than halved since 1990.
- Britain, which has a target to reach net zero emissions by 2050, also plans to decarbonise the electricity sector by 2030, a move which will require a rapid ramp-up in renewable power such as wind and solar.
- Emissions from energy make up around three quarters of total greenhouse gas emissions and scientists have said that the use of fossil fuels must be curbed to meet goals set under the Paris climate agreement.
- In April the G7 major industrialised countries agreed to scrap coal power in the first half of the next decade, but also gave some leeway to economies who are heavily coal-reliant, drawing criticism from green groups.
- There is a lot of work to do to ensure that both the 2035 target is met and brought forward to 2030, particularly in Japan, the U.S., and Germany.
- Coal power still makes up more than 25% of Germany's electricity and more than 30% of Japan's power.

5.2 Brazil's coast eroding faster than ever as Atlantic advances

Context:

- In 2023, salt water almost reached a city 150 km from the mouth of the Amazon, killing freshwater fish and affecting local fishers

News:

- Global warming, combined with the silting of the Paraiba River, has contributed to the erosion of Atafona's coast and caused the destruction of 500 houses, including the collapse of a four-story building by the beach.
  - This is one of countless beachside communities losing their battles to the ocean up and down Brazil's 8,500 km of Atlantic coastline.

More on the news:

- The sea level has risen 13 cm in the region around Atafona in the last 30 years and could rise another 16 cm by 2050, according to the United Nations report "Surging Seas in a Warming World" released last month.
- Coastal areas such as Atafona could see the ocean advance inland as much as 150 meters in the next 28 years.
- The combination of climate change and global warming ... with a river that no longer carries sand to the beaches of Atafona, has caused a catastrophe for its residents and there is no hope that this situation will be reversed.
- Although dramatic, Atafona's plight is not unique in Brazil.
- The beach in Ponta Negra, one of the most popular seaside resorts on the northeast shoulder of Brazil, is also shrinking.
    - In the last two decades, it has lost 15 meters of white sand to the sea.
    - The local government is bringing sand from elsewhere in an expensive effort to recover the beach.
- At the mouth of the mighty Amazon River, a fragile ecosystem is threatened with a loss of biodiversity as the river has lost strength in the region's most severe drought on record, letting salt water from the ocean advance upstream.
    - Salt water comes further up the river and this will change the whole biodiversity of that area.
    - Last year, salt water reached almost as far upriver as Macapa, a city 150 km from the mouth of the Amazon, killing freshwater fish and impacting local fishing communities.

- The Intergovernmental Panel on Climate Change (IPCC), the U.N. body for assessing the science related to climate change, reported that sea levels are rising faster than ever, with the rate more than doubling in the past 10 years to 0.48 cm a year, compared to 0.21 cm annually in 1993-2002.
- The loss of land in coastal towns and beaches is inevitable with rising seas, questioning why city planning had not adapted.
- It is shocking to see houses being destroyed in Atafona. But you were not supposed to build houses there. You should have woods, a mangrove swamp, a sandbank, ecosystems that would naturally be prepared to hold the sea.

5.3 With Earth locked down in 2020, Moon saw cooler days and nights: Study

Context:

- Lockdowns have been shown to have starkly impacted human activities such as industrial pollution, transportation and fossil fuel burning

News:

- Effects of COVID-19 lockdowns on Earth may have reached the Moon, as lunar temperatures were found to have abnormally dipped during April-May 2020, according to a study.
    - Maximum temperatures on the Earth's natural satellite fell in this period, while nights were found to be cooler by nearly 8-10 degrees Celsius.
    - The Moon could therefore possibly serve as a "stable platform" to study climate change on Earth.

More on the news:

- Brought in to arrest the spread of the COVID-19 disease, lockdowns were first introduced in China and Italy in March 2020.
    - The measures were quickly adopted by other countries and by the following month, about half the world's population were reported to have been under some form of lockdown, including quarantine and stay-at-home orders.
- Lockdowns have been shown to have starkly impacted human activities such as industrial pollution, transportation and fossil fuel burning.
- The reduced human activity translated into lower greenhouse gas emissions and pollutant levels, and therefore, less heat being released from the Earth's surface during night-time, the researchers said.
    - Part of this heat is known to reach the Earth-facing side of the Moon at its night-time and warm the lunar surface.
- Therefore, to look for lockdown-induced effects, the researchers analysed night-time surface temperatures recorded at six sites on the Earth-facing side of the Moon from 2017-2023.
- During April-May 2020, the heat reaching the Moon was found to have significantly reduced, and was, therefore, attributed to the COVID-19 lockdowns.
    - "A decrease in the maximum temperature is observed at all sites during the global lockdown period of April 2020 and May 2020. We observed a night-time temperature change of nearly 8-10 Kelvin," the authors wrote.
- Observations of the Moon, such as night-time temperatures, could possibly support ongoing efforts to study climate change, along with informing Earth's radiation budget, they said.

5.4 Study documents extinction of 610 bird species

- The dodo, the famous flightless bird that inhabited the Indian Ocean island of Mauritius, is a case study in extinction caused by humans.
    - Hunting, habitat destruction and the introduction of non-native species doomed it in under 80 years.
- New research has documented the extinction of 610 bird species over the past 130,000 years, coinciding with the global spread of our species Homo sapiens, an avian crisis that has only accelerated in recent years and decades.
    - For instance, the Kauaʻi ʻōʻō, a Hawaiian songbird, was declared extinct just last year.
- The researchers also revealed the ecological consequences, as the disappearance of avian species erases functions they serve in innumerable ecosystems.
    - Birds undertake a number of really important ecosystem functions, many of which we depend on, such as the dispersal of seeds, the consumption of insects, the recycling of dead material - for example, vultures - and pollination.
    - If we lose species, then we lose these functions.
    - A good example of this is on the islands of Mauritius and Hawaii, where all or almost all the native frugivores - birds that eat fruit - have gone extinct.
    - The dodo and Kauaʻi ʻōʻō, believed to have had fruit as part of their diets, were among those.

- Frugivory is an important function, as in eating the fruits and then moving around, birds will disperse the seeds of the plants the fruits belong to.
- This can precipitate "secondary knock-on extinctions," with Mauritius now having many threatened tree species.

- Most of the documented extinctions occurred on islands.
- Habitat loss can have huge effects given the isolation and reduced area involved, while the introduction of animals such as rats, cats and mice can have substantial impacts given the evolution of flightlessness among many island-endemic birds that left them unable to escape new predators.
- Human hunting was a big extinction driver in the past and remains problematic in certain regions.
  - Capturing birds for the songbird trade is a big issue, particularly in Southeast Asia.
- Certain regions and species had more specific factors involved.
  - For example, avian malaria, introduced by people, has triggered large numbers of extinctions in Hawaii - particularly among the endemic Hawaiian honeycreepers - where the birds possessed no natural immunity.
- The big unknown going forward is the role of anthropogenic climate change as a driver.
  - The large flightless elephant birds endemic to Madagascar vanished after people arrived, including Aepyornis maximus, possibly the largest bird that ever existed, about 10 feet (3 meters) tall.
  - The flightless moa birds endemic to New Zealand, including the South Island giant moa that rivaled the elephant birds in size, similarly disappeared after humans colonized the islands.
  - North America's migratory passenger pigeon numbered in the billions, but was hunted into oblivion.
- The 610 species combined represented 3 billion years of unique evolutionary history, the researchers said, with each lost species like chopping off a branch from the tree of life.
  - The number 610 is "likely a large underestimate" of avian extinctions, because of a paucity of data from some locales and the fact some lost species may not have left behind skeletal remains to be found.
  - Regardless of the true number, "the vast majority of extinctions over the last 50,000 years are attributable to human actions."
- About 11,000 bird species now exist, occupying a dizzying array of ecological niches.
- The researchers projected future extinctions of more than 1,000 species over the next two centuries.
- So even if you don't care about the moral and ethical concerns regarding the loss of species, these extinctions are important for other reasons, such as the loss of species that helped the environment to function effectively.

5.5 Hanuman Plover

Context:

- Presence of Hanuman Plover confirmed in Kerala

News:

- Wetland scientists and ornithologists have finally confirmed the presence in Kerala of the recently identified shorebird species which takes its name from the monkey god Hanuman of the epic Ramayana.

About Hanuman Plover:

- It is a shorebird in Eurasia and North Africa is one of the commonest winter visitors along the seashores of India.
- Hanuman Plover has been found in Sri Lanka and South India but not reported from Kerala so far.
- It is a regional endemic bird that was recently found to be breeding in the Gulf of Mannar.

- The common English name Hanuman Plover, was given to the bird by scientists because of its distribution in Sri Lanka and South India.
- Hanuman Plover has a smaller wing, beak, and tail in comparison with its relative, Kentish Plover, Further, the feet of Hanuman Plover is greyish black and that of Kentish is dark.
    - Besides, the head of the male Hanuman plover has a distinct black stripe on its forehead missing it in the Kentish Plover.
- While we don't know if the Hanuman Plover is threatened at the moment, it lives in an area which has one of the highest human population densities on the planet.
    - Being a regional endemic resident bird, the Hanuman Plover should be included in the priority list of birds that deserve protection.

5.6 India's energy demand to triple by 2050

- With a Gross Domestic Product (GDP) growth of 7% and power demand rising by over 8% this year, India is now the third-largest power market globally, and its energy demand is set to triple by 2050, making it a critical investment destination.
- India's role in the global energy transition is becoming increasingly prominent as its economy has overtaken the UK, surpassed France, and is on track to overtake major markets like Germany and Japan within the next five to ten years.
- Stating that renewables are expanding rapidly, with over 200 GW of solar and wind capacity expected by 2030, India's emergence as the second-largest solar module manufacturer, exporting to key global markets, highlights its potential.
    - However, 70% of India's power still comes from coal, with 50 GW of coal and 10 GW of nuclear expected by 2030.
- In a net-zero scenario, electrification would need to exceed 50%, a crucial focus for India as it balances its development of fossil fuel and electric economies in parallel to meet its growing energy demands.
- Country must address challenges in energy storage, grid infrastructure, and renewable deployment, while leveraging its domestic market and global partnerships to drive a low-carbon future.
- The year 2023 marked an unprecedented climate milestone, for the first time, global surface temperatures exceeded 2°C above pre-industrial levels for several days.
    - What's more concerning is that greenhouse gas emissions have not yet peaked, indicating that global temperatures will continue to rise for decades.
    - In response to these challenges, there is a growing global focus on energy transition.
    - India is at the forefront of this transition, with estimates from Bloomberg India suggesting that by 2030, the country will have more solar and wind projects than coal power plants.
- Emphasising that intermittency of renewable energy presents a significant challenge, making battery energy storage systems (BESS) essential for ensuring grid stability and enhancing renewable integration.
- Global energy demand is projected to triple, increasing from 1.8 terawatt hours to over 5 terawatt hours by 2050, primarily due to advancements in storage technology.
- Batteries play a crucial role not only in the power sector but also in transportation.
    - India's electric mobility sector is growing rapidly, with major automakers establishing battery assembly plants and leveraging the Production Linked Incentive (PLI) scheme to create 50 gigawatt hours of battery manufacturing capacity.
- Demand for lithium-ion batteries is anticipated to rise from 10 gigawatt hours today to 200 gigawatt hours by 2035, fueled by the electric vehicle market and grid-scale storage needs.
- India's strides in domestic lithium-ion battery production were particularly noteworthy, with production capacity expected to reach 150 gigawatt hours by 2030, covering 13% of total cell demand.

5.7 Forests nearly the size of Ireland lost in 2023, says study

Context:

- Deforestation continued last year at a rate far beyond pledges to end the practice by 2030, according to a major study.

More info:

- Forests nearly the size of Ireland were lost in 2023, according to two dozen research organisations, NGOs and advocacy groups, with 15.7 million acres of trees felled and burned.
  - This "significantly exceeded" levels that would have kept the world on track to eliminate deforestation by the end of the decade, a commitment made in 2021 by more than 140 leaders.
- Forests are home to 80% of the world's terrestrial plant and animal species and crucial for regulating water cycles and sequestering CO2, the main greenhouse gas responsible for global warming.
- Globally, deforestation has gotten worse, not better, since the beginning of the decade.
- We are only six years away from a critical global deadline to end deforestation, and forests continue to be chopped down, degraded, and set ablaze at alarming rates.
  - In 2023, 9.1 million acres of tropical primary forest - particularly carbon rich and ecologically biodiverse environments - disappeared, a figure that should have fallen significantly to meet the 2030 objective.
- In high-risk regions, researchers pointed to backsliding in Bolivia and in Indonesia.
  - The report said there was an "alarming rise" in deforestation in Bolivia, which jumped 351% between 2015 and 2023.
  - In Indonesia, deforestation slumped between 2020-2022 but started rising sharply last year.

5.8 Global coral bleaching event expands, now the largest on record

- The mass bleaching of coral reefs around the world since February 2023 is now the most extensive on record, the National Oceanic and Atmospheric Administration (NOAA) has said.
  - A staggering 77% of the world's coral reef areas – from the Atlantic to the Pacific to the Indian oceans – have so far been subjected to bleaching-level heat stress, according to satellite data, as climate change fuels record and near-record ocean temperatures across the world.
  - "This event is still increasing in spatial extent and we've broken the previous record by more than 11% in about half the amount of time," said NOAA Coral Reef Watch coordinator.
  - This could potentially have serious ramifications for the ultimate response of these reefs to these bleaching events.
- The NOAA coral reef authority declared the global bleaching event in April 2024, making it the fourth of its kind since 1998.
  - The previous record from the 2014 to 2017 mass bleaching affected just below 66 percent of the world's reef area.
- Triggered by heat stress in warm oceans, coral bleaching occurs when corals expel the colourful algae living in their tissues.
  - Without these helpful algae, the corals become pale and are vulnerable to starvation and disease.
  - A bleached coral is not dead, but ocean temperatures need to cool off for any hope of recovery.
- At least 14% of the world's remaining corals were estimated to have died in the previous two global bleaching events.
- Though this mass bleaching is already the most widespread, affecting reefs in 74 countries and territories, NOAA has so far stopped short of calling, it the "worst" on record.

    - In coming months and years scientists will conduct underwater assessments of dead corals to help tally up the severity of the damage.
- It seems likely that it is going to be record-breaking in terms of impacts.
- We've never had a coral bleaching event this big before.
- In just the last six weeks, bleaching has been confirmed in the waters of Palau, Guam and Israel.
    - Heat stress also remains high in the Caribbean and South China Sea.
- In response to the bleaching record, scientists have called a special emergency session on coral reefs to be held at the United Nations Convention on Biological Diversity summit (COP16) in Colombia at the end of the month.
    - World leaders will discuss last-ditch strategies to avert the functional extinction of corals, including further protections and financing.
    - The meeting will bring together the global funding community to discuss what they are going to do about it?
- Scientists had previously projected that coral reefs would cross a tipping point at 1.5 degrees Celsius (2.7 F) of global warming, whereby up to 90% of reefs would be lost.
    - The latest record bleaching adds to growing evidence that reefs have already passed a point of no return at just 1.3 C (2.3 F) of warming.
    - This would have dire implications for ocean health, subsistence fisheries and tourism.
    - Every year, reefs provide about $2.7 trillion in goods and services, according to a 2020 estimate by the Global Coral Reef Monitoring Network.
- The ongoing bleaching has been made worse by El Nino, a natural climate pattern that can temporarily warm some oceans, which ended in May.
- Some forecasters are projecting the world could move into a La Nina climate pattern in coming months, which typically brings cooler ocean temperatures that coral scientists hope might give corals a chance to recover.
    - Yet there is concern that even with a La Nina that might not happen, with 2024 on track to be the world's warmest year on record.
- If current ocean temperatures are the new normal, the world may be entering a period "where we're more or less in a state of chronic global bleaching."

5.9 Mining dust

Context:

- A Darjeeling-based company is transporting basalt dust from Jharkhand and using it as an organic fertiliser to enrich soil and accelerate carbon sequestration.

Rock weathering:

- All rocks naturally break down into minerals over thousands of years.
    - This happens mainly due to being exposed to rain and heat, and the consequence of this process is that atmospheric carbon reacts with these minerals (calcium and magnesium largely) and becomes bicarbonates.
    - Eventually through aquifers, or underground streams and rivers, they make their way into the oceans where the carbon is locked in for aeons.
- The oceans, thus, are the major carbon sinks and capture about 30% of the CO2 from human activities.
    - Left to nature, this process takes aeons.
    - However, with the levels of carbon dioxide building up in the air and a consensus by the Intergovernmental Panel on Climate Change that some amount of carbon dioxide already present in the air needs to be removed by 2050, for keeping temperatures from exceeding 2 degree Celsius by

the end of the century, governments as well as businesses are experimenting and investing in schemes to accelerate natural carbon removal processes.
    - This is where 'enhanced' rock weathering comes in.

Basaltic rock and carbon sequestration:

- Basaltic rock, a kind of volcanic rock, is rich in minerals such as calcium and magnesium.
- Many parts of Maharashtra and Gujarat, where the volcanic Deccan Traps are located, are rich in such basaltic rock as parts of Jharkhand and West Bengal where the Rajmahal Traps are situated.
    - The latter are regularly mined for construction.
- Once such basaltic rock is crushed into a fine powder, its effective surface area is greatly increased.
    - This accelerates the formation of bicarbonate anywhere from ten-fold to a hundred-fold and can be flushed into the ocean – depending on the soil, temperature and rivers – within a month.
- Being an organic fertiliser, the basaltic dust enriches the soil as well as accelerates carbon sequestration.
- Factors such as rock, the kind of agricultural fields, climate significantly influenced weathering.

5.10 New genus of jumping spiders 'Tenkana' discovered in south India

News:

- A team of arachnologists has discovered a new genus of jumping spiders, 'Tenkana', found across southern India, encompassing two previously known species.
    - It also introduced a new species, Tenkana jayamangali, from Karnataka.

More info:

- The name Tenkana comes from the Kannada word for south, reflecting that all the known species are from southern India and northern Sri Lanka.
    - This new group belongs to the Plexippina subtribe of jumping spiders and is different from related groups such as Hyllus and Telamonia.
- Unlike related species that live in forests, Tenkana spiders prefer drier areas and ground habitats.
    - They have been found in Tamil Nadu, Puducherry, Karnataka, Telangana and Andhra Pradesh.
- Two species that were previously in Colopsus - Tenkana manu (found in south India and Sri Lanka) and Tenkana arkavathi (from Karnataka) - have now been moved to the new genus.
- The team also described Tenkana jayamangali for the first time, named after the Jayamangali river in Karnataka, where it was first seen.

5.11 Bhitarkanika National Park

Context:

- Cyclone 'Dana' brings unique challenge as it's likely to make landfall near Odisha's Bhitarkanika National Park

News:

- With cyclone 'DANA' predicted to cross the Odisha coast near Bhitarkanika National Park, the forest division has deployed teams, ready to manage the threat of crocodiles and snakes that may stray into human settlements in the event of storm surges and heavy rainfall.

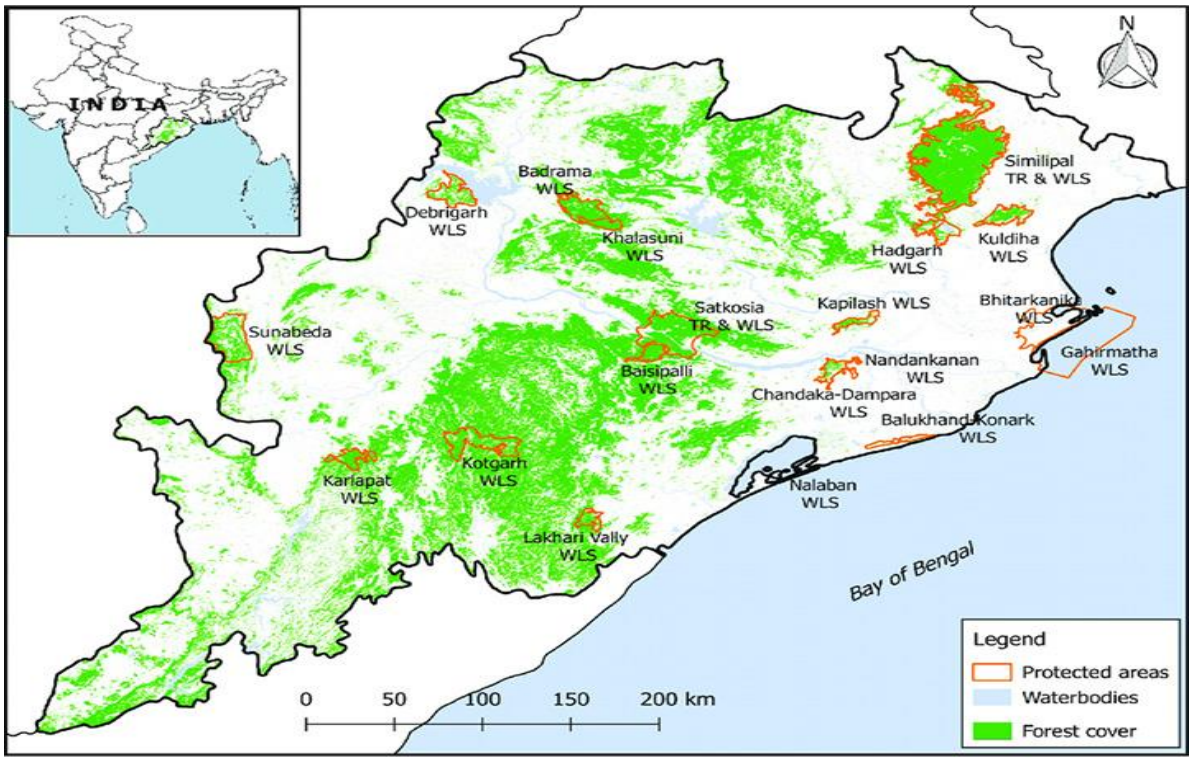
More info:

- Bhitarakanika is one of India's finest biodiversity hotspots.
- In last decade, most human-crocodile conflicts have been reported in areas close to Bhitarkanika National Park, India's largest habitation of estuarine crocodiles.

- The present headcount of crocodiles in Bhitarkanika as per latest census is 1811 – about 70% of India's saltwater crocodile population in the wild.
- Bhitarkanika is dotted with innumerable creeks and mudflats – a distinct feature of the estuarial region.
- The Brahmani and Baitarani Rivers meet Bay of Bengal near Bhitarkanika and tides from the sea creates a unique world for flora and fauna.
- Odisha currently has 220 sq. km. (22,000 hectares) of mangrove forests.
    - Most of it (192 sq. km.) is found in Kendrapara, around the Bhitarakanika National Park.
- In fact, Kalibhanjdia island, spread over 8.5 sq. km. in Bhitarkanika, attracts the attention of scientists world over.
    - It is a great assemblage of genetic diversity in mangrove forests, with 70% of all mangrove species found within the small area.

About Bhitarkanika National Park:

- It is a national park in Odisha in eastern India.
- It obtained the status of a Ramsar site in 2002.
- The area is also been designated as the second Ramsar site of the State after the Chilika Lake.
- It is surrounded by Bhitarkanika Wildlife Sanctuary.
- Gahirmatha Beach and Marine Sanctuary are to the east, separating the swamp region and mangroves from the Bay of Bengal.
- The national park and wildlife sanctuary is inundated by the rivers Brahmani, Baitarani, Dhamra, and Pathsala.
- It hosts many mangrove species, and is the second largest mangrove ecosystem in India.
- The park is home to the saltwater crocodile, Indian python, black ibis, wild boar, rhesus monkey, chital, darter, cobra, monitor lizard.
- Olive ridley turtles nest on Gahirmatha Marine Sanctuary and other nearby beaches.
- Bhitarkanika has one of the largest populations of endangered saltwater crocodile in India.
- Birds such as Asian open bill, cormorants, darters, black ibis, and egrets are frequently seen in the park.
- It used to be the hunting grounds of the erstwhile King of Kanika.



5.12 Delhi's air quality

Context:

- Delhi's air quality 'very poor' due to calm winds

News:

- After a two-day gap, Delhi's air quality turned 'very poor' as calm winds prevented dispersion of pollutants.

More info:

- Under the Graded Response Action Plan (GRAP), a set of emergency measures to control air pollution in the Delhi-NCR region during winter, air quality is categorised into four stages: Stage I - Poor (AQI 201-300); Stage II - Very Poor (AQI 301-400); Stage III - Severe (AQI 401-450); and Stage IV - Severe Plus (AQI above 450).
- According to the India Meteorological Department (IMD), wind speed in the city was recorded at 0 kmph.
- Favourable wind speed had improved Delhi's air quality from 'very poor' to 'poor' over the last two days.
- The prominent pollutants in Delhi were PM10 and PM2.5.
    - PM2.5 is fine particulate matter capable of penetrating deep into the respiratory system and triggering health problems.
    - PM10 is particulate matter that is 10 micrometres or less in diameter. These tiny solid or liquid particles suspended in the air can be inhaled deep into the lungs, potentially leading to issues such as asthma, bronchitis and other respiratory diseases.

5.13 Sea foam

- Sea foam needs two ingredients: something to increase the surface tension of the water, like a bubble bath, and something to froth it up, like water running into a tub.
- In the ocean or sea, the bubble bath is usually dissolved organic material, and strong surface winds or the breaking of waves on the beach stir up the water with air to make bubbles.
    - The organic material comes from a number of sources, usually a concentration of biomass such as the phytoplankton bloom that causes a red tide or a fish kill.
    - A bloom is an increase in the numbers of some species or complex of species that then die or are eaten, releasing organic material.
    - The material can also come from sewer spills and other terrestrial runoff.
- In addition, there are a number of mechanisms that concentrate the foam, which is commonly blown up on the beach, for example.
- Sea foam is seldom seen in the open ocean as most areas do not support high concentrations of plankton, though there are spots where the right conditions for an organic bloom occur.

5.14 Horseshoe crabs

Context:

- Horseshoe crabs have been around for millions of years, but their habitats are increasingly being degraded.
    - Scientists begun tagging them to track their movements and study them better on the beaches they come to nest on.

About Horseshoe crab:

- Found only on select coasts around the world, it has survived 445 million years, as fossils show, without undergoing any morphological change.

- It belongs to a class called Merostomata, living fossils, or those organisms that haven't changed in millennia.
- Today, its existence is threatened by anthropogenic changes in the ocean.
- Although the beaches of Balasore (Odisha) were once teeming with horseshoe crabs, their numbers have drastically declined since then.
- The International Union for Conservation of Nature (IUCN) also slots horseshoe crabs in the 'data deficient' category, highlighting the lack of comprehensive information about the species.
    - However, the Wildlife Institute of India (WII) conducted the first detailed survey of horseshoe crabs along the east coast of India in 2005.
        - This survey resulted in the listing of the crab in the Schedule IV of the Wildlife (Protection) Act, 1972.
- The crab's blue blood is used to produce a rapid diagnostic reagent, limulus amebocyte lysate, essential for testing the toxicity of injectable drugs.
- One litre of horseshoe crab blood can fetch a few lakh rupees due to its biomedical applications in America.
- **There are four species of horseshoe crab:**
    - The mangrove (Carcinoscorpius rotundicauda), which inhabits the coastal waters of South and Southeast Asia.
    - The Atlantic or American (Limulus polyphemus), found along the Atlantic coast of the United States and the southeastern Gulf of Mexico.
    - The coastal (Tachypleus gigas), also native to South and Southeast Asia.
    - The tri-spine (Tachypleus tridentatus), found in Southeast and East Asia.
- **India is fortunate to have two species:** Carcinoscorpius rotundicauda and Tachypleus gigas, both found along the Odisha coast.
- Scientists say tides play a crucial role in the arrival of horseshoe crabs on Odisha's beaches.
- During high tide, the crabs come ashore, when the waves rise to 2.6 metres.
- Their numbers peak when the waves reach 3.1 metres.
- Full moon and new moon are the ideal occasions, with the waves rising high.
- Their choice of beach also depends on the sediment composition.
- Horseshoe crabs choose sandy beaches where the grain size ranges between 63 and 120 microns.
    - This specific sand grain size range allows for optimal water retention, which occurs about six to seven inches below the surface.
    - If the grains are larger, water retention is poor, making the site unsuitable for spawning.
- Mature female crabs come to these beaches to lay eggs and release 400-500 eggs per clutch.
    - Males are typically attached to the females during this process.
    - Water is essential for the activation of the eggs, once they are produced; without it, the eggs remain dormant.
    - Nesting takes place along the margin of the high tide line, ensuring the eggs remain inundated as the tide rises and falls.
    - Over a period of 40 to 42 days, the eggs incubate and the embryos develop.
    - Temperature also plays a role in this process, and the Odisha coastal weather helps them breed through the year.
- In Balaramgadi, the intertidal zone extends up to 7 km into the continental shelf, followed by a deeper zone.
    - It is within this shelf area that hatching takes place.
- The horseshoe crab uses 10 legs to walk and two to feed.
- The species is endangered by the gradual loss of its habitat.

- These crabs feed on decomposed insects and algae.
- The spawning and nursery grounds along most parts of Odisha's coast have been damaged.
    - The crabs found the State's sandy beaches and estuarine mudflats near mangrove forests favourable.
    - However, the mangrove forests are thinning, and sandy beaches are undergoing transformation due to human activities.
    - Shoreline fortifications like stone patching and the use of geotubes to protect the shore from erosion have worsened the situation.
    - Being an intertidal species, horseshoe crabs do not naturally come ashore.
    - Without their preferred habitats, they lay eggs irregularly and younger crabs become easy prey for natural predators like crows and dogs.
- India is yet to establish a robust conservation plan for the crab.
    - This is an extremely important species. We need to develop a conservation strategy.
- Unregulated regular fishing activities, rough stone patching (stones placed to protect the beach from erosion), and discarding of fishing nets along the coast are major reasons behind horseshoe crab mortality.
    - Crabs wash ashore in the tide and subsequently get trapped in the cracks of stone patching on the beach.
- All safe spawning grounds of horseshoe crabs along the Balasore coast have been documented, particularly where there is no fishing.
    - The Defence Research and Development Organisation has protected a fairly large stretch of the Balasore coast as a no-activity zone.
- A conservation reserve can be explored here to protect the crab's spawning ground.
- The areas inhabited by horseshoe crabs have already been declared Coastal Regulatory Zone-1 (A) under the Integrated Coastal Zone Management Project that aims to protect coastal ecosystems and coastal communities.
    - In those areas, activities are not permissible.
- The fishermen say there are already turtle protection zones to facilitate natural breeding along the coast.
    - Frequent cyclones and low pressure areas reduce their time at sea.
    - One more prohibition for horseshoe crabs will adversely impact their livelihood.

Mains

5.15 Jal Jeevan Mission

Context:

- Tap water reaches 78.58% of rural households under JJM

Introduction:

- The Jal Jeevan Mission (JJM) was launched on August 15, 2019, with the ambitious goal of providing tap water supply to every rural household by 2024.
- At the time of its inception, only 3.23 crore (17%) of rural households had tap water connections.
- The mission aims to bridge this gap by providing nearly 16 crore additional households with tap water by 2024, ensuring the functionality of existing water supply systems, and directly benefiting over 19 crore rural families.
- This initiative is intended to reduce the rural-urban divide and enhance public health.

Key Achievements:

- As of October 6, 2024, Jal Jeevan Mission has successfully provided tap water connections to 11.95 crore additional rural households, bringing the total coverage to more than 15.19 crore households, which accounts for 78.58% of all rural households in India.

Objectives:

- Providing Functional Household Tap Connection (FHTC) to every rural household.
- Prioritizing FHTC provision in quality-affected areas, drought-prone regions, desert areas, and Sansad Adarsh Gram Yojana (SAGY) villages.
- Ensuring functional tap connections in schools, Anganwadi centers, gram panchayat buildings, health and wellness centers, and community buildings.
- Ensuring the sustainability of water supply systems, including water sources, infrastructure, and funding for regular operations and maintenance.
- Empowering and developing human resources in the water sector, covering construction, plumbing, electrical work, water quality management, water treatment, catchment protection, and more.
- Raising awareness about the significance of safe drinking water and involving stakeholders to make water everyone's responsibility.

Impact of JJM:

- The World Health Organization (WHO) estimates that achieving JJM's goals will save over 5.5 crore hours daily, primarily for women, otherwise spent collecting water.
- Nobel laureate Prof. Michael Kremer's research suggests that safe water coverage could reduce mortality among children under five by nearly 30%, potentially saving 136,000 lives annually.

Quality Assurance and Monitoring:

- The mission incorporates advanced technologies such as sensor-based IoT solutions for water supply measurement, AADHAR linking for targeted delivery, and geo-tagging of assets. Transparency and effective monitoring are ensured through the online 'JJM dashboard' and mobile app, providing real-time progress updates.

Challenges:

- The mission faces several challenges, such as a lack of dependable water sources in certain areas, groundwater contamination, uneven geographical terrain, scattered rural habitations, and delays in obtaining statutory clearances etc.

Conclusion:

- Jal Jeevan Mission has made remarkable strides toward achieving its ambitious goal of providing every rural household in India with a functional tap water connection.
- With over 15.19 crore households, numerous schools, and Anganwadi centres now benefitting from reliable access to clean water, the mission is significantly improving the quality of life in rural areas.
- This initiative not only addresses water scarcity but also empowers communities, particularly women, by alleviating the burden of water collection and enhancing public health outcomes.
- The mission’s emphasis on community participation, sustainability, and technological innovation underscores its long-term vision.
- As the mission progresses, it continues to transform lives and foster a healthier, more equitable future for rural India.

5.16 India’s climate action

Introduction:

- There is an urgent need for decisive action to combat climate change, a challenge that is no longer a distant threat but an immediate reality affecting lives, economies, and the future of the planet.
    - India's responsibility as one of the world's fastest-growing economies, country's commitment to balancing sustainable development with global climate change mitigation efforts is significant.
    - The importance of science-based targets, which, in alignment with the goals of the Paris Agreement, aim to limit global warming to well below 2 degrees Celsius, with aspirations to restrict it to 1.5 degrees.

India's key climate targets include:

1. A reduction of 33-35% in greenhouse gas emissions intensity by 2030, using 2005 levels as a baseline.
2. A commitment to increasing non-fossil fuel energy capacity to 500 GW.
3. An ambitious goal to achieve net-zero emissions by 2070.

- Collaboration in achieving the above targets, urging stronger partnerships between government, industry, academia, and civil society is needed.
- Innovation will be central to India’s strategy, whether through advancements in renewable energy, sustainable agriculture, or green technologies.
- The robust policy framework established by the Government of India to guide climate action, with the National Action Plan on Climate Change (NAPCC) playing a pivotal role.

The NAPCC, launched in 2008, comprises eight key missions that address various aspects of climate adaptation and mitigation:

- **National Solar Mission:** Aims to promote solar energy technologies and achieve 100 GW of solar power capacity by 2022.
- **National Wind Energy Mission:** Focuses on expanding wind energy capacity and encouraging innovation in wind technology.
- **National Mission for Energy Efficiency:** Seeks to enhance energy efficiency through programs such as the Perform, Achieve and Trade (PAT) scheme.
- **National Mission on Sustainable Habitat:** Aims to promote energy efficiency in buildings, urban planning, and waste management.
- **National Water Mission:** Focuses on water conservation and equitable distribution, addressing the impacts of climate change on water resources.
- **National Mission for Sustaining the Himalayan Ecosystem:** Works to protect the fragile Himalayan ecosystem through research and monitoring.
- **National Mission on Agricultural Adaptation:** Aims to build resilience in agriculture by promoting sustainable practices and crop diversification.
- **National Mission on Green India:** Seeks to increase forest cover, restore degraded ecosystems, and enhance ecosystem services.

India has developed various sector-specific strategies to strengthen its climate goals. These goals include:

- **Energy Sector:** Investments in renewable energy sources like solar, wind, and biomass, alongside the implementation of smart grids and energy storage.
- **Transportation:** Promotion of electric vehicles (EVs) and enhancement of public transportation systems.
- **Agriculture:** Focus on climate-resilient crops, improved irrigation, and sustainable farming practices.
- **Urban Development:** Encouragement of sustainable urban planning, green building practices, and waste management initiatives.

- **Water Resources:** Promotion of water conservation, rainwater harvesting, and enhanced river basin management.
- **Disaster Management:** Strengthening resilience against climate-induced disasters through improved early warning systems and community preparedness.

5.17 Managing Chennai monsoon

Introduction:

- Over the past few years, Chennai has continued to receive unprecedented rainfall during the annual northeast monsoon.
    - Sudden bursts of increased rainfall, with large volumes of water in very short spans, often result in urban floods, revealing the city's vulnerability.
- Confronting the challenges of climate change, Chennai needs to find a solution that primarily enables its water reservoirs to absorb, store or recharge groundwater.
- The focus shifts to the imperatives of organised urban planning and the need to protect and rejuvenate Chennai's water reservoirs - Pallikaranai marsh, Ennore creek and other large reservoirs such as Chembarambakkam lake and Red Hills lake.
- The organic and rapid growth of the city has disrupted the natural hydrological cycle with the expansion of concrete and tar-paved surfaces, indiscriminate constructions and felling of trees and vegetation.
    - Environmentalists suggest that this could be some of the many reasons behind urban floods, besides augmenting the capacity of the three rivers and their reservoirs - Adyar, Cooum and Kosasthalaiyar.
- The city requires a new imagination of its relationship to the unpredictable monsoons, the sea, and its water reservoirs.

Here are five takeaways from the recent rains:

1. Public awareness:

- Over the last three decades, Chennai has been at the forefront of rainwater harvesting.
    - Chennai's history indicates that well-designed rainwater harvesting systems, following safety standards, can substantially absorb excess rainwater and minimise the adverse impact of floods.
- Public awareness on waste disposal, preparedness and water conservation practices are essential to address climate-induced calamities and build resilience.

2. Rainwater harvesting systems:

- In the face of heavy rains, residential complexes and institutions have begun to construct rainwater harvesting wells, as well as renew existing ones that have been defunct.
    - The initiative, however, needs to be more widespread recognising its intrinsic benefits.
    - It is a pragmatic indication to new apartment complexes, to be more diligent and provide for well-designed rainwater harvesting pits that collect excess rains to permeate the soil.
- The Chennai Metropolitan Board guidelines suggest that water collected from the terraces can be directed through a filtration process into storage tanks.
    - While it can considerably reduce the floodwaters, it assures a long-term water security to Chennai.
- Integrating these aspects into the Third Masterplan, presently under preparation by the Chennai Metropolitan Development Authority, could strengthen the city's capacity to address urban floods.
    - It has several other ancillary benefits such as reducing urban heat, recharging groundwater, and minimising the ingress of brackish seawater.
- Apartment complexes that have recharged groundwater, through rainwater harvesting, have discovered an improvement in water quality.

- Over the past decades, innumerable studies by Chennai Metropolitan Board have indicated the effectiveness of rainwater harvesting in reducing flood water volume and stopping water logging of roads.
- Large education campuses can contribute to augmenting and recharge of groundwaters.
- However, it's a greater challenge to address and mitigate the impacts of such cataclysmic rains.

3. Permeable pavements and surfaces:

- Public awareness about designing permeable, porous pavements and surfaces can encourage and allow rainwater to infiltrate the soil and recharge groundwater naturally - urban parks and gardens, porous pavements, retention wells, and green roofs.
- Permeable pavements and surfaces have had a significant impact on reducing urban heat as well.
    - While much of these details are known, their dissemination could ensure effective adoption.

4. Integrated database system:

- Drawing from urban lessons of medieval Madras, these elements of rainwater harvesting can be combined with Chennai's road network and its stormwater drain system — to assist in the natural flow of water into rivers and rejuvenate the lakes and other water reservoirs, through a natural process.
- Stormwater channels have also been equipped with filtration and recharge wells in the city today.
- A pragmatic neighbourhood approach, scientifically undertaken, ensuring surface and drain slopes and levels, requires a monitoring committee, including neighbourhood citizen groups, to coordinate the efforts.
- Digital technologies and apps, documenting citizen data of inundation, flooding, and other issues can empower a citizen-based participation and aid the planning process, providing local data.
- Low-lying areas would undoubtedly require more concerted efforts in infrastructure investments and planning.

5. Protecting natural ecosystems:

- The impetus to creating urban green spaces, accessible to all, is imperative, for several reasons.
- During earlier natural calamities, the Greater Chennai Corporation had invited environmentalists and citizen groups to draw up ecological guidelines for tree-planting.
- Protecting natural ecosystems and biodiversity, regions like the Guindy deer-park and Vandalur area, and other local parks act as natural flood regulators as well.
- Rejuvenating untended parks, Open Space Reservation lands and other derelict zones would consolidate these nature-based solutions considerably.
- The flood mitigation process would require a constant monitoring and maintenance of stormwater drains.
- In the present scenario of Chennai's growth, nature-based solutions (through the creation of new green spaces and rejuvenation of natural water reservoirs) can support a natural "stormwater management".
- Several studies have demonstrated the contribution of such nature-based solutions (if appropriately designed) in complementing the urban drainage system.
- The need for an integrated database system with early-warning systems has to be implemented to coordinate efforts.
    - Information on rescue, evacuation, helplines, relief measures, hospital support, and other relevant information have augmented such extreme predicaments.
- Areas with incomplete canals, or roads under construction have been the most affected.
    - However, on a positive note, the early warning updates received by citizens provided adequate time to evacuate to safety.
- Several parts of Chennai continue to battle the receding floods, inundating low-lying areas.
    - Prioritising vulnerable communities and neighbourhoods for infrastructural remedies is imperative.

- In the long-term, flood mitigation measures have often influenced the microclimate, and have the potential to make the city cooler and more liveable.

Conclusion:

- Citizen groups can participate in urban neighbourhood discussions to suggest local observations.
- Community groups monitoring stormwater canals adjacent to their homes have informally emerged in Chennai since the last decade.
    - If these volunteer efforts by citizen groups can be supported in the planning process, the city can chart a resilient road map to cope with natural calamities.

5.18 What do the Atlantic Ocean hurricane forecasts foretell for India?

Introduction:

- Meteorologists had previously forecast a historic hurricane season for 2024 based on the expectation that a strong La Niña would emerge this winter.
    - But while the hurricanes Helene and Milton may seem consistent with this forecast, 2024 has evolved to be a year with a summer with no major hurricanes.
    - One important reason is that the strong La Niña has played truant thus far.
    - In fact weather agencies are currently downgrading their La Niña forecasts.
- The 2023 hurricane season was history's fourth-most active despite the strong El Niño that year.
- Meteorologists expect a subdued hurricane season during an El Niño and an earnest one during a La Niña.
    - Now, are they to assume that the record warming during 2023-2024 has flipped the hurricane season on us or that the link between hurricanes and El Niño/La Niña has flipped? They'll need to wait and watch.
- Forecasting seasonal cyclone activity is a challenging task but hurricane forecasts have overall become more accurate, especially in terms of narrowing the cone of uncertainty of the storms' landfall.
    - Some major challenges remain vis-à-vis forecasting the intensities, however.
- The more worrisome fact is that the forecasting community has acquired hardly any skill in terms of the aftermath of a hurricane, i.e. after it makes landfall.
    - Post-landfall rain and winds wreak considerable damage to property and lead to loss of lives.

The challenge of forecasting cyclones:

- A shortcoming in any forecast automatically raises the stakes for how well people and governments can plan for hurricanes and, in India's part of the world, cyclones.
- The climate models used to develop projections don't explicitly resolve cyclones.
- Any projections for the future are based on other resolved metrics that indirectly indicate cyclonic activity and its potential intensity.
- Historical analyses of global cyclones suggest there hasn't been a detectable increase in the total number of cyclones.
    - However, the number of strong cyclones has increased.
- Cyclones draw the energy they need from the upper ocean, and the upper oceans are warming in all cyclone-producing regions of the planet.
    - This has led to many instances of rapid intensification: when the maximum cyclone wind speed increases by 55 km/hr or more within a 24-hour period.
    - Rapid intensification has proven hard to predict.
- The North Indian Ocean is also reported to be experiencing an increasing number of cyclones, especially in the Arabian Sea.

- The fact that the last few years have been unusually quiet only underscores the challenge of predicting seasonal cyclone numbers, cyclones as individual events, how they react to global warming, and of course their post-landfall effects.

Good, bad, and ugly:

- India has made impressive progress in forecasting cyclones together with a disaster management plan that has been equally effective at reducing the loss of lives.
- More good news for the North Indian Ocean is that the typical stretch of ocean where cyclones intensify is relatively small, over both the Arabian Sea and the Bay of Bengal, thus limiting the size and strength of the cyclones.
    - Most cyclones over the Arabian Sea also tend to be steered northwestward, away from India.
- The bad news is that the Indian subcontinent and other countries along the rim of the Indian Ocean are highly vulnerable not only to the chronic stressors of climate change but also to the acute stressors.
    - The chronic stressors refer to the warming, rising sea levels, and the increasing incidence of rainfall extremes and dry spells, all of which happen in the background.
    - The acute stressors ride on top of the chronic stressors and exacerbate their effects.
        - These include heavy rainfall events, flash droughts, and cyclones.
        - For example, inundation from a cyclone will get worse as sea levels rise.
        - Or a heatwave that co-occurs with a drought will make water scarce, wilt crops, and disrupt power supply (because power plants need water, too).
- A few days ago, parts of Tamil Nadu suffered heavy rain and flooding.
    - This has become an annual event because warming in the Indian Ocean, especially the Bay of Bengal, has been extending the southwest monsoon into the northeast monsoon and delivering both excess and extreme rainfall.
- Forecasting woes are also in full display: a low-pressure system predicted to cause flooding in Chennai veered north and completely missed the city.
    - Now, imagine a city has to evacuate thousands of people when a cyclone is predicted.
- Forecasts will continue to get better but our expectations will also continue to rise.

From nation to region:

- Our region needs critical advances in the quality of the predictions of rapid intensification and landfall and of the cyclones post-landfall.
- Additional efforts are also required to project the cyclone risk in the coming years at hyperlocal scales.
- India remains an economically developing country, and any increments in its ability to manage its financial and human resources will be critical for the foreseeable future.
    - This is essential context for why hyperlocal risk maps can make a big difference: it will be too expensive for us to cover all regions for cyclone risk.
- India has also started to bring mitigation and adaptation actions into its mainstream fiscal policies and budgetary processes by investing in renewable energy, electric vehicles, weather and climate forecasting, early warning systems, and disaster management.
- The ugly news is that India's dreams of sustained economic development can never materialise unless the entire subcontinent is resilient.
- India's (and the Indian subcontinent's) vulnerabilities to chronic and acute climate stressors aren't only India's socio-economic vulnerabilities: they are also India's national security issues.
    - The country's strategies for building cooperation, trade, and stability in the region have to now include the constituent countries' climate risks as well.
    - This can start by establishing subcontinent-wide weather and climate networks and improving forecasts and projections for all parts of India's wider neighbourhood.

5.19 Why is Delhi's air quality deteriorating?

What factors contribute to the deterioration of air quality in Delhi during the winter months? How does stubble burning affect PM 2.5 levels? What role do urban emissions from vehicles play in determining air quality? Why is a coordinated approach necessary to tackle the air pollution crisis?

Introduction:

- With the withdrawal of the southwest monsoon and the onset of winter, the air quality in Delhi has started to nose-dive.
    - This week, the city and its adjoining territories have consistently recorded particulate matter (PM 2.5) levels exceeding 300, or 'very poor' air quality, and forecasts suggest that this could worsen in the coming days.
    - As is now an established pattern, the decline in air quality coincides with the burning of farm stubble, primarily from Punjab.

Contribution of stubble burning to air pollution:

- Stubble burning refers to a traditional practice of farmers burning the remnants of paddy stalks after harvesting.
    - This method is often the quickest way, as farmers in Punjab and Haryana have a narrow window of October and November to clear their fields and sow wheat for the winter.
    - Agricultural researchers, while analysing the economics of rice-wheat cropping pointed out that rising labour costs made it expensive for farmers to collect rice stalks strewn across the field that resulted from the use of mechanical devices such as rice shredders and combine harvesters.
    - Though the burning of rice stalk was initially condemned as a waste of valuable manure, concerns were also raised about its harm to farmers' health.
        - However, its link to worsening air quality in Delhi was quantified only over the last decade and a half.
        - Today, the use of sophisticated instruments, modelling studies, and computational methods have enabled the estimation, almost daily, of stubble burning's contribution to air quality in Delhi.
- A study by the research and advocacy group Climate Trends of winter pollution trends in 2023 found a "strong correlation" between wind direction originating from Punjab and Haryana and the resulting pollution levels in Delhi.
    - In the case of Punjab, during winter, 54% of the time the wind from the State blew towards Delhi, it led to a spike in air pollution; when the wind originated from Haryana, the figure stood at 27%.
    - Every additional fire incident was correlated with an increase in PM2.5 levels of 12.44 units.
- Studies over the years, most recently in 2023 by a consortium of IIT Kanpur, IIT Delhi, TERI, and Airshed, Kanpur, found that from mid-October to the end of November 2022, the role of stubble burning to air quality was on average 22% and peaked to as much as 35%.
    - This is fairly consistent with previous studies that have estimated the contribution of stubble burning to range from 20%- 40%.
    - Based on these measurements, the Indian Institute of Tropical Meteorology-Pune (IITM-Pune) maintains an air quality forecast system that models the flow of airborne pollutants through cities.
- It shows the dynamic nature of stubble burning's impact on Delhi's pollution.
    - For instance, from October 8 to 19 this year, farm fires accounted for less than 1.2% of the PM 2.5 load in Delhi.
        - During this period, the average AQI stayed from 130 -198 (or the 'moderate' pollution category).
        - However, on October 21, when stubble burning's relative contribution rose to 3.2%, Delhi's AQI immediately plummeted to 'very poor' (310).

- On October 23, when the relative contribution of burning reached the seasonal high of 16%, the index deteriorated to 364, still in the 'very poor' region.
- On October 26, the stubble burning contribution slightly dipped to 14.5%, and the AQI improved to 270 or 'poor' quality.

Inference from the above observations:

- The transitioning period from the withdrawal of the monsoon to the onset of winter causes a sharp drop in windspeed, and cause air pollutants to hover closer to the ground rather than being flushed away to the higher realms of the atmosphere.
  - In this situation, any additional source of pollutants - such as from stubble burning - can dramatically spike the pollutant load in Delhi.
  - Also, nearly 55% of the pollution in Delhi originates outside its territorial borders, as studies have shown.
    - Thus, relatively small spikes can push the index as much as 100 points and change categories anywhere from 'poor' to 'very poor.'

Is stubble burning the sole villain in Delhi's pollution?

- Urban Emissions, a research outfit that tracks air pollution trends nationally, reports that from 2016-23, the improving air quality reflected in the index going from a high of 285 in 2017 to a low of 173 in 2021.
  - However, in six of these seven years, the index stayed above 216 and therefore within the AQI categorisation of 'poor' air quality.
  - However, in Punjab, the farm fires reduced by over an order of magnitude from 17,467 in 2018 (as of October 25, that year) to 1,749 (October 25) this year.
  - Fire incidents in Haryana too have halved since 2020.
  - The paddy harvested in Punjab is more than twice that in Haryana and yet, this has only improved the index by 65 points at the most.
- Significantly, December, January, and February are officially considered the winter months by the India Meteorological Department and by this time, the atmospheric conditions that create a trap for pollutants and prevent them from being flushed out, grow stronger.
  - However, stubble burning almost entirely ceases.
  - Despite that, data compiled by Urban Emissions says, the air quality index has consistently remained in the 'very poor' and 'severe' (400+) category from 2016-23.
  - This suggests that sources other than stubble burning contribute significantly to air pollution.

Other factors:

- On October 25 this year, stubble burning was responsible for nearly 15% of Delhi's air pollution.
  - On the same day, 'Delhi transport' which includes particulate matter from vehicles and vehicles crossing into Delhi was responsible for about 18% of the PM 2.5 load, according to the IITM's air quality forecast system.
- The IIT Kanpur, IIT Delhi, and Teri consortia analysis of the sources of pollution in Delhi found that the real-time source apportionment of PM 2.5 results show secondary inorganic aerosols (SIA), which travel from beyond Delhi, contribute the highest to Delhi's pollution load.
- The average of winter pollution source apportionment shows SIA (32%) and biomass burning within and outside Delhi (24%) contribute the most followed by vehicles at 17%.
  - The SIAs form when gaseous precursors like sulfur dioxide (SO2), nitrogen oxides (NOx), and ammonia (NH3) react to form ammonium sulfate or ammonium nitrate.
  - In winter, the mean contribution of SIA from the sources within Delhi is 16% and the rest 84% from outside Delhi.

Conclusion:

- In the last few years, policymakers have realised that the sources of air pollution can be tackled only via an airshed approach that requires coordinated action by multiple States including those beyond Delhi to evolve a joint response to the pollution crisis.

6. Security and Defence

6.1 India's fourth nuclear submarine launched into water

News:

- India's fourth nuclear-powered ballistic missile submarine (SSBN), referred to as S4*, was launched into water.

More info:

- This submarine is bigger and more capable than the first, INS Arihant (S2), which is essentially a technology demonstrator developed under the Advanced Technology Vessel programme.
- India currently has two SSBNs operational.
    - INS Arihant was quietly commissioned into service in 2016.
        - It has a displacement of 6,000 tonnes and is powered by an 83 MW pressurised light-water reactor with enriched uranium.
    - The second SSBN, INS Arighaat (S3), which retains the same reactor and dimensions with several technological upgrades, was commissioned end-August.
    - The 3rd SSBN Aridhman (S4) is currently undergoing sea trials and is expected to be commissioned, into service next year.
- The first two SSBNs share the same reactor, while the S4 and S4* have an improved reactor.
- The S4* is bigger and can carry a number of the K-4 submarine launched ballistic missiles (SLBM).
- Earlier this month, the Cabinet Committee on Security approved the construction of two indigenous nuclear attack submarines (SSN), also called hunter-killers, a critical requirement for the Indian Navy to monitor the Indo-Pacific.
- INS Arihant is presently armed with a 750km range K-15 SLBM.
- The S4* carries the advanced 3,500 km range SLBM K-4 that was tested for the first time in 2020.
    - The K-4 will be the mainstay of India's undersea nuclear deterrence as it provides standoff capability to launch nuclear weapons while submerged in Indian waters until a 5,000 km range SLBM is developed and fielded.
- A robust, survivable, and assured retaliatory capability is in line with India's policy to have 'Credible Minimum Deterrence' (CMD) that underpins its 'No First Use' commitment.
    - In 1998, India conducted nuclear tests under Phokran-II, and in 2003, India declared its nuclear doctrine based on CMD and a NFU policy while reserving the right of massive retaliation if struck with nuclear weapons first.

7. Social Issues

7.1 Gandhi's education policy and NEP 2020

Context:

- Gandhi's education policy and NEP 2020: Where they meet and where they diverge
  - While Gandhi's Nai Talim advocated learning through doing and manual labour similar to NEP's vocationalisation, the two differ on end goals

Introduction:

- Ten years before Independence, Mahatma Gandhi put together a set of ideas on education called Nai Talim which was actually a culmination of several decades of thinking and experimenting on education.
  - An early experience was Gandhi's Tolstoy Farm in South Africa where he and his associate Kallenbach educated children including Gandhi's own who came from at least four different linguistic and religious backgrounds.
- Gandhi's Nai Talim was put into practice by many Gandhian volunteers.
- Congress governments that had come to power in the 1937 elections tried to implement some of his ideas too.
- After Independence, there was a serious attempt to bring Gandhi's ideas to reality in education but the march of modernity took its toll and soon enough India had little use for Nai Talim.
- Gandhi, in his own novel ways, sought to address key issues of education in India at that time: equity, access, as well as quality of education and results.
- The National Education Policy 2020 says that predecessor policies were more focused on equity and access whereas it's now time to address the growing needs of a nation aspiring to be a developed economy.
  - But the route it takes has only a few tenuous links to Gandhi's vision although the Ministry of Education has sought to point out distinct parallels between the two.

Frugal, self-sufficient education:

- As could be expected of Mahatma Gandhi, education was a highly ethical endeavour.
  - The ideal product of his Nai Talim was a simple living; high thinking individual who was dedicated to serving others, always stood for harmony and cooperation, was very good with manual work and took to it, and was committed to peace and non-violence.
  - He or she was also an expert craftsman. Gandhi's system of learning was by doing.
- Gandhi, for all his religiosity and mixing of religious themes with the freedom struggle, did not want religious education.
  - His focus was the village and promotion of handicrafts.
- At a time when the costs of social services provided by government had to be met largely through liquor revenue, Gandhi, who abhorred liquor consumption, advocated that all primary education institutions should be self-sufficient and pay for themselves.
  - He wanted wealthy donors funding medical colleges and big industrialists such as the Tatas paying for engineering colleges.
- Schools had to be self-sufficient too. The expenses were to be minimal. Students themselves were to maintain and run their schools with teachers also serving as active manual workers. Gandhi's school was frugal.

- And he wanted his schools to earn by creating value through handicrafts that students would learn and do.
    - These handicrafts were to be context-driven just as most other aspects of his Nai Talim were. In practice, however, such vocationalization seemed to reinforce hereditary occupations of the caste system.
- Gandhi, however, greatly stressed on the dignity and equality of all forms of manual labour. Work was worship and all students and teachers had to clean the school premises including bathrooms and latrines.
    - This was Gandhi's caste-busting measure.
- For Gandhi, Swaraj meant autonomous, self-sufficient and empowered Indians who were not constrained by state power. The village was to be practically a republic. Self-sufficiency was the acid test for a Nai Talim school.
- Gandhi sought to achieve "literary" goals of education though work and action. He saw English education as producing clerks for government jobs.
- Over the years, however, India has decisively moved away from these notions.

Claims of convergence:

- The Union Ministry of Education has sought to draw parallels between Gandhi's Nai Talim and the NEP 2020.
    - It has pointed out that the NEP advocates education in mother tongue just as Gandhi did.
    - In South Africa, Gandhi sought to teach Gujarati children in Gujarati and Tamil children in Tamil.
- Just as in Nai Talim, the NEP wants school students to learn another Indian language that Gandhi preferred to be Hindi.
    - NEP advocates the learning of several languages, more than just two or even three.
- The NEP has stressed on how to learn rather than just creating the content for learning.
    - Content is available freely in today's world and what is important is how is the content to be learned.
- Just as Gandhi would have liked, the NEP seeks to de-emphasize institutions and promote cross-disciplinary and cross-institutional learning as well as non-classroom methods such as online courses.
    - For Gandhi, classrooms were tyrannical.
- Another thrust of the NEP has been towards vocationalization of education.
    - Gandhi inverted the equation and advocated education based on doing.
    - But the current orientation is towards producing a skilled and productive workforce, not necessarily one that is highly literary through and through.
- But where the NEP and Gandhi markedly differ is the overall goal of education.
    - There is no mention of peace or non-violence in the NEP.
    - While the document talks of regard for diversity, inclusiveness and respect for traditions and traditional knowledge, it is silent on a higher ethical focus for India as a nation and how education will serve that.
- The intent of the NEP is not to imbibe selflessness, tolerance and love for fellow human beings in Indian students.
    - The goal is to produce a skilled, knowledgeable and empowered worker.

7.2 International Day of Non-Violence 2024

Introduction:

- The International Day of Non-Violence, celebrated annually on October 2, marks the birth anniversary of Mahatma Gandhi, a global beacon of peace and non-violence.
    - This day, proclaimed by the United Nations in 2007, serves as a reminder of the power of non-violence in shaping societies.

Gandhi's Legacy of Non-Violence:

- Mahatma Gandhi's philosophy of Satyagraha and non-violent resistance remains one of the most potent forces for change in modern history.
- His peaceful protests against British rule, particularly the Dandi March in 1930, exemplified his belief in the power of non-violence to confront oppression.
- For Mahatma Gandhi, non-violence was not merely a political tool but a way of life, grounded in the belief that peace could only be achieved through peaceful means.
- Mahatma Gandhi famously said, "Non-violence is the greatest force at the disposal of mankind. It is mightier than the mightiest weapon of destruction."
    - This belief continues to inspire movements around the world, from Martin Luther King Jr.'s fight for civil rights in the United States to Nelson Mandela's struggle against apartheid in South Africa.
    - His ideas influenced countless leaders and movements, underscoring the universal appeal of non-violence as a powerful instrument of resistance and reform.

Mahatma Gandhi's Relevance in Today's World:

- In an era marked by political, social, and environmental challenges, Mahatma Gandhi's principles of non-violence resonate deeply.
- Terrorism, conflict, climate change, and growing inequality emphasize the urgent need for peaceful solutions.
- Gandhi's belief in the intrinsic goodness of humanity offers a roadmap for healing divisions and addressing modern crises, including pandemics and poverty.
- His philosophy reminds us that peace is not just a distant ideal but an achievable goal! His teachings offer a timeless message of hope and reconciliation.
- Mahatma Gandhi's wisdom extended beyond political resistance to touch on issues of sustainability.
    - His famous quote, "There is enough for everyone's need, but not for everyone's greed," underscores the link between non-violence and responsible resource use.
- In today's context, his values of simplicity, conservation, and self-reliance are reflected in India's initiatives like the Swachh Bharat Abhiyan (Clean India Campaign), which promotes cleanliness and environmental sustainability.

Global Commemoration of Non-Violence: Honoring Gandhi's Legacy:

- The International Day of Non-Violence serves as a global reminder of Mahatma Gandhi's enduring philosophy of peace and non-violence.
    - Observed on his birth anniversary, this day pays tribute to the principles of non-violent resistance that he championed throughout his life.

Celebrating Gandhi's Legacy:

- Mahatma Gandhi's teachings continue to profoundly influence India's social and political framework.
- Various government departments and institutions actively uphold and promote his ideals, ensuring that Gandhi's vision for a cleaner, self-reliant, and peaceful society is integrated into modern governance and public life.
- Swachh Bharat Abhiyan (Clean India Mission), launched in 2014, stands as one of the most significant initiatives reflecting Mahatma Gandhi's philosophy of cleanliness as essential to nation-building.
    - The campaign, aiming to create a cleaner and healthier India, resonates with Gandhi's belief that "cleanliness is next to godliness."
    - It motivates citizens to take collective responsibility for maintaining their surroundings, fostering both individual and community involvement.

- The Swachhata Hi Seva (SHS) 2024 campaign, with its theme of 'Swabhaav Swachhata, Sanskaar Swachhata', was held from 17th September to 1st October.
    - The campaign culminated with Gandhi Jayanti on 2nd October, marking the 10th anniversary of the Swachh Bharat Mission.
    - The SHS campaign focused on promoting behavioral change and community participation to maintain cleanliness and sanitation across India.

Khadi: A Symbol of Self-Reliance and Sustainability

- Mahatma Gandhi's advocacy for self-reliance and sustainability continues to resonate through the promotion of Khadi, the hand-spun fabric that symbolizes simplicity and economic independence.

Conclusion:

- The International Day of Non-Violence is a powerful reminder of the enduring relevance of Mahatma Gandhi's teachings.
    - By embracing non-violence, not only as a strategy but as a way of life, we can build a more harmonious and sustainable world for future generations.
    - Through education, awareness, and the promotion of non-violent solutions to global challenges, we honor the legacy of Mahatma Gandhi and his profound contributions to humanity.
    - His timeless message-that peace is achievable through non-violent action-continues to inspire millions around the world.

7.3 Why the academic ranking framework for higher education needs a relook

Context:

- An examination of how the NIRF rankings can be streamlined and refined to be more inclusive and equitable

Introduction:

- Recently the National Institute Ranking Framework (NIRF) published its results under various categories including Overall, Universities, State Public Universities, Open Universities, Skill Universities, Colleges, Research Institutions, Innovation Institutions, Engineering, Management, Pharmacy, Architecture and Planning, Law, Medical, Dental, Agriculture and Allied Sectors.
    - The ranking framework has enabled the colleges to benchmark themselves using the framework and build capacity to meet the demand.
- The idea of including state public universities as a separate category is an inclusive approach.
    - This was implemented based on central universities being able to access relatively higher funding resources in contrast to state public universities.
    - However, still there is scope for streamlining and refining the framework to be more inclusive and equitable.
- It has been consistently inferred that only Delhi-based institutions occupy the top five to six positions followed by colleges from other states.
    - Delhi-based institutions primarily focus on undergraduate education and postgraduate courses are mostly conducted by the Delhi University.
    - On the other hand, the ranked institutions in South India predominantly have research as a culture owing to their postgraduate education.
    - The question of comparing institutions of different orders on the same platform is not equitable as the efforts in curating and managing the data would not be of the same order.

Justice and fairness:

- Though "outreach and inclusivity" are part of the parameters, the equity performance of academic institutions is not reckoned as part of the NIRF metrics to measure the practice of "justice" and "fairness" through distributive equity that solicits a different treatment to the disadvantaged institutions in order to practice SDG 4.
    - Therefore, colleges that perform excellently well with the available socio-economic status (SES) and demographic constrictions are not able to scale up under the ranking framework.
- Institutions ranked due to their exclusive cognitive excellence and meritocratic philosophy for admissions are valued through the existing framework more than inclusive institutions that admit students hailing from varied learning styles.
    - Institutions with socio-economic advantage, demographic, historical legacy, exclusive identity, familial networks, social support system, personal endowments, material wealth, and a host of other intangibles that work in tandem to boost their prospects have to be differentiated from that of disadvantaged while evaluating performance under various rubrics.
- Assessment of 'teaching and learning' processes gives importance to the infrastructure as per the framework than to the competency of the human resources, thus requiring a controlled perception building by the institution.
    - However this has led to marketing manipulations by the institutions.
    - Thus, if one goes only by the NIRF ranking, students ending up in a college with a low quality of education but better infrastructure with best data capture or simulation system.

Institution's USP:

- Each institution is known for intangible non-cognitive traits as a unique selling proposition (USP) that would add value to its culture.
    - Academic success, personality and leadership development are created through 'social learning' integrated as part of the 'campus life' through non-credited activities.
    - Though prescribing metrics for this is beyond this article's scope, it can be perceived that a longitudinal qualitative assessment to capture the institution's USP through qualitative assessment would beget a comprehensive perception.
    - A few representative performance indicators of social learning could be civic responsibility, political agility, networking ability and social astuteness.

Conclusion:

- It is obvious that NIRF ranking is all about the institution's agility to curate data proactively through proper documentation for assessment. The question as to whether the data and the academic reality are conformable is a question that is to be debated, as NIRF does not involve physical verification.

7.4 Online education: How Gen Z and millennials can leverage it for career growth

Introduction:

- Significant and hitherto unseen: That's how the change in the Indian higher and continuing education landscape can be described, especially with online learning emerging as a crucial tool for growth.
- Studies show that 28% of Generation Z (Gen Z) and 23% of millennials in India are keen on seeking higher education and skill enhancement, highlighting a shift toward lifelong learning.
- With around 377 million Gen Z individuals and over 300 million millennials, these digitally native generations hold immense potential to drive India's progress through online education.
- As one of the world's youngest nations, India is on the verge of an educational shift, driven by digital learning.

- In an increasingly competitive global economy, online platforms provide unique opportunities for India's youth to upskill and stay relevant.
    - Demand is particularly high for online courses in business management, technology, data analytics, and emerging fields like artificial intelligence (AI).
    - The flexibility, accessibility, and affordability of online education help individuals advance their careers while strengthening India's global economic position.
- Over 60 universities, including IITs, IIMs, and IIITs, now offer robust online programs.
- Reforms that began with the New Education Policy 2020 ensure that only top-ranked institutions provide credible, approved programs online, further improving their quality.
    - Other than this, nationally and internationally renowned platforms are also offering credible online certifications in courses that are in demand in the market especially renowned and MNC job providers.

Online education: A gateway to professional growth

- Specialized skills are crucial in today's rapidly evolving economy.
- As industries transform, online education has become a key enabler, offering courses tailored to meet industry needs.
- Unlike traditional institutions, which can be limited by geography or time, online platforms make top-tier education accessible from anywhere.
- Platforms like Swayam sponsored by the Government of India, and Coursera provide courses in fields like AI, machine learning, cybersecurity, and digital marketing – which allow learners to study at their own pace, making education more personalized.
    - This flexibility is especially valuable for millennials balancing jobs with a desire to upskill, as well as for Gen Z students exploring career options.
    - Certifications from these platforms are increasingly recognized by employers as proof of continuous learning and adaptability.

Building a global outlook:

- Online education fosters a global perspective, an essential asset in today's interconnected world.
- These platforms bring together learners from diverse countries, regions and background enriching their understanding of global markets.
- Exposure to international courses and collaboration with peers from different backgrounds prepares young Indians for the challenges of a globalized economy.
- The collaborative nature of online platforms enhances global exposure through cross-cultural discussions, group projects, and live seminars.
    - Such interactions equip both Gen Z and millennials with the skills to thrive in multinational environments, positioning them well for international partnerships and innovation.
- Developing a global mindset through online education extends beyond personal growth - it has significant implications for India's role on the world stage.
    - As more young Indians learn to collaborate across borders, India can strengthen its global presence, fostering new partnerships and innovation.

Fuelling India's economic growth:

- Upskilling India's youth in business, technology, and emerging sectors through online education can significantly boost the country's growth.
- Digital technologies like AI, blockchain, and data analytics are reshaping industries, making the demand for skilled professionals critical.
    - Online education bridges this gap, enabling India's youth to acquire the advanced skills needed to keep India at the forefront of global innovation.

- Online education is also a catalyst for entrepreneurship.
    - It provides aspiring entrepreneurs with access to courses in business management, finance, leadership, and innovation, equipping them to launch and scale ventures.
        - This is especially beneficial in India's startup ecosystem, leveraging a digitally skilled workforce to disrupt markets and create opportunities.
- Additionally, online education can increase women's participation in the workforce.
    - For many women, especially in rural areas, traditional education is limited by societal and logistical barriers.
    - Online learning offers a more inclusive pathway, allowing women to gain skills, re-enter the workforce, or take on leadership roles.
    - By empowering women, India can unlock a significant source of talent, driving further growth.

Strengthening India's leadership in business:

- As Gen Z and millennials upskill through online education, their expertise and global outlook will shape India's position in the global business landscape.
- Beyond technology, online education helps young professionals excel in various industries, from healthcare to fintech.
- As businesses prioritize sustainability and digital transformation, Indian youth with the right skills are well-positioned for leadership roles both at home and abroad.
- A digitally skilled workforce is crucial for driving innovation.
- By embracing online education, young Indians can become change agents, advancing their careers and contributing to India's emergence as a global leader in business and technology.
- India's future economic success and global leadership depend on its youth.
- With 377 million Gen Z individuals and 300 million millennials, online education offers a pathway to acquire the skills and perspectives needed to thrive in a rapidly changing world.
- By leveraging digital learning, India's youth can accelerate their growth and contribute to the nation's progress as a global powerhouse.
    - With the right skills, mindset, and drive, they have the potential to propel India into a new era of innovation and growth.

Challenges of online education:

- Despite the potential of online education to transform India's youth and contribute to national progress, several challenges must be addressed to realize its full impact:

Digital divide and accessibility:

- A significant barrier is the digital divide between urban population that enjoy reasonably high-speed internet access, and rural regions often lack the necessary infrastructure for seamless online learning.
    - Limited access to reliable internet and digital devices hinders the participation of many young Indians, particularly those in remote areas, thereby restricting the inclusivity of online education.

Quality assurance and credibility:

- Although reforms have improved the credibility of online programs, ensuring consistent quality across diverse providers remains a challenge.
    - Maintaining high standards across platforms is crucial to ensuring that online certifications and degrees remain valuable in the job market.

Digital literacy and motivation:

- Many learners, especially in rural and lower-income segments, may struggle with digital literacy, impacting their ability to engage effectively with online platforms.

- Additionally, the self-paced nature of online education requires a high degree of self-discipline and motivation, which can be challenging for students accustomed to traditional, structured learning environments.

Employer recognition and integration into the job market:

- While online certifications are gaining acceptance, many employers still value traditional degrees from reputed institutions over online credentials.
  - Bridging this perception gap is essential for ensuring that online learners receive equal opportunities in the job market.

Cultural attitudes and gender barriers:

- Societal norms, particularly in rural areas, can limit access to education for women.
  - Despite the flexibility of online learning, cultural barriers may still prevent women from fully utilizing these opportunities.

Conclusion:

- Addressing these challenges requires serious and coordinated efforts from policymakers, educational institutions, and industry leaders to ensure that online education becomes an accessible, credible, and effective path for India's youth.
- Experienced professionals participating in online learning and teaching forums including platforms not only increase credibility of courses, but also bring real time advanced knowledge to learners in a seamless manner.

8. Miscellaneous

8.1 Status of Classical Language

Context:

- The Union Cabinet has approved to confer the status of Classical Language to Marathi, Pali, Prakrit, Assamese and Bengali languages.

Classical languages:

- Classical languages are regarded as the custodians of India's ancient and profound cultural legacy, preserving the rich history, literature, and traditions of their respective communities.
    - By conferring this status, the government seeks to honor and protect the linguistic milestones of Bharat's diverse cultural landscape, ensuring that future generations can access and appreciate the deep historical roots of these languages.
    - This move not only reinforces the importance of linguistic diversity but also acknowledges the vital role these languages play in shaping the nation's cultural identity.

Declaring a language as classical:

- The designation of a language as classical is intended to recognize its historical significance and its role as a guardian of Bharat's rich cultural and intellectual heritage.
- These languages have been essential in preserving and transmitting India's ancient knowledge systems, philosophies, and values across generations for thousands of years.
- By recognizing these languages as classical, the government acknowledges their deep-rooted antiquity, vast literary traditions, and their invaluable contribution to the cultural fabric of the nation.
- This recognition highlights the significant cultural and linguistic contributions these languages have made to India's heritage.
- It will not only elevate their stature but will also facilitate efforts toward the promotion, preservation, and further research of these languages, ensuring their continued relevance in the modern world.

Criteria for declaring a language as classical:

- In 2004, the Government of India, for the first time, created a new category of languages known as Classical Languages.
- The criterion was revised in 2005 and 2024 based on the recommendations of Linguistic Experts Committees (LEC) under Sahitya Akademi to examine the proposed languages for the status of Classical Language.
- **The criteria revised in 2024 as follows:**
    - High antiquity of its early texts/recorded history over a period of 1500- 2000 years.
    - A body of ancient literature/texts, which is considered a heritage by generations of speakers.
    - Knowledge texts, especially prose texts in addition to poetry, epigraphical and inscriptional evidence.
    - The Classical Languages and literature could be distinct from its current form or could be discontinuous with later forms of its offshoots.
- The 2024 Linguistic Expert Committee also recommended the following languages to be fulfilling revised criteria to be considered as a Classical Language: Marathi, Pali, Prakrit, Assamese, and Bengali.

Languages declared as classical so far:

- Six Indian languages namely Sanskrit, Tamil, Telugu, Kannada, Malayalam and Odia were earlier accorded the status of Classical Language.

- The Union Cabinet has approved to confer the status of Classical Language to Marathi, Pali, Prakrit, Assamese and Bengali languages on October 03, 2024, thus bringing the total number of classical languages to 11.
- The Ministry of Home Affairs initially granted the status to Tamil and Sanskrit, and the Ministry of Culture took over the responsibility for further implementations and future recognitions.
    - The Ministry of Culture established the Linguistic Experts Committee (LEC) on November 1, 2004, to assess future proposals for the recognition of classical languages.

Steps taken to promote classical languages:

- The Ministry of Education has taken various steps for advancing Classical Languages.
- In 2020, three Central Universities were established through an Act of Parliament to promote Sanskrit.
- The Central Institute of Classical Tamil was created to facilitate translating ancient Tamil texts, promoting research, and offering courses for university students and language scholars.
- To further enhance the study and preservation of Classical Languages, the Centres for Excellence for studies in Classical Kannada, Telugu, Malayalam, and Odia were established under the auspices of the Central Institute of Indian Languages in Mysuru.
- Additionally, several national and international awards have been introduced to recognize and encourage achievements in the field of Classical Languages.
- Other benefits provided by the Ministry of Education include National Awards for Classical Languages, university chairs, and centers dedicated to promoting Classical Languages.

Impact of a language being declared classical:

- The inclusion of languages as Classical Languages will create significant employment opportunities, especially in the academic and research sectors.
- Additionally, the preservation, documentation, and digitization of ancient texts in these languages will generate jobs in areas such as archiving, translation, publishing, and digital media.
- Recognizing the languages as classical encourage scholarly research, preservation, and the revitalization of ancient texts and knowledge systems, which are essential to India's intellectual and cultural identity.
- Furthermore, it instills a sense of pride and ownership among the speakers of these languages, promoting national integration and aligning with the broader vision of a self-reliant and culturally rooted India.

Conclusion:

- Union Cabinet's decision to confer Classical Language status to Marathi, Pali, Prakrit, Assamese, and Bengali reflects a deep recognition of the invaluable role these languages have played in shaping India's cultural and intellectual heritage.
- This step not only acknowledges their historical and literary significance but also underscores the government's commitment to preserving and promoting India's linguistic diversity.
- The initiative is expected to foster academic and research opportunities, enhance global collaborations, and contribute to the nation’s cultural and economic growth.
- By safeguarding these languages for future generations, the government is reinforcing a broader vision of cultural self-reliance and national integration, in line with the objectives of Atmanirbhar Bharat and a culturally rooted India.

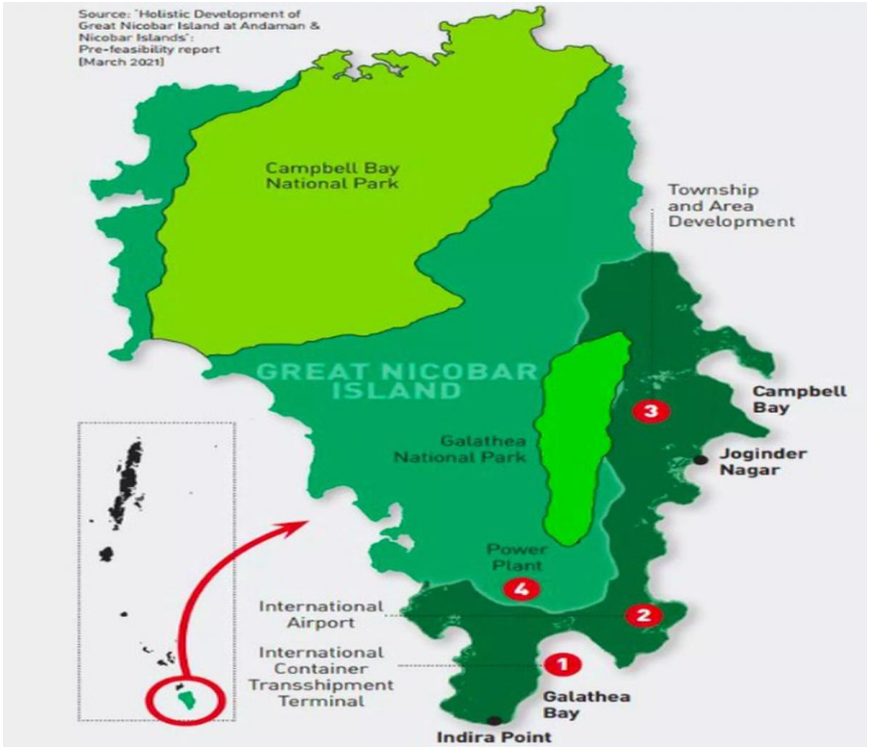
8.2 Shompen people

Context:

- Some members of the reclusive tribe voted in the 2024 election amidst fears that their forests on the Great Nicobar island will be destroyed by a proposed port and shipping container terminal project

Forest home in danger:

- According to the 2011 Census, there are only around 229 members of the Shompen tribe, which makes its home in the Nicobar Islands along with the much more numerous Nicobarese tribe.
- The Shompen, a semi-nomadic forest-dwelling tribe believed to have been resident in the Great Nicobar Island for at least 60,000 years, have historically preferred limited contact outside of their groups.
- In May 2024, seven of them voted in the general election, amidst a contentious plan to develop a trans-shipment container terminal, port, and solar power plant in the Great Nicobar Island.
    - This will involve razing nearly a million trees in about 130 square km of rainforest, which are the primary source of sustenance to the forest-dwelling Shompen.
    - Such projecs could have disastrous consequences for the Shompen.
    - Living in the forest, in the way they want to, is their supreme concern.
    - Such major infrastructure projects aren't correct [in the Great Nicobar Island].
    - They are virgin forests and part of it has already been destroyed.
- Unlike the Nicobarese who live along the coast stretches of the island, the Shompen live in the interiors, they hunt and fish in the rivers.
- Shompen and Nicobarese have lived in peace with each other though they maintain separate habitats.
- The tribes that have lived on the Nicobar Islands for millennia are links to humanity's early history.
- The Shompen may be few in number but their knowledge of the forests in their islands is supreme.



8.3 International Abhidhamma Divas

Context:

- On October 17, 2024, Vigyan Bhavan in New Delhi will come alive with the celebration of International Abhidhamma Divas, hosted by the Ministry of Culture in collaboration with the International Buddhist Confederation (IBC).
    - The event will hold a special significance this year, following the recent recognition of Pali as a classical language by the Indian government.

Introduction:

- Central to Buddha's teachings is the Abhidhamma, a profound philosophical component that extends beyond ethical conduct into the realms of mental discipline and self-awareness.

International Abhidhamma Divas:

- International Abhidhamma Divas, observed globally, celebrate the philosophical cornerstone of Abhidhamma, recognizing its timeless relevance in guiding ethical conduct and mental discipline.

- The occasion underscores the enduring bond between Buddhism and India, where Buddha's teachings continue to inspire not only spiritual seekers but also those pursuing a life of mindfulness and inner peace.
- The Divas serves as a reminder of India's unique role in preserving and promoting the legacy of Buddhism to the world, a bridge between ancient wisdom and contemporary spiritual practices.

Historical Background and Significance:

- Abhidhamma Divas commemorates the day when Lord Buddha descended from the celestial realm, Tāvatiṃsa-devaloka, to Sankassiya (now Sankisa Basantapur) in Uttar Pradesh.
- The Asokan Elephant Pillar, a historical marker at the site, marks this significant event.
- According to Theravāda Buddhist texts, Lord Buddha spent three months teaching the Abhidhamma to the deities in Tāvatiṃsa, including his mother.
- The celebration of Abhidhamma Divas coincides with the end of the first Rainy Retreat (Vassa) and the Pavāraṇā festival, a time when monks and nuns conclude their retreat period with a ceremony.

Teachings of Abhidhamma:

- The Abhidhamma, or "Higher Teaching" of the Buddha, provides a profound and systematic analysis of mind and matter.
- Unlike the more conventional teachings in the Sutta Piṭaka, which use everyday language, the Abhidhamma adopts a specialized and analytical approach to explore reality.
- It offers a detailed framework for understanding the nature of existence, addressing the processes of birth, death, and mental phenomena in a precise and abstract manner.
    - To convey these intricate concepts, the Abhidhamma developed a specialized vocabulary in Pali, forming the basis of Buddhist philosophy and psychology.
    - Key terms include "citta" (consciousness), "cetasika" (mental factors), "rūpa" (materiality), and "nibbāna" (final liberation).
    - This technical language serves as a guide to gaining insight and achieving liberation, facilitating a deeper understanding of ultimate realities and the workings of the mind.
- Traditionally, it is believed that Buddha first taught the Abhidhamma to the gods in the Tavatimsa heaven, including his mother, and later conveyed these teachings to his disciple Sariputta, who expanded upon them in the six core books of the Abhidhamma Piñaka.
    - These texts cover various topics, such as moral and mental states, aggregates, causal relationships, and the path to emancipation, forming a comprehensive system for understanding the mind and achieving spiritual growth.
- The seven treatises of the Abhidhamma Piñaka, notably the Paññhāna, delve into causal relations with unparalleled depth, showcasing the Buddha's profound insight.
    - The meticulous analysis provided by these texts has made the Abhidhamma an essential tool for practitioners seeking to develop insight and grasp the essence of Buddha's teachings.

Classical Status to Pali language:

- The story of the Abhidhamma and its profound teachings is deeply intertwined with the ancient Pali language, a sacred medium that has preserved the essence of Buddhist wisdom for centuries.
- Recognized recently as a Classical Language by the Government of India, Pali highlights its literary significance within Buddhism and Jainism.
- It is believed that this ancient language, shaped from various dialects, served as the vehicle for delivering Lord Buddha's teachings around 500 B.C., ensuring that his insights could resonate through time.
- The entire body of Buddhist canonical literature is written in Pali, with the Tipitaka or "Threefold Basket" being its most notable collection.

- This includes the Vinaya Pitaka, which outlines ethical monastic rules, the Sutta Pitaka, a rich compilation of the Buddha's discourses, and the Abhidhamma Pitaka, which delves into ethics, psychology, and the intricate analysis of mind and reality.
- A rich commentarial tradition has developed around these texts, with works such as the Aṭṭhasālinī and Sammohavinodanī being crucial for understanding the nuanced teachings of the Abhidhamma, all composed in Pali.

- Moreover, Pali literature encompasses the Jataka Kathas, which recount the stories of the Buddha's previous lives, reflecting shared moral values prevalent among the Indian populace.
- The conferral of Classical Language status to Pali is not just an honor; it paves the way for revitalization efforts.
- Government initiatives aimed at promoting Pali studies in educational institutions are set to enhance research on its historical significance, ensuring that the literary heritage of Buddhism is preserved for future generations.
- The preservation of the Abhidhamma teachings has heavily relied on the scholarly and liturgical status of Pali.
- Monasteries and educational institutions have played a crucial role in keeping the Abhidhamma tradition alive, with dedicated scholars and monks engaging deeply with these texts.
  - This connection not only honors the historical importance of Pali but also encourages a renewed engagement with the insights embedded within its texts, fostering a deeper understanding of the Abhidhamma's relevance in today's world.

Conclusion:

- The International Abhidhamma Divas, coinciding with the recognition of Pali as a classical language, represents a significant stride in India's efforts to preserve and promote Buddhism's rich legacy.
- By granting classical status to Pali, India acknowledges its historical significance and ensures that the profound wisdom of Buddhist scriptures continues to inspire future generations.
- This celebration aligns with India's broader mission to revive interest in Buddhism.
- It fosters scholarly exchanges and global engagement while reinforcing the nation's role as a key center for Buddhist studies.
- Through such initiatives, India nurtures a deeper appreciation for the enduring teachings of Lord Buddha.

8.4 Puthari, a local harvest festival

Context:

- Tribals celebrating Puthari, a local harvest festival, at Puthurvayal near Gudalur in Tamil Nadu.
  - The festival, jointly observed by local Maundadan Chettis, Paniyas, Irulas, Kurumbas, Kotas, and Todas of the Nilgiris, falls just before the paddy is ready for harvest.

About Puthari festival:

- "Puthari" is one of the most important festivals for Kodavas, which is celebrated in a grandeur and traditional form in the month of Birchyar i.e. between November and December on the full moon day.
- This festival is celebrated in the honour of annual rice harvest and getting the harvested paddy home.
  - The Kodava people or Kodavas or Codavas are an endogamous Dravidian ethno-linguistic group from the region of Kodagu in the southern Indian state of Karnataka.

8.5 Raigad Fort

Context:

- The fort of Raigad is part of the 12 forts nominated for UNESCO World Heritage under the title "Maratha Military Landscapes of India"

About Raigad fort:

- It carries the echoes of Chhatrapati Shivaji Maharaj's reign.
- The "Sabhasad Bakhar" (Ancient letter) reflects how Chhatrapati Shivaji Maharaj selected the Raigad fort as the capital of the Maratha Empire.
    - It mentions, "Chhatrapati Shivaji Maharaj observed the potential of the hill or Rairi, which has steep escarpment and is the tallest of all mountains and hills in the region.
    - The seamless and unbroken nature of the rock was a great potential.
    - The fort of Daulatabad is also a good fort; however, it is not as good as Raigad, as this is taller and better, hence will be most suitable as a capital and a throne for the king."
- Raigad, surrounded by valleys shaped by the Kal and Gandhari rivers, stands as an isolated massif without connections to neighbouring hills.
- Its impregnable nature, attributed to physiographic features like steep cliffs and 1500-foot escarpments, is underscored by innovative military defence tactics.
- Grant Duff, a British historian of the Maratha period has drawn parallels between Raigad and the Rock of Gibraltar.
    - He has gone to the extent of labelling Raigad as the Gibraltar of the east.
- The theme of the backdrop of this year's Rashtriya Ekta Divas celebrations at Kevadiya, Gujarat is the Raigad Fort.

History of Raigad Fort:

- In 1653 CE, Raigad (then known as Rairi) was captured by the Maratha forces from the Mores'.
- In order to make the fort worthy of being a capital, Shivaji Maharaj assigned the work of reconstruction of the fort to Hiroji Indulkar.
    - Subsquently, on 6th June, 1674 CE a grand coronation ceremony of Shivaji Maharaj was held on Raigad post, during which he attained the title of "Chhatrapati".
- The fort served as the second capital of Chhatrapati Shivaji Maharaj and played an important role in the administration and expansion of the Maratha Kingdom.
- It is identified as Durgaraj (king of forts).
- Various landmarks have lent it the credo of 'Shiva teerth'.
    - The fort has attained the status of a holy shrine for the Shivbhakts as thousands of people throng the fort.
- Shivaji Maharaj had wrested the Fort from Chandrarao More in 1656 CE.
- Shivaji Maharaj had ruled Hindvi Swaraj from Raigad Fort for six years till his death in 1680 CE.
- It is quite unfortunate that except Shivaji Maharaj's Samadhi, Naqqar Khana, Sirkai Devi Temple, Jagadishwar Temple – a shrine dedicated to Lord Siva - most of the structures located within the fort, including the Hall of Public Audience (Rajsadar), Royal Complex, Queens' palace (Ranivasa), Bazarpeth, Manore (pleasure pavilions), Wadeshwar Temple, Khublada Burj, Massid Morcha, Nanne Darwaza are in a bad state of preservation.

8.6 Birsa Munda

Context:

- PM Modi asks to celebrate 150th birth anniversary of Birsa Munda

About Birsa Munda:

- Birsa Munda was a young freedom fighter and a tribal leader, whose spirit of activism in the late nineteenth century, is remembered to be a strong mark of protest against British rule in India.
- Born and raised in the tribal belt around Bihar and Jharkhand, Birsa Munda's achievements are known to be even more remarkable by virtue of the fact that he came to acquire them before he was 25.
- In recognition of his impact on the national movement, the state of Jharkhand was created on his birth anniversary in 2000.
- Born on November 15, 1875, Birsa spent much of his childhood moving from one village to another with his parents.
- He belonged to the Munda tribe in the Chhotanagpur Plateau area.
- He received his early education under the guidance of his teacher Jaipal Nag.
- On the recommendation of Jaipal Nag, Birsa converted to Christianity in order to join the German Mission School.
    - He, however, opted out of the school after a few years.
    - The impact of Christianity was felt in the way he came to relate to religion later.
- Having gained awareness of the British colonial rulers and the efforts of the missionaries to convert tribals to Christianity, Birsa started the faith of 'Birsait'.
- Soon members of the Munda and Oraon community started joining the Birsait sect and it turned into a challenge to British conversion activities.
- During the period, 1886 to 1890, Birsa Munda spent a large amount of time in Chaibasa which was close to the centre of the Sardars agitation.
    - The activities of the Sardars had a strong impact on the mind of the young Birsa, who soon became a part of the anti-missionary and anti-government program.
- By the time he left Chaibasa in 1890, Birsa was strongly entrenched in the movement against the British oppression of the tribal communities.
- On March 3, 1900, Birsa Munda was arrested by the British police while he was sleeping with his tribal guerilla army at Jamkopai forest in Chakradharpur.
- He died in Ranchi jail on June 9, 1900 at a young age of 25.
- Though he lived a short span of life and the fact that the movement died out soon after his death, Birsa Munda is known to have mobilised the tribal community against the British and had also forced the colonial officials to introduce laws protecting the land rights of the tribals.
- Birsa's achievements as a young tribal revolutionary has continued to be celebrated over decades now and he has successfully carved out a space for himself in popular and folk literature, academia, and mass media.

9. Mapping

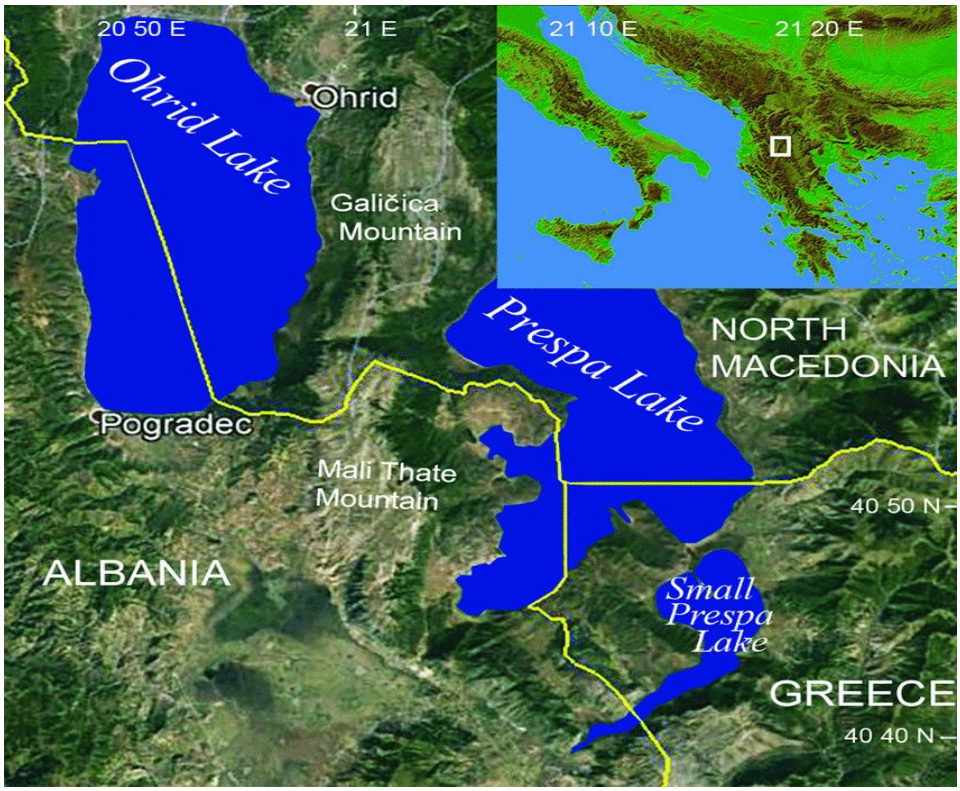
9.1 Little Prespa Lake

Context:

- Little Prespa Lake on Albanian-Greek border slowly dying

More info:

- Plants and reeds have sprouted up as the waters of Little Prespa Lake on the Albanian-Greek border recede, their beauty overshadowing a painful truth: the lake is slowly dying.
- The once crystal-clear lake has mostly been transformed into a marshy watering hole in this corner of southeastern Albania.
- The majority of Little Prespa Lake, also known as Small Lake Prespa, sits in Greek territory, with just its southern tip crossing into Albania.
- It is a smaller cousin of the larger Great Prespa Lake to the north.
- According to experts, of the 450 hectares of Little Prespa Lake in Albania, at least 430 hectares have been transformed into swamps or dried up.
- For the inhabitants, the beginning of the misfortune dates back to the 1970s, when communist authorities diverted the Devoll River to irrigate fields around the nearby Albanian city of Korca.
- Climate change has exacerbated the problem, experts said.
- Rising temperatures and increasingly mild winters with little snowfall and a scarcity of precipitation have battered the lake.



9.2 Depsang and Demchok

Context:

- Disengagement in Depsang and Demchok first step, de-escalation next: EAM Jaishankar on India-China ties

About Depsang (Plains):

- It is a high-altitude gravelly plain in the northwest portion of the disputed Aksai Chin region of Kashmir, divided into Indian and Chinese administered portions by a Line of Actual Control.
- India controls the western portion of the plains as part of Ladakh, while the eastern portion is controlled by China and claimed by India.
- The Line of Control with Pakistan-administered Gilgit-Baltistan is 80 kilometres west of the Depsang Plains, with the Siachen Glacier in-between.
- Ladakh's traditional trade route to Central Asia passed through the Depsang Plains, with the Karakoram Pass lying directly to its north.
- The area sees frequent tension between China and India.

Geography:

- The Depsang plains are located in the north-western Aksai Chin.
- They are bounded on the north by the valley of the Chip Chap River and on the west by the Shyok River.
- On the east, they are bounded by low hills of the Lak Tsung range, which separate them from the basin of the Karakash River.
- In the south, the Depsang Plains proper end at the Depsang La pass.
- The Karakoram Pass is located to the north of the Depsang Plains, while the Lingzi Thang plains lie to the southeast.
- On the west is the southern part of the Rimo glacier, the source of the Shyok River.

Line of Actual Control:

- In 1962, China and India fought a war over the border dispute, following which the Depsang Plains have been divided between the two countries across a Line of Actual Control (LAC).

About Demchok:

- It is a village and military encampment in the Indian-administered Demchok sector that is disputed between India and China.
- It is administered as part of the Nyoma tehsil in the Leh district of Ladakh by India, and claimed by China as part of the Tibet Autonomous Region.
- The Line of Actual Control (LAC) passes along the southeast side of the village, along the Charding Nullah (also called Demchok River and Lhari stream) which joins the Indus River near the village.
- Across the stream, less than a kilometre away, is a Chinese-administered Demchok village.
- Around the corner of the Demchok Lhari Karpo peak is a hot spring near Demchok, whose water is believed to have medicinal qualities.
- The majority of the inhabitants of Demchok are Changpa nomadic pastoralist.

9.3 Georgia

Context:

- Georgia's president calls for Western support amid protests over parliamentary election results marred by Russian meddling allegations

About Georgia:

- It is situated at the strategically important crossroads where Europe meets Asia.
- Georgia, country of Transcaucasia located at the eastern end of the Black Sea on the southern flanks of the main crest of the Greater Caucasus Mountains.
- It is bounded on the north and northeast by Russia, on the east and southeast by Azerbaijan, on the south by Armenia and Turkey, and on the west by the Black Sea.
- Georgia declared sovereignty in 1989 and independence in 1991.
- Since emerging from the collapsing Soviet Union as an independent state in 1991, Georgia has again become the arena of conflicting interests.
- Tense relations with Russia after the 2003 "Rose Revolution" were further exacerbated by Moscow's support for the breakaway regions of Abkhazia and South Ossetia, leading to a brief war in 2008.
- Georgia had been granted EU candidate status in 2023 but its path to membership has faltered as EU leaders said the media law amounted to "backsliding" by Tbilisi.

9.4 Santhal Pargana

Context:

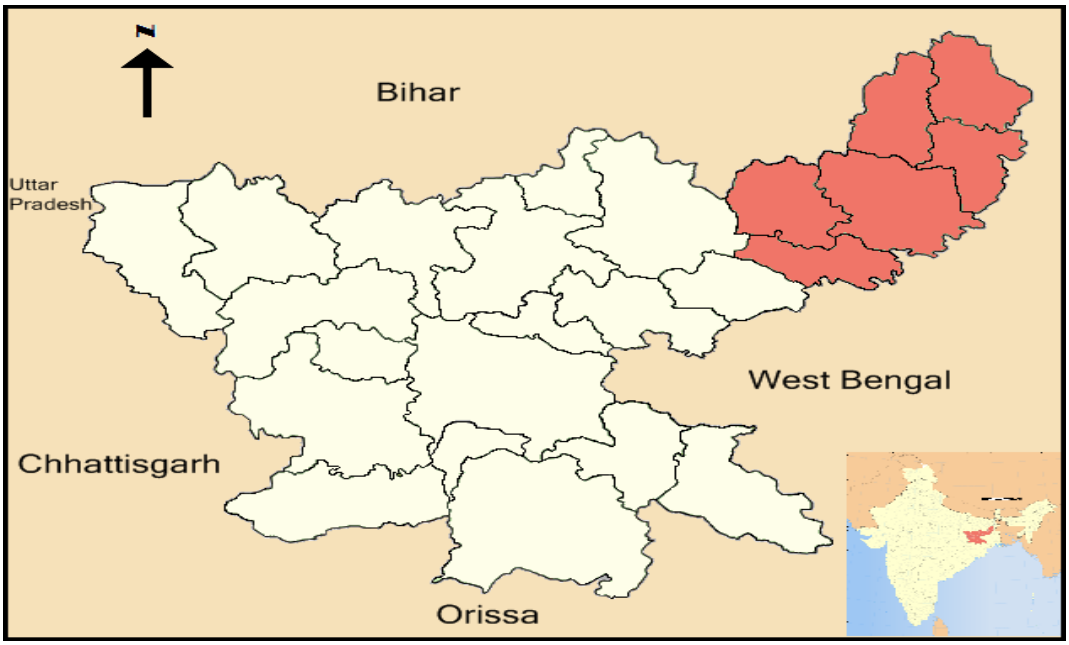
- In the National Commission for Scheduled Tribes' report on the demographic changes in Jharkhand's Santhal Pargana region, the Commission has recommended roping in non-State actors, specifically non-governmental organisations (NGOs), to deal with the alleged problem of "Bangladeshi infiltration" into the State.
    - The report concludes that the demographic changes in Santhal Pargana region over the last seven decades had been caused by alleged infiltration of illegal immigrants from Bangladesh.

About Santhal Pargana:

- Santhal Pargana division constitutes six district administration units known as the divisions of Jharkhand state in eastern India.
- Santhal Pargana derives its name from two words: "Santhal", a major inhabited tribe in the region and Pargana, a unit of administration in Persian language used mostly by medieval rulers.
- Santhal Pargana is one of the divisions of Jharkhand. Its headquarters is at Dumka.
    - Presently, this administrative division comprises six districts: Godda, Deoghar, Dumka, Jamtara, Sahibganj and Pakur.
- Majority of the population follows Hinduism. Sari Dharam is followed by the Santal tribe residents and Sarna by other tribe.

More info:

- Throughout the NCST's report, the Commission alludes that almost all issues raised by local Adivasis were a result of "illegal immigration" - from the lack of government scheme penetration and local land disputes to human trafficking, missing girls, and cybercrime.
- Jharkhand has no international borders.
    - Pakur district shares its border with West Bengal near the latter's neck, beyond which is Bangladesh.



9.5 Moldova

Context:

- Moldovans cast votes to choose president and decide on EU path

News:

- Moldovans are casting ballots in two elections that could determine whether the country, which neighbours Ukraine, remains on a pro-western path amid allegations that Russia tried to undermine the electoral process.

About Moldova:

- It is a landlocked country bordering Ukraine and Romania - emerged as an independent republic following the collapse of the Soviet Union in 1991.
- It is one of Europe's poorest countries, with its economy relying heavily on agriculture.
- Two-thirds of Moldovans are of Romanian descent, and the two countries share a common cultural heritage.
- The industrialised territory to the east of the Dniester, generally known as Transnistria or the Dniester region, was formally an autonomous area within Ukraine before 1940, when the Soviet Union combined it with Bessarabia to form the Moldavian Soviet Socialist Republic.
    - This area is mainly inhabited by Russian and Ukrainian speakers.
    - As people there became concerned at the prospect of closer ties with Romania in final years of the Soviet Union, Transnistria unilaterally declared independence in 1990.
- Since Russia's 2022 invasion of Ukraine, Moldova's pro-Western and pro-Russian factions have become increasingly divided.
- In 2023-24 the US and then the EU sanctioned several pro-Russian politicians for collusion with Russia amid attempts to destabilise Moldova.
- In 2024, voters backed proposed changes to its constitution and commitment to joining the EU by the thinnest of margins in a referendum - by 50.4% to 49.5%.
    - The knife-edge nature of the vote came as a shock to many. The referendum had been widely expected to comfortably pass.

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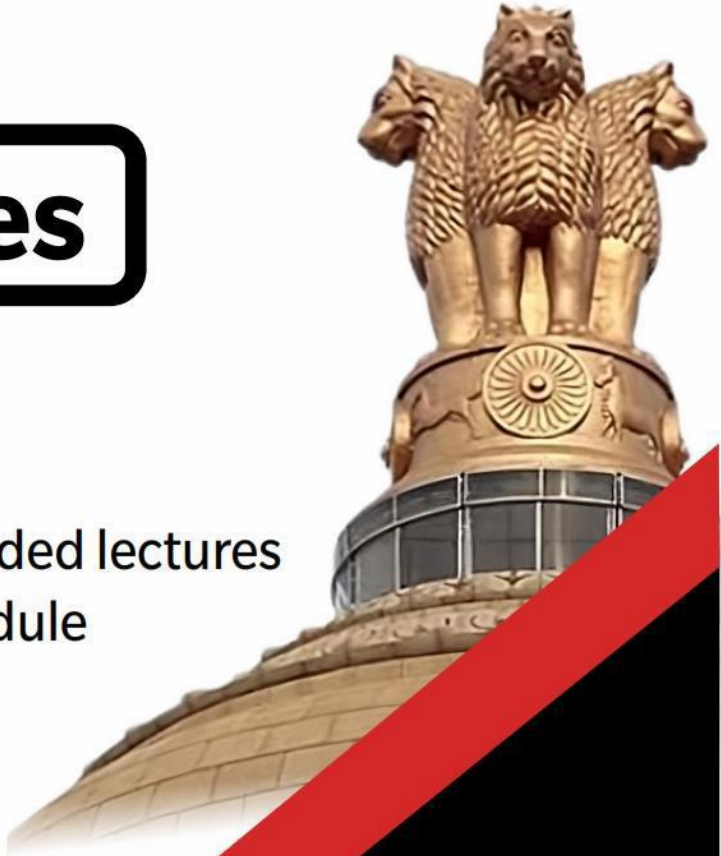

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