

Edge IAS

Celebrate Learning !



Current Affairs (December 2024)



- NCERT Based Learning
- Dedicated Current Affairs Sessions
- Recorded Lectures
- Answer Writing Practice
- Updated Study Material & Test Series
- Online Support
- Personalized Mentoring and Guidance
- Detailed CSAT Foundation

Let's

Learn

Today

www.iasedge.in

CURRENT AFFAIRS, EDGE IAS

This Document was prepared under the supervision of Mr. Pramod Singh, Director, Edge IAS.

Current Affairs, December 2024

INDEX

1. Polity and Governance	5
Prelims	5
1.1 Impeachment motion against High Court judge	5
1.2 Removal of Rajya Sabha Chairperson	6
1.3 Selection process of NHRC chief	7
Mains	8
1.4 Simultaneous polls	8
1.5 One Nation, One Election	9
2. International Relations	13
Prelims	13
2.1 Iran and Centrifuges	13
2.2 Organization for Security and Co-operation in Europe (OSCE)	14
3. Economy	15
Prelims	15
3.1 National policy paper on female labour force participation	15
3.2 RBI to allow small finance banks to extend credit lines through UPI	16
3.3 Blue Chip Stocks	16
3.4 Most Favored Nation (MFN)	17
3.5 Critical Minerals	18
3.6 Svamitva scheme	19
3.7 Swadesh Darshan Scheme of Tourism Ministry	20
Mains	21
3.8 Oilfields (Regulation and Development) Amendment Bill, 2024	21
3.9 Vadhavan port	22
3.10 India's urban infrastructure financing, needs and reality	24
3.11 Why esports should be part of the curriculum	26
3.12 Tourism Sector	28
3.13 LABOUR WELFARE AND SOCIAL SECURITY IN THE INFORMAL AND GIG ECONOMY	29
3.14 Extent of the global share of solar energy	30
3.15 India's FDI Journey Hits \$1 Trillion	31
3.16 Steps by Government to Reduce Import Dependency on Crude Oil	33
3.17 PROMOTION OF ELECTRIC VEHICLES	34
3.18 The MSME Revolution - Transforming India's Economic Landscape	35
3.19 Financial Stability Report (FSR)	36
4. Science and Tech	38
Prelims	38
4.1 Starlink satellite internet	38
4.2 Space Debris Management	38
4.3 PSLV-C59/Proba-3 Mission	39

4.4 Artemis moon missions	40
4.5 Proba-3 mission and Sun's Corona	41
4.6 AI tool to predict IVF outcomes in men with infertility	42
4.7 Multiple myeloma	43
4.8 Rooppur nuclear project	44
4.9 U.S. Anti-missile THAAD system	45
4.10 NASA's Parker Solar Probe	45
Mains	46
4.11 Did Venus ever have oceans?	46
4.12 Water on Mars	47
4.13 Hand-held 'electric labs'	49
4.14 Major Atmospheric Cherenkov Experiment (MACE)	51
4.15 Infectious disease	53
5. Environment and Ecology	55
Prelims	55
5.1 World's rarest whale	55
5.2 Floating vetiver islands	55
5.3 GRADED RESPONSE ACTION PLAN (GRAP) FOR NCR	56
5.4 U.N.'s highest environmental honour	56
5.5 Delhi's poor AQI: Can air purifiers help?	58
5.6 Conservation status of great Indian bustard	58
5.7 PM2.5 pollution	59
5.8 Slender-billed curlew	59
Mains	60
5.9 The toxins of the Bhopal disaster	60
5.10 Global drylands	62
5.11 India State of Forest Report 2023	63
5.12 Green Skills	65
6. Social Issues	67
6.1 Transwomen in India	67
6.2 Ayushman Vay Vandana Card (AVVC)	68
6.3 WHO's latest World Malaria Report (2024)	69
7. Miscellaneous	72
7.1 UNESCO 'City of Literature'	72
7.2 IIT Delhi, IISc lead in QS sustainability rankings 2025	73
7.3 Notre-Dame de Paris	73
7.4 National Maritime Heritage Complex (NMHC)	74
7.5 Ken-Betwa river-linking project	74
7.6 Kurubas of Karnataka	76
8. Mapping	77
8.1 Bangladesh	77

8.2 Aleppo and Idlib	78
8.3 U.S. territory Guam and Island chains	79
8.4 Syria	80
8.5 Moldova	81
8.6 Mount Hermon	82
8.7 Panama Canal	83
8.8 Black Sea and Kerch Strait	84
8.9 Mediterranean Sea	85

1. Polity and Governance

Prelims

1.1 Impeachment motion against High Court judge

News:

- National Conference MP Aga Syed Ruhullah said he would move an impeachment motion in Parliament against Justice Shekhar K. Yadav, sitting judge in the Allahabad High Court, over the latter's recent remarks against Muslims.
 - MP told that he is moving impeachment motion in the Parliament in accordance with Art 124(4) of the constitution for the removal of this Justice.

Removal of Judges from Office:

- A judge may be removed from office through a motion adopted by Parliament on grounds of 'proven misbehaviour or incapacity'.
- While the Constitution does not use the word 'impeachment', it is colloquially used to refer to the proceedings under Article 124 (for the removal of a Supreme Court judge) and Article 218 (for the removal of a High Court judge).
 - **Article 124(4):** A Judge of the Supreme Court shall not be removed from his office except by an order of the President passed after an address by each House of Parliament supported by a majority of the total membership of that House and by a majority of not less than two-third of the members of the House present and voting has been presented to the President in the same session for such removal on the ground of proved misbehavior or incapacity.
 - **Article 124(5):** Parliament may by law regulate the procedure for the presentation of an address and for the investigation and proof of the misbehavior or incapacity of a Judge under clause (4).
 - **Article 218:** Application of certain provisions relating to Supreme Court to High Courts.
 - The provisions of clauses (4) and (5) of article 124 shall apply in relation to a High Court as they apply in relation to the Supreme Court with the substitution of references to the High Court for references to the Supreme Court.
- The Constitution provides that a judge can be removed only by an order of the President, based on a motion passed by both Houses of Parliament.
- The procedure for removal of judges is elaborated in the Judges Inquiry Act, 1968.

The Judges Inquiry Act sets out the following steps for removal from office:

- Under the Act, an impeachment motion may originate in either House of Parliament.
- To initiate proceedings: (i) at least 100 members of Lok Sabha may give a signed notice to the Speaker, or (ii) at least 50 members of Rajya Sabha may give a signed notice to the Chairman.
- The Speaker or Chairman may consult individuals and examine relevant material related to the notice.
 - Based on this, he or she may decide to either admit the motion or refuse to admit it.
- If the motion is admitted, the Speaker or Chairman (who receives it) will constitute a three-member committee to investigate the complaint.
 - It will comprise: (i) a Supreme Court judge; (ii) Chief Justice of a High Court; and (iii) a distinguished jurist.
 - The committee will frame charges based on which the investigation will be conducted.
 - A copy of the charges will be forwarded to the judge who can present a written defence.

- After concluding its investigation, the Committee will submit its report to the Speaker or Chairman, who will then lay the report before the relevant House of Parliament.
 - If the report records a finding of misbehaviour or incapacity, the motion for removal will be taken up for consideration and debated.
- The motion for removal is required to be adopted by each House of Parliament by: (i) a majority of the total membership of that House; and (ii) a majority of at least two-thirds of the members of that House present and voting.
 - If the motion is adopted by this majority, the motion will be sent to the other House for adoption.
- Once the motion is adopted in both Houses, it is sent to the President, who will issue an order for the removal of the judge.

1.2 Removal of Rajya Sabha Chairperson

News:

- In an unprecedented move, about 60 Opposition MPs belonging to the INDIA (Indian National Developmental, Inclusive Alliance) bloc submitted a notice in New Delhi on Tuesday (December 10, 2024) at the Rajya Sabha Secretary General P.C. Mody's office, seeking the removal of the Chairperson of the Upper House, Vice President Jagdeep Dhankhar.
- Alleging that Mr. Dhankhar, since assuming the office of Chairperson of the Rajya Sabha in August 2022, had conducted the proceedings of the House in an "extremely biased" manner, the Opposition members also presented a six-point "charge-sheet" against him in the notice.
- The notice was unlikely to be taken up as a resolution in the House as the winter session ends in less than 14 days of submitting the notice.
 - It will not be carried over to the next session (one view).
 - All notices given during a session become invalid once the session is prorogued.
- The MPs have used Article 67 of the Constitution of India to move the notice, and said that a motion for the removal of the Vice President from his office required a 14-day prior notice of intent on part of the members of the Council of States that are in support of the said resolution.
 - The present resolution should be regarded as the notice for the purposes of Article 67 of the Constitution.

Article 67:

- The language of Article 67 is wide - Rajya Sabha must pass a resolution to remove the chairperson by 'a majority of all the then members', and Lok Sabha must 'agree'.
- No Vice President has ever been removed from office in this way.
- The Opposition gave notice for a motion of no-confidence against Rajya Sabha chairperson Jagdeep Dhankhar on Tuesday (December 10), the first such action in India's parliamentary history.
- Since the Vice President and Rajya Sabha chairperson must be the same individual, the process for their removal is also the same - and is laid down under Article 67.
- The requirements for removing or impeaching the Vice President are provided under Article 67(b).
 - It states that the Vice President may be removed if a majority "all the then members of the Council (Rajya Sabha)" passes a resolution for his removal, which must then be "agreed to" by the House of the People (Lok Sabha).
 - Under this provision, "no resolution...shall be moved unless at least fourteen days' notice has been given of the intention to move the resolution".

Scenario after the notice for impeachment is given:

- Upon the expiry of the 14-day period, Rajya Sabha will take up the resolution for discussion.

- The procedure outlined in Article 67(b) will then follow.
- In the present case, it is unclear if the resolution will be taken up by the House.
 - This is because the Winter Session of Parliament is scheduled to conclude on December 20, which is less than 14 days away.
 - There are no precedents to determine whether this same resolution can be considered in the next Session of the House (second view).
- In any case, given the arithmetic in Parliament, it is almost certain that the resolution will be defeated.
 - This is largely a symbolic move of protest by the Opposition that alleges the Vice President is unfair and partisan in the way he conducts the House.

1.3 Selection process of NHRC chief

Context:

- A day after former Supreme Court judge V. Ramasubramanian was appointed Chairperson of the National Human Rights Commission (NHRC), Leader of the Opposition in the Rajya Sabha and his Lok Sabha counterpart, registered their dissent on the grounds that the process adopted was “fundamentally flawed” and a “pre-determined” exercise that ignored mutual consultation and consensus.

More info:

- The Opposition leaders argued that the committee relied on its numerical majority to finalise the names instead of fostering deliberation and ensuring a collective decision.
 - They said the NHRC is a vital statutory body tasked with safeguarding the fundamental human rights of all citizens, particularly those from oppressed and marginalised sections of society.
 - Its ability to fulfil this mandate depends significantly on the inclusiveness and representativeness of its composition.
 - A diverse leadership ensures that the NHRC remains sensitive to the unique challenges faced by various communities, especially those most vulnerable to human rights violations.

About NHRC:

- The National Human Rights Commission (NHRC) of India was established on 12 October, 1993.
 - The statute under which it is established is the Protection of Human Rights Act (PHRA), 1993 as amended by the Protection of Human Rights (Amendment) Act, 2006.
 - It is in conformity with the Paris Principles, adopted at the first international workshop on national institutions for the promotion and protection of human rights held in Paris in October 1991, and endorsed by the General Assembly of the United Nations by its Regulations 48/134 of 20 December, 1993.
- The NHRC is an embodiment of India’s concern for the promotion and protection of human rights.
- Section 2(1)(d) of the PHRA defines Human Rights as the rights relating to life, liberty, equality and dignity of the individual guaranteed by the Constitution or embodied in the International Covenants and enforceable by courts in India.
- NHRC is a unique institution because it is one of the few National Human Rights Institutes (NHRIs) in the world whose Chairperson is the former Chief Justice of the country.

Constitution of NHRC:

- The Commission consists of a Chairperson, five full-time Members and seven deemed Members.
- The statute lays down qualifications for the appointment of the Chairperson and Members of the Commission.

Appointment:

- Section 2, 3 and 4 of PHRA lay down the rules for appointment to the NHRC.
- The chairperson and members of the NHRC are appointed by the President of India, on the recommendation of a committee consisting of:
 - The Prime Minister (Chairperson)
 - The Home Minister
 - The Leader of the Opposition in the Lok Sabha (Lower House)
 - The Leader of the Opposition in the Rajya Sabha (Upper House)
 - The Speaker of the Lok Sabha (Lower House)
 - The Deputy Chairman of the Rajya Sabha (Upper House)

Mains**1.4 Simultaneous polls****News:**

- The Union Cabinet approved bills to implement "one nation, one election".
- A high-level committee headed by former President Ram Nath Kovind had made recommendations on simultaneous polls, which were accepted by the Cabinet in September.

The top 10 recommendations on simultaneous polls made by the high-level panel on simultaneous polls are:

- The government must develop a legally-tenable mechanism in order to restore the cycle of simultaneous polls.
- In the first stage, elections for the Lok Sabha and all state legislative assemblies can be held together.
- In the second step, the elections to municipalities and panchayats will be synchronised with the Lok Sabha and state assemblies in such a way that the polls to municipalities and panchayats are held within 100 days of the holding of the parliamentary and Assembly elections.
- For the purpose of synchronising the Lok Sabha and Assembly elections, the president shall notify the date of the first sitting of the Lok Sabha after a general election as the "appointed date".
- The tenure of all state assemblies formed via polls after the "appointed date" and before the expiry of the full term of the Lok Sabha will only be for the period ending up to the subsequent parliamentary polls.
 - After this one-time transitory measure, all Lok Sabha and Assembly polls will be held simultaneously.
- Fresh elections could be held to constitute a new Lok Sabha in the event of a hung House or a no-confidence motion or any such event.
 - Where fresh elections are held for the House of the People (Lok Sabha), the tenure of the House will be "only for the unexpired (remaining) term of the immediately preceding full term of the House".
- When fresh elections are held for state legislative assemblies, then such new assemblies - unless sooner dissolved - shall continue up to the end of the full term of the Lok Sabha.
- A single electoral roll and elector's photo identity card (EPIC) shall be prepared by the Election Commission (EC) in consultation with the state election commissions and the same will substitute any other electoral roll prepared by the EC.
- For making logistical arrangements for the conduct of simultaneous elections, the EC may draw up a plan and estimate in advance for the procurement of equipment, such as EVMs and VVPATs, deployment of polling personnel and security forces and make other necessary arrangements.

UPSC Mains PYQ (2017):

- 'Simultaneous election to the Lok Sabha and the State Assemblies will limit the amount of time and money spent in electioneering but it will reduce the government's accountability to the people' Discuss.

1.5 One Nation, One Election

Introduction:

- India's democratic framework thrives on the vibrancy of its electoral process, enabling citizens to actively shape governance at every level.
- Since independence, over 400 elections to the Lok Sabha and State Legislative Assemblies have showcased the Election Commission of India's commitment to fairness and transparency.
 - However, the fragmented and frequent nature of elections has sparked discussions on the need for a more efficient system.
 - This has led to the resurgence of interest in the concept of "One Nation, One Election."
- The idea, also known as simultaneous elections, proposes aligning the election cycles of the Lok Sabha and State Assemblies.
 - This would allow voters to cast their ballots for both tiers of government on the same day in their constituencies, though voting could still occur in phases across the country.
 - By synchronising these electoral timelines, the approach aims to address logistical challenges, reduce costs, and minimise disruptions caused by frequent elections.
 - The High-Level Committee Report on Simultaneous Elections in India, released in 2024, provided a comprehensive roadmap for implementing this vision.
 - Its recommendations were accepted by the Union Cabinet on 18th September 2024, marking a significant step towards electoral reform.
 - Proponents argue that such a system could enhance administrative efficiency, reduce election-related expenditures, and promote policy continuity.
- As India aspires to streamline governance and optimise its democratic processes, the concept of "One Nation, One Election" has emerged as a key reform requiring thoughtful deliberation and consensus.

Historical Background:

- The concept of simultaneous elections is not a new idea in India.
 - Following the adoption of the Constitution, elections to the Lok Sabha and all State Legislative Assemblies were conducted simultaneously from 1951 to 1967.
 - The first general elections to the Lok Sabha and State Assemblies were held together in 1951-52, a practice that continued for three subsequent general elections in 1957, 1962, and 1967.
 - However, this cycle of synchronised elections was disrupted in 1968 and 1969 due to the premature dissolution of some State Legislative Assemblies.
 - The Fourth Lok Sabha was also dissolved prematurely in 1970, with fresh elections held in 1971.
 - Unlike the First, Second, and Third Lok Sabha, which completed their full five-year terms, the Fifth Lok Sabha's term was extended until 1977 under Article 352 because of the declaration of Emergency.
 - Since then, only a few Lok Sabha terms have lasted the full five years, such as the Eighth, Tenth, Fourteenth, and Fifteenth.
 - Others, including the Sixth, Seventh, Ninth, Eleventh, Twelfth, and Thirteenth, were dissolved early.
- State Assemblies have faced similar disruptions over the years.
 - Premature dissolutions and term extensions have become a recurring challenge.
- These developments have firmly disrupted the cycle of simultaneous elections, leading to the current pattern of staggered electoral schedules across the country.

High-Level Committee on Simultaneous Elections:

- The High-Level Committee on Simultaneous Elections, headed by former President Ram Nath Kovind, was constituted by the Government of India on 2nd September 2023.

- Its primary objective was to explore the feasibility of conducting simultaneous elections for the Lok Sabha and State Legislative Assemblies.
- The committee solicited extensive public and political feedback, and consulted with experts to analyse the potential benefits and challenges associated with this proposed electoral reform.
- This report presents a detailed overview of the committee's findings, its recommendations for constitutional amendments, and the anticipated impact of simultaneous elections on governance, resources, and public sentiment.

Key Takeaways:

- **Public Response:** The Committee received over 21,500 responses, with 80% in favour of simultaneous elections.
 - The responses came from all corners of the country, including Lakshadweep, Andaman and Nicobar, Nagaland, Dadra, and Nagar Haveli.
 - The highest responses were received from Tamil Nadu, Maharashtra, Karnataka, Kerala, West Bengal, Gujarat, and Uttar Pradesh.
- **Responses from Political Parties:** 47 political parties submitted their views.
 - Of these, 32 parties supported simultaneous elections, citing benefits like resource optimization and social harmony.
 - 15 parties raised concerns about potential anti-democratic effects and marginalization of regional parties.
- **Expert Consultations:** The Committee consulted Former Chief Justices of India, Former Election Commissioners, and legal experts.
 - A majority supported the concept of simultaneous elections, emphasizing the waste of resources and socio-economic disruptions caused by frequent elections.
- **Economic Impact:** Business organizations like CII, FICCI, and ASSOCHAM supported the proposal, highlighting the positive impact on economic stability by reducing disruptions and costs associated with election cycles.
- **Legal and Constitutional Analysis:** The Committee proposed amendments to Articles 82A and 324A of the Indian Constitution to enable simultaneous elections for the Lok Sabha, State Assemblies, and local bodies.
- **Phased Approach to Implementation:** The Committee recommended implementing simultaneous elections in two phases:
 - **Phase 1:** Synchronizing Lok Sabha and State Legislative Assemblies elections.
 - **Phase 2:** Synchronizing elections for Municipalities and Panchayats with Lok Sabha and State Legislative elections within 100 days.
- **Electoral Roll and EPIC Harmonization:** The Committee highlighted inefficiencies in electoral roll preparation by State Election Commissions and recommended creating a Single Electoral Roll and Single EPIC for all three tiers of government.
 - This would reduce duplication and errors, safeguarding voter rights.
- **Public Sentiment on Frequent Elections:** Public responses indicated significant concern about the negative impacts of frequent elections, such as voter fatigue and governance disruptions, which are expected to be mitigated by simultaneous elections.

Rationale for Simultaneous Elections:

- The points below are based on the findings of the report issued by the High-Level Committee on Simultaneous Elections, headed by former President Ram Nath Kovind:
- **Promotes Consistency in Governance:** Due to the ongoing cycle of elections in various parts of the country, political parties, their leaders, legislators, and both State and Central Governments often focus their efforts on preparing for upcoming elections rather than prioritizing governance.

- The adoption of simultaneous elections would refocus the government's attention towards developmental activities and the implementation of policies aimed at promoting the welfare of the masses.
- **Prevents Policy Paralysis:** The implementation of the Model Code of Conduct during elections disrupts routine administrative activities and developmental initiatives.
 - This disruption not only hampers the progress of vital welfare schemes but also leads to governance uncertainty.
 - Holding simultaneous elections would mitigate the prolonged enforcement of the MCC, thereby reducing policy paralysis and enabling continuous governance.
- **Mitigates Resource Diversion:** The deployment of a substantial number of personnel for election duties, such as polling officials and civil servants, can lead to significant diversion of resources from their core responsibilities.
 - With elections conducted simultaneously, the need for frequent deployment would diminish, allowing government officials and public institutions to focus more on their primary roles rather than election-related tasks.
- **Preserves Regional Party Relevance:** Holding simultaneous elections does not undermine the role of regional parties.
 - In fact, it encourages a more localized focus during elections, enabling regional parties to highlight their unique concerns and aspirations.
 - This setup fosters a political environment where local issues are not overshadowed by national election campaigns, thus preserving the relevance of regional voices.
- **Enhances Political Opportunities:** Conducting elections simultaneously entails a more equitable allocation of political opportunities and responsibilities within political parties.
 - Currently, it is not uncommon for certain leaders within a party to dominate the electoral landscape, contesting elections at multiple levels and monopolizing key positions.
 - In the scenario of simultaneous elections, there arises greater scope for diversification and inclusivity among political workers representing various parties, allowing a wider range of leaders to emerge and contribute to the democratic process.
- **Focus on Governance:** The ongoing cycle of elections across the country diverts attention from good governance.
 - Political parties focus more on election-related activities to secure victories, leaving less time for development and essential governance.
 - Synchronised elections would allow parties to dedicate their efforts to addressing the needs of the electorate, reducing instances of conflicts and aggressive campaigning.
- **Reduced Financial Burden:** Conducting simultaneous elections could significantly cut down the financial costs associated with multiple election cycles.
 - This model reduces the expenditure related to the deployment of resources like manpower, equipment, and security for each individual election.
 - The economic benefits include a more efficient allocation of resources and better fiscal management, fostering a conducive environment for economic growth and investor confidence.

Conclusion:

- The High-Level Committee on Simultaneous Elections, led by former President Ram Nath Kovind, has laid the groundwork for a transformative shift in India's electoral process.
- By aligning the election cycles of the Lok Sabha and State Legislative Assemblies, the committee's recommendations promise to address long-standing challenges associated with frequent elections, such as governance disruptions and resource wastage.

- The proposed phased approach to implementing simultaneous elections, along with constitutional amendments, could pave the way for a more efficient and stable electoral environment in India.
- With widespread public and political support, the concept of simultaneous elections stands poised to streamline India's democratic processes and bolster the efficiency of governance.

UPSC Mains PYQ (2017):

- Simultaneous election to the Lok Sabha and the State Assemblies will limit the amount of time and money spent in electioneering but it will reduce the government's accountability to the people". Discuss.

2. International Relations

Prelims

2.1 Iran and Centrifuges

Context:

- Iran to begin enriching uranium with thousands of advanced centrifuges: U.N. watchdog

News:

- Iran will begin enriching uranium with thousands of advanced centrifuges at its two main nuclear facilities at Fordo and Natanz, the United Nations' nuclear watchdog said, further raising tensions over Tehran's programme as it enriches at near weapons-grade levels.

More info:

- The notice from the International Atomic Energy Agency only mentioned Iran enriching uranium with new centrifuges to 5% purity, far lower than the 60% it currently does - likely signalling that it still wants to negotiate with the West and the incoming administration of President-elect Donald Trump.
- In a statement, the IAEA outlined the plans Iran informed it of, which include feeding uranium into some 45 cascades of its advanced IR-2M, IR-4 and IR-6 centrifuges.
 - Cascades are a group of centrifuges that spin uranium gas together to more quickly enrich the uranium.
 - Each of these advanced classes of centrifuges enrich uranium faster than Iran's baseline IR-1 centrifuges, which have been the workhorse of the country's atomic programme.
- Weapons-grade levels of enrichment are around 90 per cent.
- Since the collapse of Iran's 2015 nuclear deal with world powers following the U.S.' unilateral withdrawal from the accord in 2018, it has pursued nuclear enrichment just below weapons-grade levels.
- Iran, as a signatory to the Treaty on the Non-Proliferation of Nuclear Weapons, has pledged to allow the IAEA to visit its atomic sites to ensure its programme is peaceful.
- Tehran also had agreed to additional oversight from the IAEA as part of the 2015 nuclear deal, which saw sanctions lifted in exchange for drastically limiting its programme.

Centrifuge:

- A centrifuge is a device that uses centrifugal force to subject a specimen to a specified constant force - for example, to separate various components of a fluid.
 - This is achieved by spinning the fluid at high speed within a container, thereby separating fluids of different densities (e.g. cream from milk) or liquids from solids.
 - It works by causing denser substances and particles to move outward in the radial direction. At the same time, objects that are less dense are displaced and moved to the centre.
- Medium-sized centrifuges are used in washing machines and at some swimming pools to draw water out of fabrics.
- Gas centrifuges are used for isotope separation, such as to enrich nuclear fuel for fissile isotopes.
- A prominent use of gas centrifuges is for the separation of uranium-235 (²³⁵U) from uranium-238 (²³⁸U).



2.2 Organization for Security and Co-operation in Europe (OSCE)

Context:

- Russian foreign minister attends OSCE meeting in Malta, along with U.S. and Ukraine

About OSCE:

- The OSCE has a comprehensive approach to security that encompasses politico-military, economic and environmental, and human aspects.
 - It therefore addresses a wide range of security-related concerns, including arms control, confidence- and security-building measures, human rights, national minorities, democratization, policing strategies, counter-terrorism and economic and environmental activities.
- The OSCE has 57 participating States from Europe, Central Asia and North America.
- The OSCE Chairpersonship is held for one calendar year by the OSCE participating State designated as such by a decision of the Ministerial Council.
 - The function of the Chairperson-in-Office (CiO) is exercised by the Minister of Foreign Affairs of that State.
- All 57 participating States enjoy equal status, and decisions are taken by consensus on a politically, but not legally binding basis.
- At OSCE Summits, the Heads of State or Government of the OSCE participating States set the Organization's priorities and provide orientation for several years.
- Secretariat, Vienna:** The Secretariat assists the Chairmanship in its activities, and provides operational and administrative support to field operations and, as appropriate, to other Institutions.
- The OSCE's activities cover areas from "hard" security issues such as conflict prevention to fostering economic development, ensuring the sustainable use of natural resources, and promoting the full respect of human rights and fundamental freedoms.

3. Economy

Prelims

3.1 National policy paper on female labour force participation

Context:

- Centre working on national policy paper on female labour force participation

News:

- The Centre will soon bring out a national policy document on female labour force participation with a focus on providing an enabling atmosphere like a viable care economy structure.
 - Care economy is the sector of economic activities related to the provision of care, both paid and unpaid, for the present and future populations.
 - It includes direct care, such as feeding a baby as well as indirect care, such as cooking and cleaning, health care, education and other personal and domestic services.

More info:

- An inter-ministerial team from the Ministries of Skill Development, Labour, Rural Development and Women and Child Development is working on the policy paper.
- The move comes amid a recent World Bank report which said women faced a sharp drop in their labour force participation post-marriage in India.
 - According to the report, it is estimated that in India post-marriage, female employment rates drop by 12 percentage points, about one-third of the female pre-marital employment rate, even in the absence of children.
- Deliberations were on between the various ministries and that the document would focus on building a care-giving infrastructure to boost women's participation in the labour market.

Core skilling package:

- One of the initiatives being explored is a core skilling package for caregivers for children.
- The policy paper will also look at providing child care facilities for women in the informal sector such as for workers under the National Rural Employment Guarantee Scheme.
- The Ministry of Women and Child Development already runs the 'Palna' scheme or the National Programme on Anganwadi-cum-Crèche, which provides day-care facilities for children of working parents.
 - The scheme aims to increase the participation of women in the workforce by providing a safe and secure environment for children's health, nutrition, and cognitive development.
 - The scheme is for children between the ages of 6 months and 6 years.
 - It provides a range of services, including nutritional support, health and cognitive development, growth monitoring, immunisation, and education.
 - A total of 1,000 Anganwadi creches have been made operational till now as part of this scheme.
- Union Labour Ministry data say that in 2021-2022, the female labour force participation rate in India was higher in rural areas than in urban areas.
 - In rural areas, 36.6% of women aged 15 years and above were in the labour force, compared to 23.8% in urban areas.

3.2 RBI to allow small finance banks to extend credit lines through UPI

News:

- The Reserve Bank proposed to allow small finance banks to extend pre-sanctioned credit lines through Unified Payments Interface (UPI).
 - UPI is an instant real-time payment system developed by National Payments Corporation of India (NPCI) for transactions through mobile phones.

More info:

- In September 2023, the scope of UPI was expanded by enabling pre-sanctioned credit lines to be linked through UPI and used as a funding account by commercial banks excluding Payments Banks, Small Finance Banks (SFBs) and Regional Rural Banks.
- Credit line on UPI has the potential to make available low-ticket, low-tenor products to "new-to-credit" customers.
- SFBs leverage a high-tech, low-cost model to reach the last-mile customer and can play an enabling role in expanding the reach of credit on UPI.
 - Therefore, RBI proposed to permit SFBs to extend pre-sanctioned credit lines through the UPI.
- The Reserve Bank has been deploying traditional as well as new-age communication techniques as a key part of its toolkit to ensure transparency and greater impact of its decisions, explain the rationale behind its decisions, and disseminate various awareness messages to a wider audience.
- The Reserve Bank has been expanding the scope of its public awareness activities including through social media over the last few years.
 - In continuation of this endeavour, the Reserve Bank proposes to launch podcasts for wider dissemination of information that is of interest to the general public.

3.3 Blue Chip Stocks

Context:

- Equity benchmark indices Sensex and Nifty ended lower on Monday (December 9, 2024), dragged down by selling in blue-chip stocks Reliance Industries, Hindustan Unilever, Axis Bank and mixed global trend.

About Blue Chip Stocks:

- Blue chip companies are those big, sound and stable companies that have remarkable stature in the market.
- Stocks that are issued by blue-chip companies, i.e. companies with a large market capitalisation, are termed blue-chip stocks.
- Many traders and investors choose to opt for blue chip stocks because of their stability and rising dividends.
- Blue chip stocks are often considered a good option for investment due to their dependable returns.
- Individuals can invest in Blue-chip stocks in India either directly or through Mutual Funds.

Features of Blue-chip Stocks:

- Blue-chip stocks generate returns quarterly in the form of dividends.
- Since big companies with stable financial performance issue these stocks, the risk factors associated with blue-chip stocks are comparatively less.
- The term of investment is usually over 7 years.
 - Such extended term makes Blue-chip stocks suitable for achieving long-term financial goals owing to their long investment horizon.

- The gains generated through blue-chip shares in India are treated as income under Section 80C of the Income Tax Act.

3.4 Most Favored Nation (MFN)

Context:

- Switzerland scraps MFN status to India, dividend income to face higher tax

News:

- Switzerland has withdrawn the Most Favored Nation (MFN) status granted to India following an adverse court ruling against Nestle, a move that will result in adverse tax implications for Indian entities operating in the European nation.
 - With this, from January 1, 2025, Indian companies will be subject to a higher withholding tax on income generated in Switzerland.

More info:

- Switzerland told that it is for the avoidance of double taxation with respect to taxes on income.
- This means that Switzerland will tax dividends that Indian entities will earn in that country at 10% from January 1, 2025.

Most Favored Nation (MFN):

- Treating other people equally Under the WTO agreements, countries cannot normally discriminate between their trading partners.
- Grant someone a special favour (such as a lower customs duty rate for one of their products) and you have to do the same for all other WTO members.
 - This principle is known as most-favoured-nation (MFN) treatment.
- MFN is so important that it is the first article of the General Agreement on Tariffs and Trade (GATT), which governs trade in goods.
- MFN is also a priority in the General Agreement on Trade in Services (GATS) and the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS), although in each agreement the principle is handled slightly differently.
- Together, those three agreements cover all three main areas of trade handled by the WTO.
- Some exceptions are allowed.
 - For example, countries can set up a free trade agreement that applies only to goods traded within the group - discriminating against goods from outside.
 - Or they can give developing countries special access to their markets.
 - Or a country can raise barriers against products that are considered to be traded unfairly from specific countries.
 - And in services, countries are allowed, in limited circumstances, to discriminate.
 - But the agreements only permit these exceptions under strict conditions.
- In general, MFN means that every time a country lowers a trade barrier or opens up a market, it has to do so for the same goods or services from all its trading partners - whether rich or poor, weak or strong.
- The most-favoured-nation (MFN) principle is a cornerstone of the multilateral trading system conceived after World War II.
- It seeks to replace the frictions and distortions of power-based (bilateral) policies with the guarantees of a rules-based framework where trading rights do not depend on the individual participants' economic or political clout.

- Rather, the best access conditions that have been conceded to one country must automatically be extended to all other participants in the system.
- This allows everybody to benefit, without additional negotiating effort, from concessions that may have been agreed between large trading partners with much negotiating leverage.
- In the context of the GATS, the MFN obligation (Article II) is applicable to any measure that affects trade in services in any sector falling under the Agreement, whether specific commitments have been made or not.
 - Exemptions could have been sought at the time of the acceptance of the Agreement.
 - They are contained in country-specific lists, and their duration must not exceed ten years in principle.

3.5 Critical Minerals

- Critical minerals, such as cobalt, copper, lithium, nickel and rare earths, play crucial roles in the production of clean energy technologies, ranging from wind turbines to electric vehicles.
- India is all set to launch a Critical Mineral Mission in the upcoming year to secure vital resources for green energy and technology.
 - The initiative involves government, industry, and research collaboration, focusing on acquiring overseas assets like lithium and cobalt, particularly in Australia, and boosting domestic mining through auctions and roadshows.
 - With a series of high-profile roadshows abroad along with plans to acquire critical mineral assets in Australia, India is set to woo international investors and make its mark on the global mining map.
- The countries are now racing in a bid to secure these vital resources, which include lithium and cobalt, through a complex web of policies and alliances, realising that critical minerals are the new lifeblood of the 21st-century economy.
- According to an estimate by the World Bank, by 2050, the production of minerals, including lithium and cobalt, will need to increase by nearly 500% in a bid to meet the growing demand for clean energy technologies.
 - At the same time, the International Energy Agency foresees that the rise in electric vehicles and battery storage will speed up the demand for these minerals at least 30 times by 2040.
- Critical minerals are also the backbone of the semiconductor industry.
 - As the country pushes to become a global hub for semiconductor manufacturing - a sector that is likely to reach one trillion dollars globally by 2030 - the need for a stable supply of critical minerals becomes even more urgent.
 - Semiconductors, tiny chips that power everything from smartphones to electric vehicles, depend heavily on materials like silicon, cobalt, and rare earth elements, in addition to access to technology.

About Critical Minerals:

- Critical minerals are those minerals that are essential for economic development and national security.
- The lack of availability of these minerals or concentration of extraction or processing in a few geographical locations may lead to supply chain vulnerabilities and even disruption of supplies.
- The future global economy will be underpinned by technologies that depend on minerals such as lithium, graphite, cobalt, titanium, and rare earth elements.
- These are essential for the advancement of many sectors, including hightech electronics, telecommunications, transport, and defence.
- They are also vital to power the global transition to a low carbon emissions economy, and the renewable energy technologies that will be required to meet the 'Net Zero' commitments of an increasing number of countries around the world.
- Government has released a list of 30 critical minerals for India.

- These minerals are Antimony, Beryllium, Bismuth, Cobalt, Copper, Gallium, Germanium, Graphite, Hafnium, Indium, Lithium, Molybdenum, Niobium, Nickel, PGE (Platinum-Group Elements), Phosphorous, Potash, REE (Rare Earth Elements), Rhenium, Silicon, Strontium, Tantalum, Tellurium, Tin, Titanium, Tungsten, Vanadium, Zirconium, Selenium and Cadmium.
- A joint venture company namely Khanij Bidesh India Ltd. (KABIL) has been incorporated with the equity contribution from three Central Public Sector Enterprises namely, National Aluminium Company Ltd, Hindustan Copper Ltd and Mineral Exploration Company Ltd with the objective to identify and acquire overseas mineral assets of critical & strategic nature such as Lithium, Cobalt & others so as to ensure supply side assurance.
- KABIL has engagements with countries like Argentina, Australia etc. to acquire critical & strategic minerals assets.

UPSC Mains PYQ (2021):

- Discuss the multi-dimensional implications of uneven distribution of mineral oil in the world.

3.6 Svamitva scheme

Context:

- PM Modi to distribute 58 lakh property cards under scheme to digitise rural property records

More info:

- The Svamitva scheme of the Panchayati Raj department, was launched in April 2020 with the objective of recording property rights.
- The scheme is aimed at facilitating monetisation of properties, helping the owners get bank loans, reducing property disputes and aiding in village-level planning.
- The property cards are now being recognised by banks for providing loans.
- In many cases, it has also helped women establish their ownership.
- The scheme has also aided in identifying open spaces, facilitating better planning for community development.
- The scheme's targets are likely to be achieved by 2026.
- The scheme has been onboarded by 31 States and Union Territories.
 - Of these, Sikkim, Telangana and Tamil Nadu had participated only in the pilot phase.
- Telangana and Bihar have their own version of this scheme.

About Svamitva (Survey of Villages and Mapping with Improved Technology in Village Areas) scheme:

- SVAMITVA, a Central Sector scheme of the Ministry of Panchayati Raj provides a 'Record of Rights' to village household owners with the issuance of legal ownership cards (Property cards/Title deeds) to the property owners by mapping land parcels using drone technology.

Objectives:

- Creation of accurate land records for rural planning and reducing property-related disputes.
- To bring financial stability to the citizens in rural India by enabling them to use their property as a financial asset for taking loans and other financial benefits.
- Determination of property tax, which would accrue to the GPs directly in States where it is devolved or else, add to the State exchequer.
- Creation of survey infrastructure and GIS maps that can be leveraged by any department for their use.
- To support in the preparation of a better-quality Gram Panchayat Development Plan (GPDP) by making use of GIS maps.

- The scheme is a reformative step towards the establishment of clear ownership of property in rural inhabited (Abadi) areas, by mapping of land parcels using drone technology and providing 'Record of Rights' to village household owners with the issuance of legal ownership cards (Property cards/Title deeds) to the property owners.
- There are about 6.62 lakh villages in the country which will be eventually covered in this scheme.
- The entire work is likely to be spread for five years.

Benefits:

- Drone Digitally Maps All the Land Parcels of the Inhabited Area of the Village.
- Creation of Property Cards on the Exact Area of Each Property in the Village.
- Proprietary Rights to the Village Household Owner.
- Property as a Financial Asset for Taking Loans and Other Financial Benefits.
- Reduce Property Disputes and Legal Cases.
- Determination of Property Tax.
- Creation of Accurate Land Records for Rural Planning.
- Better Gpdp - Leveraging Gis Database/ Maps Created for Better Planning and Execution of Plans.

Eligibility:

- The applicant should have a property in rural inhabited (Abadi) area.

Exclusions:

- Agricultural Lands are not covered under this scheme.

3.7 Swadesh Darshan Scheme of Tourism Ministry

Context:

- 76 projects sanctioned under Swadesh Darshan Scheme of Tourism Ministry

More info:

- The Swadesh Darshan Scheme was launched by the Centre in 2014-15 for the integrated development of theme-based tourist circuits.
- It was revamped as Swadesh Darshan 2.0 in order to develop sustainable and responsible destinations with tourist and destination-centric approach.
- Swadesh Darshan 2.0 is a generational shift to evolve Swadesh Darshan Scheme as a holistic mission to develop sustainable and responsible tourism destinations covering tourism and allied infrastructure, tourism services, human capital development, destination management and promotion backed by policy and institutional reforms.
- As parts of efforts to enhance tourist experiences across all points of the tourist value chain, the Ministry has formulated guidelines for 'Challenge Based Destination Development' as sub-scheme of Swadesh Darshan 2.0.
 - Under this scheme, proposals have been invited under four thematic categories namely Spiritual Tourism, Culture and Heritage, Vibrant Village Programme, Ecotourism and Amrit Dharohar Sites.
- Apart from this, a total of 48 projects are being developed under the PRASHAD Scheme, out of which 23 have been completed.
- The PRASHAD or 'Pilgrimage Rejuvenation and Spiritual Heritage Augmentation Drive' scheme provides financial assistance to the State governments and union territories for development of tourism infrastructure at the pre-identified pilgrimage destinations.
- The government has also sanctioned a total of 40 projects across 23 States under the Special Assistance to States for Capital Investment (SASCI) as a follow up to the Budget announcements 2024-25.

- These funds are meant to infuse long-term interest-free loans for a period of 50 years to States for comprehensive development of iconic tourist centers in the country and branding and marketing them at a global scale.
- India registered 18.89 million International Tourist Arrivals (ITAs) and 9.52 million Foreign Tourist Arrivals (FTAs) in India during 2023.
- The Foreign Exchange Earnings (FEEs) through tourism during 2023 were ₹2,31,927 crore.

Mains

3.8 Oilfields (Regulation and Development) Amendment Bill, 2024

What is the Centre's new Oilfields Bill? How will it impact India's petroleum industry?

Introduction:

- According to the Centre for Monitoring Indian Economy (CMIE), India's oil and petroleum imports for the past three quarters have been worth at least thrice the country's quarterly oil and petroleum exports.
 - Imports have largely remained unchanged in spite of policy measures aimed at boosting domestic production - such as the Hydrocarbon Exploration and Licensing Policy (HELP), the Discovered Small Fields (DSF) policy, gas pricing reforms, and reduced royalty rates for deepwater, ultra-deepwater, and high-pressure/high-temperature areas.
 - For India to reduce its import dependence, the increase in domestic production must outpace the country's rapidly growing energy demand
- This Bill aims to ensure policy stability for oil and gas producers and allow international arbitration.
- Promising private sector companies 'zero interference' by the government, the Bill would enhance India's domestic output and cut down its reliance on oil imports.

Proposed amendments and effect on India's oil industry:

Mineral oils definition and lease:

- Currently, the petroleum industry is burdened by delays in obtaining environmental and forest clearances, complexities in land acquisition, absence of comprehensive standards, procedures, and guidelines for operational and safety compliance.
- India is believed to hold yet-to-find potential of 13 billion tons of oil equivalent.
 - This bill addresses two critical issues to help India exploit these resources – separation of petroleum and mining activities and expanding the definition of mineral oils.
- In the Oilfields (Regulation and Development) Act, 1948, petroleum and natural gas were the only two defined as mineral oils.
 - This Bill expands the definition to include coal bed methane, oil shale, shale gas, shale oil, tight gas, tight oil, and gas hydrate, but does not include coal, lignite and helium occurring in the petroleum process.
 - Subsequently, the Bill alters the previously used mining lease to introduce a 'petroleum lease' which allows companies to explore, prospect (search for oil and gas fields), produce, make merchantable, and dispose of mineral oils.
 - Mining leases in use will remain valid.
 - The broader definition (of mineral oils) enables the efficient exploration, development, and production of both conventional and unconventional hydrocarbon resources without any policy confusion.
 - This (separation of leases) eliminates redundant or irrelevant approvals, streamlining the regulatory framework.

Expands Centre's regulatory powers, decriminalises offences:

- Under the 1948 Act, the Centre was empowered to regulate the grant, terms and conditions, and time period of leases, production, storage and conservation of mineral oils and collecting royalties, fees and taxes for mineral oils.
- This Bill expands the Centre's powers to include framing rules for lessees to reduce emissions, sharing of oil production and processing units, merger of leases and resolving disputes on leases.
- With India and the energy sector's focus on green technology, this Bill also urges oil companies to use oilfields for other purposes like hydrogen production, carbon capture utilization and storage or coal gasification.
- The global oil industry is increasingly prioritizing decarbonization with methane capture, carbon capture, utilization and storage (CCUS), and other low-carbon technologies.
 - Current viability of such projects in India is subject to challenges, government support, in the form of a policy direction to begin with and possible incentives in the future, could make these projects sustainable.
- Further, the Bill also decriminalises offences related to the above-mentioned petroleum activities, such as those pertaining to invalid leases and non-payment of royalties; however, it increases the monetary fine for them from Rs. 1000 to Rs 25 lakhs.
- Refuting any claims of avenues for misuse of the decriminalisation clause, govt sources stress that it has been a long-standing demand of the industry, as many operators are increasingly outsourcing specific operations to optimize costs.
 - By shifting from criminal penalties to administrative fines for minor infractions, companies can focus on compliance and operational improvements without the fear of severe legal consequences.
 - This will foster a more predictable environment, encourage innovation, and streamline the regulatory process.

Opening up no-go areas to oil exploration:

- The Centre has allowed oil exploration within previously defined no-go areas, such as those near missile testing sites.

Conclusion:

- This Bill is an attempt by the Centre to catch up and make up for somewhat tardy or slow focus on implementation in the past as oil exploration and production was not in focus for previous governments.
- While these reforms are designed to enhance exploration and production, achieving a meaningful reduction in import dependency will require a sustained and significant growth in domestic production, particularly in oil, natural gas, and deployment of renewable energy.

UPSC Mains PYQ (2018):

- "Access to affordable, reliable, sustainable and modern energy is the sine qua non to achieve Sustainable Development Goals (SDGs)". Comment on the progress made in India in this regard.

3.9 Vadhavan port**Context:**

- The greenfield port once completed will double India's container trade and will also be among the top 10 ports globally

More info:

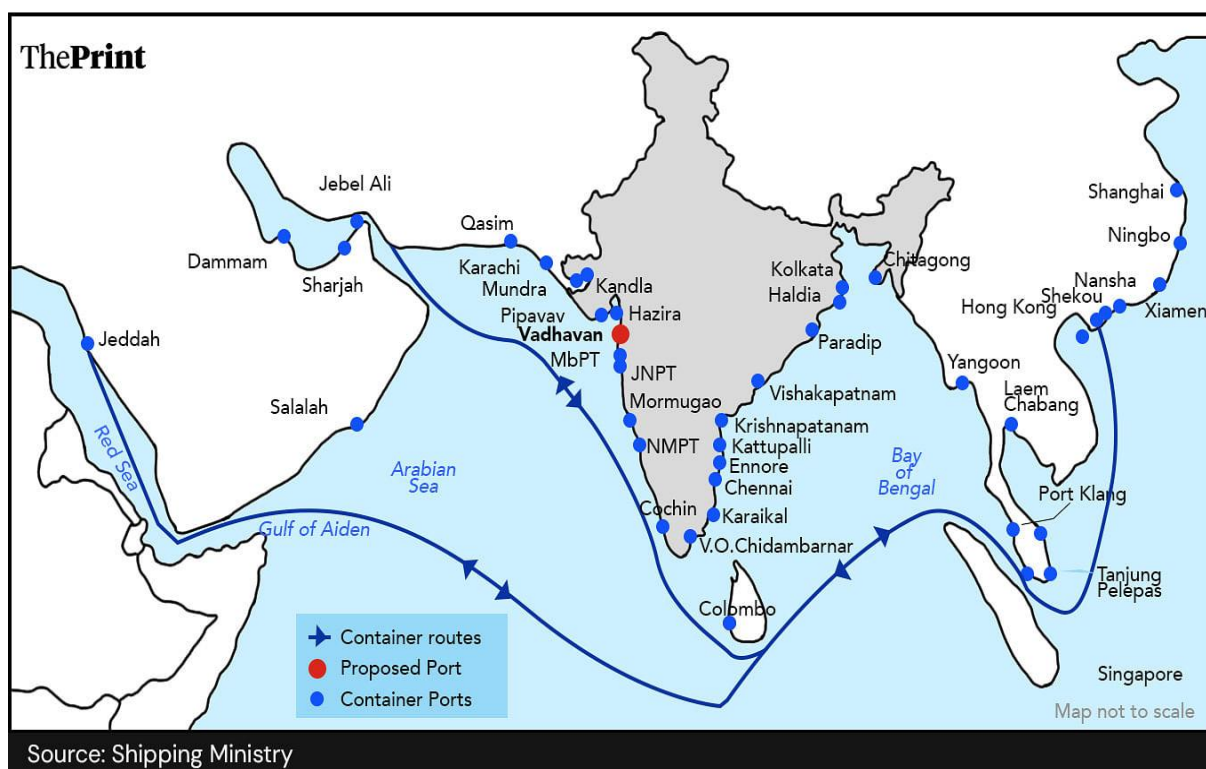
- The Vadhavan greenfield port, which is under construction near Dahanu in Maharashtra, will double India's container trade from the current levels upon completion.

- Scheduled to be finished by 2034, it is projected to be among the top 10 ports in the world.
 - By 2029, four terminals will be completed and five terminals will be added by 2034.
- The project with an outlay of ₹76,000 crore is being constructed by Vadhavan Port Project Limited (VPPL), a joint venture between Jawaharlal Nehru Port Authority (JNPA) and Maharashtra Maritime Board (MMB) with shareholding of 74% and 26%, respectively.

Significance of the port:

- Western side and northern side of the country represent 75% of EXIM (export-import) container trade.
- Noting that other regions have other ports and do not require that much capacity for the present and future, Mundra port and Jawaharlal Nehru Port (JNP) do 65% EXIM trade and both are almost full, running at 90% capacity.
- India desperately needs another port, otherwise it will not take care of the growing demand of the EXIM trade.
- This is a deep draught port with 20m depth.
- The largest vessel ever produced in the world will call on this port and that will save 25% or \$100 because currently, the vessel goes to ports in Jebel Ali, Colombo, and Singapore, and then cargo is shipped onwards by smaller vessels.
- The new port will also act as a transshipment port for other neighbouring countries.
- The Vadhavan port will comprise nine container terminals.
- Currently, about 25% of the country's cargo is transshipped, and of that 20% is from the western side.
 - With the new port on the western seaboard, 100% of this cargo will come to the new port.
- In addition, for northern and western cargo there will be a 25% reduction in logistics costs and also nearer to the northern hinterland.
 - For bigger vessels, it is directly 10% cheaper, and a distance of 150km is saved on the northern side.
 - This is a game changer for India.
- The turnaround times at Indian ports have significantly improved in recent years.
 - At Jawaharlal Nehru Port (JNP), the turnaround time is 22 hours, better than the global average, and it will reduce further at Vadhavan.
- It is a green project from inception, with shore power, green power, green e-vehicles.
- The project envisages the creation of a total capacity of 298 million metric tonnes per annum (MMTPA); as also EXIM trade flow facilitation through the proposed India Middle East Europe Economic Corridor and the International North South Transportation Corridor; accommodation of mainline mega vessels operating on international shipping routes connecting the Far East, Europe, the Middle East, Africa, and America.
- Given the long tradition of seafaring in the country, India is aiming to be among the top 10 ship-building countries by 2030 while aiming to be in the world's top five by 2047.
- We are also confident that the rich resource pool and a vibrant democratic set-up will embolden our ports to handle 10,000 million tonnes of cargo by 2047, Minister of Ports, Shipping & Waterways, Sarbananda Sonowal said.

VADHAVAN PORT'S PROXIMITY TO INTERNATIONAL TRADE ROUTE



3.10 India's urban infrastructure financing, needs and reality

With the urban population set to rise exponentially, urban India's future depends on the ability to address the key financial and structural challenges

Introduction:

- India's urban population will increase from 400 million in the last decade to 800 million over the next three decades.
 - While this offers an opportunity to transform India's urban landscape, there are significant financial challenges that must be overcome to get there.
 - A recent World Bank report estimates that India will require about ₹70 lakh crore by 2036 to meet its urban infrastructure needs.
 - Current government investment (2018 figures) in urban infrastructure stands at around ₹1.3 lakh crore annually.
 - This is just a little over one-fourth of the required ₹4.6 lakh crore per year.
 - Broadly, about 50% is estimated for basic urban services, with the other half for urban transport.

Issues at the local level:

- Municipal finances, a crucial component of urban infrastructure funding, have remained stagnant for decades.
 - Since 2002, municipal finance has stayed at just 1% of GDP.
 - Municipal bodies contribute 45% of urban investments, while the remainder is managed by parastatal agencies.
 - Despite an increase in central and State transfers from 37% to 44%, the financial health of municipalities remains precarious.
 - Tax revenue grew by only 8% between 2010 and 2018, grants by 14%, and non-tax revenue by 10.5%.

- However, the share of municipalities' own revenue sources has declined from 51% to 43%, reflecting a diminishing capacity for self-sufficiency.
- Collection inefficiencies also exist in urban local bodies (ULB).
 - For instance, data from 2017-18 reveals that ULBs in Bengaluru and Jaipur collect only 5%-20% of their potential tax revenue.
 - Nationwide, property tax collection stands at a paltry ₹25,000 crore, which is only 0.15% of GDP.
 - Further, cost recovery for services ranges from 20% to 50%, highlighting the significant gap between the costs of urban services and the revenues generated from them.
- Indian cities also struggle with low absorptive capacity, further complicating the urban infrastructure landscape.
 - According to the Fifteenth Finance Commission report, about 23% of total municipal revenue remains unspent, indicating a surplus in the municipal system that is not being effectively utilised.
 - Even major cities such as Hyderabad and Chennai only managed to spend 50% of their capital expenditure budgets in 2018-19.
 - The utilisation of central scheme funds also leaves much to be desired, with the Atal Mission for Rejuvenation and Urban Transformation (AMRUT) achieving 80% utilisation and the Smart Cities Mission reaching 70%.
- Public-private partnerships (PPPs), another crucial avenue for urban infrastructure financing, have seen a marked decline over the past decade.
 - PPP investments in urban infrastructure peaked at ₹8,353 crore in 2012 but plummeted to just ₹467 crore by 2018.
 - The viability of PPP projects is often dependent on the availability of payments or viability funding for ensuring bankability; but due to the lack of project-specific revenues, these projects further diminish commercial attractiveness.

The next step is reform:

- Given the myriad of financial challenges outlined, it is imperative to adopt a dual-pronged approach with specific long-term and medium-term measures.
 - In the long term, carrying out structural reform would be critical.
 - These reforms should include strengthening State finance commissions to enhancing autonomy and capacity for better financial management at the municipal level.
 - Additionally, empowering municipal governments with greater financial and administrative autonomy will be critical in enabling them to manage and allocate resources more effectively for urban development.
 - This can then attract the much-needed private capital, through mechanisms such as debt borrowing, and municipal bonds.
 - In the medium term, the following measures can significantly transform the development of sustainable urban infrastructure.
 - First, develop a robust pipeline of projects.
 - The High-Powered Expert Committee and 12th Plan Working Group have developed a financing framework to meet the ₹70 lakh crore urban infrastructure investment requirement over the next 20 years.
 - ✓ About 15% of this total investment could potentially come through PPPs, translating to roughly 250-300 PPP projects annually.
 - ✓ To achieve this, a pipeline of 600-800 projects must be in place.
 - Second, decouple project preparation from financial assistance.
 - The last two decades have shown that investments in urban infrastructure have not advanced to the extent required, often due to hurried project preparation.

- As new national programmes are conceived, it is essential to decouple project preparation from financial assistance.
 - ✓ Ensuring that these projects are designed for financial, social, and environmental sustainability is vital, especially given India's vulnerability to climate change.
- Third, leverage Digital Public Infrastructure (DPI) for improved operations.
 - Urban service delivery, particularly in public transport, remains hampered by outdated practices.
 - Embracing DPI can revolutionise the management and the operation of public services, positioning India as a global leader in this domain.
- Fourth, capture land value in transport projects.
 - With half of the ₹70 lakh crore investment by 2036 earmarked for urban transport, particularly metro rail projects, there is a unique opportunity to harness land value.
 - Metro and rail projects should be integrated with urban development, ensuring that they bring jobs closer to transit hubs and contribute to the overall efficiency and design of cities.

The need for collaboration:

- India's urban future hinges on the ability to address these financial and structural challenges head-on.
- The stakes are high, and this is the window for action.
 - By pursuing both immediate and long-term strategies, India can build urban infrastructure that meets the demands of its growing cities, thus ensuring sustainable and inclusive development for the decades to come.
- The path forward will require collaboration across government levels, private sector participation, and a relentless focus on innovation and governance efficiency.

UPSC Mains PYQs (2013, 2016):

- Discuss the various social problems which originated out of the speedy process of urbanization in India.
- With a brief background of quality of urban life in India, introduce the objectives and strategy of the 'Smart City Programme.'

3.11 Why esports should be part of the curriculum

Introduction:

- In his last Independence Day speech, Prime Minister Narendra Modi mentioned gaming, encouraging the sector to bring the country's "rich heritage" to the forefront.
- A few tried and tested models from around the globe can serve as a guide to transform our approach to the sector, solving key issues - including differentiation of skill-based games from real-money games, rising unemployment, brain drain.
- The Indian education system has a pivotal opportunity to incorporate gaming and esports and provide an option for children to take up game development as a discipline to have the tools to make and understand the process of constructing games from scratch.
 - Finland, for example, whose education system emphasizes creativity and innovation, has introduced coding and game design at the school level.
- Incorporating game development into India's curriculum provides the baseline for students to develop technical skills, which could lead to developing games that reflect India's rich cultural heritage.
- Creating games from scratch at a school level has multiple benefits.
 - First, while studying game design, players understand the difference between games of skills, which require you to invest your time learning the mechanics and enhancing your reflexes to be good at it compared to games of luck.

- The latter asks you to throw your money away to get that quick dopamine hit.
- Introducing game development in the curriculum can create a regulated environment where children learn about responsible play and ethical game design, discouraging gambling tendencies from a young age.
- Next, indie games have been doing very well in 2024 and these are the games that are different from heavy-budget games.
 - Indie titles focus on making solid gameplay that genuinely engages the gamer, promotes the entrepreneurial aptitude of developers, puts them on the marketplace for the global audience, and gives rise to culturally relevant and globally competitive titles.
 - Setting up game studios should allow developers to hire more employees and help mitigate unemployment while keeping the youth engaged in creative endeavors.
 - Currently, a few Indian studios have already made games that reflect our culture like Raji: An Ancient Epic, but the quality of live-service games is rather disappointing with heavily-funded games missing their marks and failing to impress the mass audience.

U.S., India and South Korea:

- Universities across the U.S., such as the University of California, and Irvine, offer scholarships for esports players and have established dedicated gaming programs.
 - The country also has College esports, where various universities make their in-house esports team compete against other colleges, and the players can get promoted to bigger league esports and make a sustainable career out of their passion.
- India currently has local esports tournaments, where talents are mostly groomed by organizations to hopefully break even with their budget after securing enough sponsorships and paying the monthly salaries of the players.
- India could adopt such practices to support indigenous esports leagues similar to the stature of the IPL, and allow organizations to thrive in an ecosystem, giving them a talent pipeline from the colleges and universities who can afford the infrastructure to have their team.
 - This should encourage more players to become confident in the ecosystem backed by the government and grind their favourite titles to become potent at them.
- South Korea is a good example to emulated in this.
 - The East Asian country integrated esports into its cultural and educational fabric setting up even esports high schools, such as the Mapo High School in Seoul, that train students in game strategy, teamwork, and professional gaming careers.
 - Mapo High School was also attended by Lee “Faker” Sang-hyeok, arguably the greatest esports player of all time.
 - The gaming industry contributes significantly to South Korea’s economy, generating billions of dollars annually.
 - India can emulate this by setting up grassroots esports programs and academies that give opportunities to play video games with the necessary tools to sharpen their skills, opening pathways to employment in a growing sector.
- Even without having a proper structure in place, India won many bronze medals such as in the 2024 Asian Esports Games in Bangkok in the eFootball game, Commonwealth Esports Championship 2022 in Dota 2, and the 2018 Asian Games in Hearthstone.
- With over 900 million internet users projected by 2025, the Indian gaming market is poised for exponential growth and these changes.
 - However, a lack of structured guidance and an esports ecosystem leaves young players vulnerable to gambling-related habits and become burned in the process.

Are policymakers clued in?

- The gaming industry offers diverse career opportunities from programming and animation to marketing and event management.
 - By providing foundation training in these areas, schools can equip students with skills for high-demand jobs in India and prevent brain drain.
- India is home to a fifth of the world's youth population, and esports and gaming is a young profession with fairly young people playing the game.
 - With the age bar going down every year, our country can benefit from investing in the ecosystem.
- A few state governments have shown initiatives.
 - An example is the Tamil Nadu CM Trophy 2024 in Chennai, which included esports.
 - Bihar organised its State Esports Open Championship in Patna to promote esports and find talent.
 - But there needs to be a regular system that is reliable and accessible for most Indian gamers.
- To make India a hub for game development and esports, the disconnect between policymakers and the target population that aspires to pursue the field is to be solved.
- The government should also capitalize on a big niche by using its young skilled manpower.
 - This can be achieved in three ways.
 - First is curriculum reform where colleges and schools can introduce courses in game development, and esports management.
 - Second is investing in infrastructure and setting up gaming labs and training facilities in colleges.
 - Lastly, awareness campaigns are needed to help educate parents and educators about the prospects of gaming and esports to cut down the society's stigma against it.

Conclusion:

- Learning from global pioneers and tailoring these practices to Indian needs is the key so that we can empower our youth to turn their passions into sustainable careers with a constant focus on their passion for esports.

3.12 Tourism Sector

Ministry of Tourism has taken several initiatives over the years for development of tourism sector in the country.

Some of these key initiatives are:

- The Ministry of Tourism under the schemes of 'Swadesh Darshan', National Mission on 'Pilgrimage Rejuvenation and Spiritual Heritage Augmentation Drive (PRASHAD)' and 'Assistance to Central Agencies for Tourism Infrastructure Development' provides financial assistance to State Governments/Union Territory Administrations/ Central Agencies for the development of tourism related infrastructure and facilities at various tourism destinations in the country.
- The Ministry of Tourism has revamped its Swadesh Darshan Scheme as Swadesh Darshan 2.0 (SD2.0) with the objective to develop sustainable and responsible destinations following a tourist & destination centric approach.
- Financial assistance has also been provided to the State Governments/UTs for organizing fairs/festivals & tourism related events under Domestic Promotion & Publicity including Hospitality (DPPH) Scheme.
- Dekho Apna Desh initiative launched with the objective to encourage citizens to travel within the country.
- Thematic tourism like wellness tourism, culinary tourism, rural, eco-tourism, etc. amongst other niche subjects are promoted so as to expand the scope of tourism into other sectors as well.

- With an aim to enable lawful inward movement of foreigners including foreign tourists, Government has taken a number of initiative over the last few years to liberalize, streamline and simplify visa regime with a view to facilitate the legitimate foreign travellers.
 - Facility of e-Visa for 07 sub-categories i.e., e-Tourist visa, e-Business visa, e-Medical visa, e-Medical Attendant visa, e-Ayush Visa, e-Ayush Attendant Visa and e-Conference visa for the nationals of 167 countries has been provided.
 - Visa fee has also been substantially reduced.
- For improving air connectivity to important tourist destinations, Ministry of Tourism has collaborated with Ministry of Civil Aviation under their RCS-UDAN (Regional Connectivity Scheme - Ude Desh ka Aam Naagrik) Scheme.
 - As on date, 53 tourism routes have been operationalized.
- Ministry of Tourism is running Pan-India Incredible India Tourist Facilitator (IITF) Certification Program, a digital initiative that aims at creating an online learning platform with the objective of creating a pool of well trained and professional Tourist Facilitators/Guides across the country and generating employment opportunities at local level.
- Conducting Programmes under the 'Capacity Building for Service Providers' (CBSP) Scheme to train and up-grade manpower to provide better service standards.
- Ministry of Tourism also launched a national responsible tourism initiative by the name of 'Paryatan Mitra' and 'Paryatan Didi'.
 - The initiative encompasses providing tourism related training and awareness to all individuals who interact and engage with tourists in a destination.

3.13 Labour Welfare and Social Security in The Informal And GIG Economy

- The Government of India has introduced a pension scheme for unorganized workers namely Pradhan Mantri Shram Yogi Maan-dhan (PM-SYM) to ensure old age protection for Unorganised Workers.
 - The scheme was launched in 2019.
 - The third party evaluation of PM-SYM was done by Indian Institute of Public Administration that recommended inter-alia, to increase income limit from Rs.15000 to Rs.18000 and entry age for eligibility criteria to be relooked to 18 to 50 years.
- For the first time, the definition of 'gig workers' and 'platform workers' and provisions related to the same have been provided in the Code on Social Security, 2020 which has been enacted by the Parliament.
 - The Code provides for framing of suitable social security measures for gig workers and platform workers on matters relating to life and disability cover, accident insurance, health and maternity benefits, old age protection, etc.
- The Ministry of Labour and Employment had launched the e-Shram-"One Stop-Solution" in October 2024.
 - This entails integration of different social security/welfare schemes at single portal i.e. e-Shram.
 - This enables unorganised workers registered on e-Shram to access social security schemes and see benefits availed by them so far, on single portal i.e. e-Shram.
- "Labour" as a subject is in the Concurrent List of the Constitution of India and under the Codes, the power to make rules has been entrusted to Central Government as well as State Governments.
- As a step towards implementation of the four Labour Codes, the Central Government has pre-published the draft Rules under Labour Codes.
- As per available information, 32, 31, 31 and 31 State/Union Territories have also pre-published the draft Rules under the Code on Wages, 2019, the Industrial Relations Code, 2020, the Code on Social Security, 2020 and the Occupational Safety, Health and Working Conditions Code, 2020, respectively.

- The Labour Codes strengthen the protection available to workers, including unorganized workers in terms of statutory minimum wage, social security and healthcare of workers.
- The Code on Wages, 2019 has envisaged statutory right for minimum wages and timely payment of wages to all workers to support sustainable growth and inclusive development.
- Besides, the Code on Social Security, 2020 aims to extend social security benefits to all workers both in the organised and unorganised sectors.
- The Labour Codes have been aligned with the present economic scenario and technological advancements along with reduction in multiplicity of definitions & authorities.
- The Codes also ease compliance mechanism aiming to promote ease of doing business/setting up of enterprises and catalyze creation of employment opportunities while ensuring safety, health and social security of every worker.
- Use of technology, such as, web-based Inspection has been introduced in order to ensure transparency & accountability in enforcement.
- A provision for worker reskilling fund has been envisaged in the Industrial Relations Code, 2020 for re-skilling the retrenched workers which provides for crediting fifteen days' wages last drawn by the worker.

UPSC Mains PYQ (2016):

- How globalization has led to the reduction of employment in the formal sector of the Indian economy? Is increased informalization detrimental to the development of the country?

3.14 Extent of the global share of solar energy

Introduction:

- The World Solar Report 2024 by the International Solar Alliance (ISA) was released recently.
 - From 1.22 GW in 2000, the world's solar capacity has surged to 1,419 GW in 2023, charting a CAGR of about 36%.
 - Today, solar capacity represents three-quarters of all renewable capacity additions worldwide.

New solar technologies:

- Quantum dot solar cells have achieved a record-breaking efficiency of 18.1%, offering a promising approach to enhance solar energy capture and power atmospheric water harvesting technologies.
- Researchers are creating self-healing solar panels to extend the lifespan and reduce the maintenance of existing solar cell technologies.
- Solar-powered phyto-mining uses solar energy to power the extraction of valuable metals from soil-using plants, offering a sustainable alternative to traditional mining practices.
- Solar paver blocks integrated with building infrastructure and BIPV (Building Integrated PV), like transparent solar panels, allow light transmission and visibility.
 - The development of these alternative technologies will reduce reliance on critical materials like lithium and rare earth elements.
- The solar sector is also prioritising recycling panels and implementing circular economy practices to minimise environmental impact.

Reducing costs:

- The 2024 World Solar Report shows that the average auction prices for utility-scale solar photovoltaic (PV) projects have consistently decreased across all regions.
 - Utility-scale solar PV costs averaged \$40/MWh in 2024.
 - India topped the global charts in solar PV capacity granted through auctions, securing a notable auction price of \$34/MWh.

- Investment in solar PV technology within the power sector is expected to surpass the \$500 billion mark by 2024, outstripping the combined investment in all other generation forms.

Global market:

- As of 2023, China dominates solar PV as 43% (609 GW) of the cumulative capacity of solar panels installed globally is from China.
 - The U.S. contributes 10% (137.73 GW).
 - Japan, Germany, and India each captured a 5-6% share.
 - Emerging solar markets like Brazil, Australia, Italy, and Spain each contributed about 2%.
- Solar PV manufacturing has nearly doubled in capacity for wafers, cells, and modules in 2023.
 - China maintained the highest share in component manufacturing in 2023, with 97% in wafers, 89% in cells, and 83% in module installation capacity.

Solar impact on other industries:

- Employment in the solar PV sector rose to 7.1 million jobs in 2023, up from 4.9 million in 2022 worldwide, indicating a significant increase from the previous year and underscoring the sector's role in job creation and economic development.
- Solar-powered irrigation systems are transforming agriculture.
 - The global solar pump market is expected to grow at a CAGR of 5.8% from 2021 to 2027, driven by declining costs of solar PV technology, cost competitiveness of solar-powered pumps, especially when compared to diesel-powered water pumping, and increased awareness among farmers.
- Beyond crop farming, agrivoltaics systems are being used in livestock management, with solar panels installed in pastures to provide shade for animals while simultaneously generating electricity.
- One of the key factors driving the adoption of solar systems has been the introduction of pay-as-you-go business models, allowing users to pay for their systems in small, regular instalments.

Conclusion:

- Technological advancements have made solar energy more affordable, while new applications are further driving adoption.
- We must promote technology and finance transfer, especially to the least developed and small island developing countries, to ensure no one is left behind.

UPSC Mains PYQ (2020):

- India has immense potential of solar energy though there are regional variations in its developments. Elaborate.

3.15 India's FDI Journey Hits \$1 Trillion

Introduction:

- India has achieved a remarkable milestone in its economic journey, with gross foreign direct investment (FDI) inflows reaching an impressive \$1 trillion since April 2000.
 - This landmark achievement was bolstered by a nearly 26% rise in FDI to \$42.1 billion during the first half of the current fiscal year.
 - Such growth reflects India's growing appeal as a global investment destination, driven by a proactive policy framework, a dynamic business environment, and increasing international competitiveness.
- FDI has played a transformative role in India's development by providing substantial non-debt financial resources, fostering technology transfers, and creating employment opportunities.

- Initiatives like "Make in India," liberalised sectoral policies, and the Goods and Services Tax (GST) have enhanced investor confidence, while competitive labour costs and strategic incentives continue to attract multinational corporations.
- Over the last decade (April 2014 to September 2024), total FDI inflows amounted to \$709.84 billion, accounting for 68.69% of the overall FDI inflow in the past 24 years.
 - This robust inflow of investments underscores India's pivotal role in shaping the global economic landscape.

Factors Driving the Change:

- India's remarkable achievement in attracting foreign direct investment (FDI) can be attributed to a range of contributing factors:
 - **Competitiveness and Innovation:** India's ranking in the World Competitive Index 2024 jumped three positions to 40th, from 43rd in 2021.
 - Additionally, India was named as the 48th most innovative country among the top 50 nations, securing the 40th position out of 132 economies in the Global Innovation Index 2023, a significant improvement from its 81st position in 2015.
 - These rankings highlight the country's progress in enhancing its innovation ecosystem and competitive edge.
 - **Global Investment Standing:** India was the third largest recipient of greenfield projects with 1,008 greenfield project announcements, as per the World Investment Report 2023.
 - The number of international project finance deals in India also increased by 64%, making it the recipient of the second largest number of international project finance deals.
 - These statistics underscore India's growing prominence on the global investment stage.
 - **Improved Business Environment:** India made remarkable progress in improving its business environment, climbing from 142nd in 2014 to 63rd in the World Bank's Doing Business Report (DBR) 2020, published in October 2019 before its discontinuation.
 - This 79-rank jump over five years reflects the government's sustained efforts to simplify regulations, reduce bureaucratic hurdles, and create a more business-friendly environment, significantly boosting investor confidence.
 - **Policy Reforms:** To promote FDI, the government has put in place an investor friendly policy, wherein most sectors, except certain strategically important sectors, are open for 100% FDI under the automatic route.
 - Further, to simplify tax compliance for startups and foreign investors, the Income Tax Act, 1961 has been amended in 2024 to abolish angel tax and to reduce income tax rate chargeable on income of a foreign company.

Other notable developments:

- Taiwanese companies are increasingly shifting their supply chains to India due to global trade tensions, with FDI from Taiwan surpassing US\$ 665 million between 2018 and 2024.
- 2024 marked a key policy change with the Ministry of Finance's notification on FDI in the space sector, facilitating expanded investment opportunities for Indian space startups.

Conclusion:

- India's remarkable progress in attracting foreign direct investment is evident from the \$42.1 billion inflows during the first half of the current fiscal year and the cumulative \$1 trillion since April 2000.
- Factors like improved global competitiveness, a dynamic innovation ecosystem, and a business-friendly environment have been key drivers.
- Initiatives such as "Make in India," liberalisation of sectoral policies, and recent policy changes, including greater FDI in the space sector, reflect the country's proactive approach.

- As India continues to align with global economic trends, it is well-positioned to further strengthen its role on the global stage, fostering sustainable growth and development.

UPSC Mains PYQ (2016):

- Justify the need for FDI for the development of the Indian economy. Why is there a gap between MOUs signed and actual FDIs? Suggest remedial steps to be taken for increasing actual FDIs in India.

UPSC Mains PYQ (2014):

- Foreign Direct Investment (FDI) in the defence sector is now set to be liberalized: What influence is this expected to have on Indian defence and economy in the short and long run?

3.16 Steps by Government to Reduce Import Dependency on Crude Oil

- Government has adopted a multi-pronged strategy to reduce the import dependency on crude oil which, inter alia, include demand substitution by promoting usage of natural gas as fuel/feedstock across the country towards increasing the share of natural gas in economy and moving towards gas based economy, promotion of renewable and alternate fuels like ethanol, compressed bio gas and biodiesel, creating electric vehicle charging infrastructure, refinery process improvements, promoting energy efficiency and conservation, efforts for increasing production of oil and natural gas through various policies initiatives, etc.
- For promoting the use of Compressed Bio Gas (CBG) as automotive fuel, Sustainable Alternative Towards Affordable Transportation (SATAT) initiative has also been launched.
- Government has also taken several other steps to insulate common citizens from high international prices, which included diversifying the crude import basket, invoking the provisions of Universal Service Obligation to ensure availability of petrol & diesel in domestic market, increasing the blending of ethanol in petrol, etc.
- Recently PSU OMCs (Public sector Oil Marketing Companies) have carried out intra-state freight rationalisation.
 - This has benefitted consumers located at remote areas, far from Petroleum Oil & Lubricants (POL) Depots in form of reduced Petrol and Diesel prices in remote parts within the states.
 - This initiative has also reduced the difference between the maximum and minimum retail prices of Petrol or Diesel within a state.
- During the last ten years, Ethanol Blending Program (EBP) by Public Sector OMCs has resulted in approximate savings of more than Rs. 1,08,655 crore of foreign exchange as on 30.09.2024.
 - The ethanol produced from sugar-based feedstock has helped sugar factories to reduce its surplus sugar inventory and generate revenue early to clear the dues of cane farmers.
 - During the last ten years, EBP has helped in expeditious payment of approx. Rs. 92,409 crore to the farmers as on 30.09.2024.
 - It is anticipated that 20% ethanol blending in petrol is likely to result in payment of more than Rs. 35,000 crore annually to the farmers.
- India's energy sector is undergoing a significant transformation with a growing focus on cleaner sources of energy.
 - Government is working towards achieving 500 GW of installed electricity capacity from non-fossil sources by 2030.
 - Schemes such as Pradhan Mantri Kisan Urja Suraksha evam Utthaan Mahabhiyan (PM-KUSUM), PM Surya Ghar Muft Bijli Yojana, National Programme on High Efficiency Solar PV Modules, National Green Hydrogen Mission, have been launched.

- Scheme for setting up of Ultra Mega Renewable Energy Parks is being implemented to facilitate the project developers for expeditious completion of such projects.
- Government has also approved the Viability Gap Funding (VGF) scheme for offshore wind energy projects for installation and commissioning of 1 GW of offshore wind energy projects.
- Further, The Ministry of New and Renewable Energy is implementing the National Green Hydrogen Mission, with an objective to make India a global hub of production, usage and export of Green Hydrogen and its derivatives.
- Government also notified the National Bioenergy Programme (NBP) with an aim to promote the use of bioenergy and waste-to-energy technologies to support clean energy solutions to enhance energy security and support sustainable development in India.
- To promote green fuel and other alternate fuels, public sector undertaking oil and marketing companies (IOCL/BPCL/HPCL) are required to install facilities for marketing at least one new generation alternate fuels i.e. CNG/LNG/Electric Vehicle Charging points etc. at their retail outlets.

UPSC Mains PYQ (2018):

- “Access to affordable, reliable, sustainable and modern energy is the sine qua non to achieve Sustainable Development Goals (SDGs)”. Comment on the progress made in India in this regard.

3.17 Promotion of Electric Vehicles

- Ministry of Heavy Industries has formulated the following schemes to promote the development of an indigenous, end-to-end Electric Vehicle (EV) ecosystem in India and to enhance India’s manufacturing capabilities and exports:
 - **Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles in India (FAME India) Scheme Phase-II:** The Government implemented this scheme for a period of five years from 1st April, 2019.
 - The scheme incentivised e-2Ws, e-3Ws, e-4Ws, e-buses and EV public charging stations.
 - **Production Linked Incentive (PLI) Scheme for Automobile and Auto Component Industry in India (PLI-Auto):** The Government notified this scheme in 2021 for Automobile and Auto Component Industry in India for enhancing India's manufacturing capabilities for Advanced Automotive Technology (AAT) products.
 - The scheme proposes financial incentives to boost domestic manufacturing of AAT products with minimum 50% Domestic Value Addition (DVA) and attract investments in the automotive manufacturing value chain.
 - **PLI Scheme for Advanced Chemistry Cell (ACC):** The Government in 2021 approved PLI Scheme for manufacturing of ACC in the country.
 - The scheme aims to establish a competitive domestic manufacturing ecosystem for 50 GWh of ACC batteries.
 - **PM Electric Drive Revolution in Innovative Vehicle Enhancement (PM E-DRIVE) Scheme:** This scheme was notified in September, 2024.
 - It is a two-year scheme which aims to support electric vehicles including e-2W, e-3W, e-Trucks, e-buses, e-Ambulances, EV public charging stations and upgradation of vehicle testing agencies.
 - **PM e-Bus Sewa-Payment Security Mechanism (PSM) Scheme:** This Scheme notified in October, 2024, aims to support deployment of more than 38,000 electric buses.
 - The objective of scheme is to provide payment security to e-bus operators in case of default by Public Transport Authorities (PTAs).
 - **Scheme for Promotion of Manufacturing of Electric Passenger Cars in India (SPMEPCI)** was notified in March, 2024 to promote the manufacturing of electric cars in India.

- This requires applicants to invest a minimum of ₹4150 crore and to achieve a minimum DVA of 25% at the end of the third year and DVA of 50% at the end of the fifth year.
- As per the information provided by the Ministry of Mines, they have set up Khanij Bidesh India Limited (KABIL), a joint venture company with equity contributions from National Aluminium Company (NALCO), Hindustan Copper Limited (HCL) and Mineral Exploration and Consultancy Limited (MECL).
 - Its overarching mission is to identify and acquire overseas mineral assets that hold critical and strategic significance, specifically targeting minerals like Lithium, Cobalt and others.
 - KABIL has signed an Exploration and Development Agreement with CAMYEN, a State-owned enterprise of Catamarca province of Argentina, for Exploration and mining of Five Lithium Block in Argentina.
 - KABIL is also constantly having interactions with Critical Mineral Office in Australia with the primary objective of acquiring critical and strategic mineral assets.

Measures taken by other Ministries include the following initiatives:

- Ministry of Power has issued guidelines and standards for EV Charging Infrastructure titled, "Guidelines for Installation and Operation of Electric Vehicle Charging Infrastructure-2024" in September, 2024.
 - These revised guidelines outline standards and protocols to create a connected & interoperable EV charging infrastructure network in the country.
 - These guidelines also facilitate electricity connections for EV charging stations.
- Ministry of Finance has reduced GST on EVs from 12% to 5%.
- Ministry of Road Transport & Highways (MoRTH) announced that the battery-operated vehicles will be given green licence plates and be exempted from permit requirements.
- MoRTH issued a notification advising states to waive road tax on EVs, which in turn will help reduce the initial cost of the EVs.
- Ministry of Housing and Urban Affairs has amended the Model Building Bye-Laws, mandating the inclusion of charging stations in private and commercial buildings.

UPSC Mains PYQ (2022):

- Do you think India will meet 50 percent of its energy needs from renewable energy by 2030? Justify your answer. How will the shift of subsidies from fossil fuels to renewables help achieve the above objectives? Explain.

UPSC Mains PYQ (2014):

- National urban transport policy emphasizes on moving people instead of moving vehicles. Discuss critically the success of various strategies of the government in this regard.

UPSC Mains PYQ (2013):

- Write a note on India's green energy corridor to alleviate the problems of conventional energy.

3.18 The MSME Revolution - Transforming India's Economic Landscape

- Micro, Small, and Medium Enterprises (MSMEs) exports have witnessed a remarkable rise, increasing from ₹3.95 lakh crore in 2020-21 to ₹12.39 lakh crore in 2024-25, underscoring their critical role in boosting India's economy and strengthening global trade.
- The total number of exporting MSMEs in 2024-25 has also increased considerably from 52,849 in 2020-21 to 1,73,350 in 2024-25.
- MSMEs demonstrated an exemplary growth trajectory, contributing 45.73% to exports in 2023-24, which increased to 45.79% by May 2024, highlighting their growing impact on India's trade performance.

- The MSME sector in India has consistently demonstrated remarkable resilience and adaptability, significantly contributing to the nation's GDP over the years.
- The Gross Value Added (GVA) by MSMEs in India's GDP was 29.7% in 2017-18, rising to 30.1% in both 2022-23.
- Even amid the unprecedented challenges posed by the COVID-19 pandemic, the sector sustained a contribution of 27.3% in 2020-21, rebounding to 29.6% in 2021-22.
- These figures highlight the sector's pivotal role in driving economic growth and stability, reflecting its enduring strength and importance to the Indian economy.
- The growth in MSME sector is reflected in the scaling up of small and micro enterprises into medium enterprise.
- In accordance with the Revised Classification applicable w.e.f 1st July 2020, MSME are classified as below:
 - **Micro Enterprise:** Where the investment in plant and machinery or equipment does not exceed one crore rupees and annual turnover does not exceed five crore rupees.
 - **Small Enterprise:** Where the investment in plant and machinery or equipment does not exceed ten crore rupees and annual turnover does not exceed fifty crore rupees.
 - **Medium Enterprise:** Where the investment in plant and machinery or equipment does not exceed fifty crore rupees and annual turnover does not exceed two hundred and fifty crore rupees.
- Between July 1, 2020, and July 24, 2024, a significant number of enterprises transitioned to Medium enterprises.
- During the financial year 2020-21 to 2021-22, 714 Micro enterprises scaled up to medium and 3,701 Small enterprises were upgraded to Medium enterprises.
 - This number increased steadily with the financial year 2023-24 to 2024-25 witnessing further growth, with 2,372 Micro enterprises and 17,745 Small enterprises scale up to Medium.
 - This progression reflects the robust growth and dynamism of the MSME sector in India.
- MSME's are the backbone of India's economic landscape, pivotal in employment generation, entrepreneurship promotion, and economic development.
- Through resilience, innovation, and adaptability, MSMEs have consistently driven the nation's growth, providing employment to millions and fostering inclusive development.
- As India strives to position itself as a global economic powerhouse, the MSME sector undoubtedly plays a central role, fostering innovation, generating employment, and enhancing export competitiveness.

3.19 Financial Stability Report (FSR)

Context:

- Economy exhibiting resilience, GDP to grow at 6.6 pc in FY25: RBI report

News:

- The Reserve Bank has released the December 2024 issue of the Financial Stability Report (FSR), which reflects the collective assessment of the Sub-Committee of the Financial Stability and Development Council (FSDC) on the resilience of the Indian financial system and risks to financial stability.

More info:

- The Indian economy is exhibiting resilience and stability, and the gross domestic product (GDP) is projected to grow at 6.6 per cent in 2024-25, aided by a revival in rural consumption, a pickup in government consumption and investment, and strong services exports, a RBI report said.
- The soundness of scheduled commercial banks (SCBs) has been bolstered by strong profitability, declining non-performing assets and adequate capital and liquidity buffers.

- Return on assets (RoA) and return on equity (RoE) are at decadal highs, while the gross non-performing asset (GNPA) ratio has fallen to a multi-year low, the report said.
- It also said that macro stress tests demonstrate that most SCBs have adequate capital buffers relative to the regulatory minimum threshold even under adverse stress scenarios.
 - Stress tests also validate the resilience of mutual funds and clearing corporations.
- On the economy, FSR said during the first half of 2024-25, real GDP growth (y-o-y) moderated to 6 per cent from 8.2 per cent and 8.1 per cent growth recorded during H1 and H2 of 2023-24, respectively.
 - Despite this recent deceleration, structural growth drivers remain intact.
- Real GDP growth is expected to recover in Q3 and Q4 of 2024-25 supported by pick up in domestic drivers, mainly public consumption and investment, strong service exports and easy financial conditions, the RBI said.
- On inflation, the report said that going forward, the disinflationary effect of a bumper kharif harvest and the rabi crop prospects are expected to soften prices of foodgrains.
- On the flipside, the rising frequency of extreme weather events continues to pose risks for food inflation dynamics.
- Persisting geopolitical conflicts and geo-economic fragmentation can also impose upside pressures on global supply chain and commodity prices.

About Financial Stability Reports:

- The Financial Stability Reports, published by Reserve Bank of India, after approved by FSDC SubCommittee since its inception, taking inputs from financial sector regulators i.e. RBI, SEBI, PFRDA, IRDAI including Ministry of Finance, are periodic exercise for reviewing the nature, magnitude and implications of risks that may have a bearing on the macroeconomic environment, financial institutions, markets and infrastructure.
- These reports will also assess the resilience of the financial sector through stress tests.

4. Science and Tech

Prelims

4.1 Starlink satellite internet

Context:

- Andaman and Nicobar police will seek details from Elon Musk's Starlink, they said, in a bid to hunt down drug smugglers who used its satellite internet device to navigate deep seas and bring meth (methamphetamine) worth \$4.25 billion into Indian waters for the first time.

More info:

- Starlink, which says it provides coverage in international waters, has plans to launch in India, but says its coverage in territorial waters is contingent on government approval.
- India is a growing transit and destination market for methamphetamine from Myanmar, the UNODC said in its report this year.

About Starlink:

- Starlink is a satellite internet constellation operated by Starlink Services, LLC, an international telecommunications provider that is a wholly owned subsidiary of American aerospace company SpaceX, providing coverage to over 100 countries and territories.
- It also aims to provide global mobile broadband.
- As of September 2024, the constellation consists of over 7,000 mass-produced small satellites in low Earth orbit (LEO) that communicate with designated ground transceivers.
 - Nearly 12,000 satellites are planned to be deployed, with a possible later extension to 34,400.

Services:

- **Satellite internet:** Starlink provides satellite-based internet connectivity to underserved areas of the planet, as well as competitively priced service in more urbanized areas.
- **Military applications:** SpaceX also designs, builds, and launches customized military satellites based on variants of the Starlink satellite bus.
- **Starshield:** A separate Starlink service designed for government entities and military agencies.
- Starlink was activated during the Russian invasion of Ukraine, after a request from the Ukrainian government.

Internet availability and regulatory approval by country:

- In order to offer satellite services in any nation-state, International Telecommunication Union (ITU) regulations and long-standing international treaties require that landing rights be granted by each country jurisdiction, and within a country, by the national communications regulators.
 - As a result, even though the Starlink network has near-global reach at latitudes below approximately 60°, broadband services can only be provided in 40 countries as of September 2022.

4.2 Space Debris Management

- Recognising the growing importance of Space Situational Awareness (SSA) for space sustainability, ISRO System for Safe and sustainable Space Operations Management (IS4OM) has been established to focus all efforts related to spaceflight safety and debris mitigation and for dealing with the emerging challenges in operating in a congested space environment.

- Network for Space object TRacking and Analysis (NETRA) has been approved by GOI for SSA capacity building.
- ISRO adheres to the internationally accepted space debris mitigation guidelines recommended by the United Nations Committee on Peaceful Uses of Outer Space (UN –COPOUS) and Inter-Agency Space Debris Coordination Committee (IADC) to the maximum possible extent.
- For all Indian launch vehicles, Collision Avoidance Analysis (COLA) is performed to select collision threat-free lift-off time within the launch window.
 - Continual assessments of any close approach risk to ISRO's operational satellites are carried out and Collision Avoidance Manoeuvres (CAM) are performed as and when needed.
 - In case the object posing close approach risk is another active satellite, the required coordination is carried out with the owner/operator so that only one of the satellites performs the CAM.
 - Continual efforts to improve the operational methodologies for close approach assessment are pursued to adapt to the challenges posed by the surging space traffic, apart from modelling on-orbit break-up events and prediction of atmospheric re-entries of space objects etc.
- ISRO contributes substantially to shaping the pertinent guidelines and recommendations for sustainable use of space as an active member of various international agencies dealing with safety and sustainability of outer space activities, such as the Inter-Agency Space Debris Coordination Committee (IADC), IAA (International Academy of Astronautics), ISO (International Organization for Standardization), IAF (International Astronautical Federation), UN Long Term Sustainability Working Group.
- The Indian Space Policy places significant importance in space debris mitigation requirements and SSA capacity building.
- The recently unveiled Debris Free Space Mission (DFSM) initiative is also spearheaded by ISRO with an aim to achieve debris-free space missions by all Indian space actors, both governmental and non-governmental, by 2030.
 - The initiative aligns with global efforts for space sustainability, positioning India as a nation prioritizing safety, security, and sustainability in outer space activities.

4.3 PSLV-C59/Proba-3 Mission

Context:

- The PSLV-C59/PROBA-3 Mission has successfully achieved its launch objectives, deploying ESA's satellites into their designated orbit with precision.
- PSLV-C59 vehicle carried Proba-3 spacecraft into a highly elliptical orbit as a dedicated commercial mission of New Space India Limited (NSIL).

About Proba-3 Mission:

- Proba-3 is an In-Orbit Demonstration (IOD) mission of the European Space Agency.
- The mission goal is to demonstrate precise formation flying.
- It consists of 2 spacecrafts viz. the Coronagraph Spacecraft (CSC) and the Occulter Spacecraft (OSC) and it will be launched together in a stacked configuration.
- Proba-3 is a technology demonstration mission of European Space Agency (ESA).
- Proba-3 is ESA's and the world's first precision formation-flying mission.
- A pair of satellites will fly together, maintaining a fixed configuration as if they were a single large rigid structure in space, to prove innovative formation flying and rendezvous technologies.

Mission Objectives:

- Proba-3 will function as an orbital laboratory, demonstrating acquisition, rendezvous, proximity operations and formation flying, while validating innovative metrology sensors and control algorithms, opening up novel methods of mission control.
- The 2 satellites will adopt a fixed configuration in space, 150m apart while lined up with the Sun so that OSC blocks out the brilliant solar disk for the CSC.
 - This will open up continuous views of the Sun's faint corona, or surrounding atmosphere, for scientific observation.

4.4 Artemis moon missions

Context:

- NASA announces further delays in Artemis moon missions

News:

- NASA announced that new delays in the U.S. space agency's Artemis program to return astronauts to the moon for the first time since 1972, pushing back the next two planned missions amid potential policy changes under President-elect Donald Trump's administration.
- The next Artemis mission, sending astronauts around the moon and back, has slipped to April 2026, with the subsequent astronaut landing mission using SpaceX's Starship planned for the following year.

More info:

- Assuming the SpaceX lander is ready, NASA plan to launch Artemis III in mid-2027.
 - That will be well ahead of the Chinese government's announced intention" to land on the lunar surface by 2030, illustrating the competition between the world's top two space powers as they race to the moon.
- The newly announced delays came after NASA concluded an examination of the Orion crew capsule, made by Lockheed Martin and its heat shield, which had cracked and partially eroded during reentry into Earth's atmosphere on its debut 2022 uncrewed test mission, Artemis I.

About Artemis program:

- The Artemis program was established by NASA during Trump's first administration and represents the flagship American effort to return astronauts to the moon for the first time since the U.S. space agency's Apollo 17 mission.
- Unlike the Apollo missions, the Artemis program also calls for building lunar bases that will help pave the way for the more ambitious future goal of sending astronauts to Mars.
- The Artemis program has made noteworthy progress, including Orion's 2022 uncrewed launch atop NASA's giant Space Launch System (SLS), but also has experienced various delays and rising costs.
 - The roughly \$2 billion SLS per-launch price tag and its heavy cost overruns in development have made advisers to Trump's transition effort eager to upend the Artemis program and focus more heavily on Mars using SpaceX's Starship.
- NASA's Artemis I mission was a 25-day voyage around the moon ending when the Orion capsule, carrying a simulated crew of three mannequins, made a splash down in the Pacific.
 - During its blazing atmospheric reentry, heat became trapped inside the Orion heatshield's outer layer, causing cracks and raising concerns after the mission about the capsule's future models.
 - NASA officials unanimously decided at a meeting this week to keep the heat shield design as is for Artemis II, but change the capsule's return trajectory to prevent the cracking issues.
- Orion capsules on missions beyond Artemis II will have an upgraded heat shield.
 - Replacing the Artemis II heat shield would have caused a much longer delay of at least a year.

- The Artemis II mission, a flight carrying astronauts around the moon in Orion but without a landing, has experienced previous delays as well, pushing back its time table to September 2025.
 - NASA recently confirmed it would be further delayed until April 2026.
- The Artemis III lunar landing mission involves Orion transferring the astronauts in space onto Starship, which will land them on the surface.
- The United States and China, an ascending power in space, are both courting partner countries and leaning on private companies for their moon programs.
- The Artemis program has been NASA's top priority.
- Trump's first NASA chief launched the Artemis program and persuaded Congress to increase the agency's budget to fund it.

4.5 Proba-3 mission and Sun's Corona

Context:

- ISRO successfully launched the Proba-3 mission onboard a PSLV-C59 rocket, a solar experiment undertaken by the European Space Agency.
- Proba-3 mission would significantly advance understanding of Sun's Corona: Ex-ISRO scientist

News:

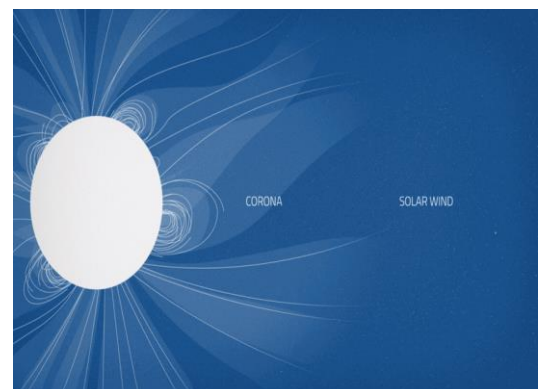
- ISRO's successful launch of European Space Agency's (ESA) Proba-3 satellites onboard PSLV-C59 rocket is a 'groundbreaking mission' and would significantly advance the understanding of Sun's corona and solar wind, a former ISRO scientist said.

More info:

- The 'innovative design and advanced technologies' used in the mission would pave the way for future space weather forecasting and solar physics research.
- This mission is a collaborative effort between the European Space Agency (ESA) and the Indian Space Research Organisation.
- Proba-3 is a pioneering mission designed to explore the Sun's corona, the outer atmosphere of the Sun.
- It aims to study the Corona, which is hotter than the Sun's surface, and explore the solar wind which is a stream of charged particles emanating from the Sun.
- The data from Proba-3 satellites would help scientists better understand and predict space weather events, which can impact the Earth's magnetic field and satellite operations.
- The two satellites - Coronagraph and Occulter - would form a 'precise formation 150 meters apart after several orbital manoeuvres in the coming days.
- The instrument in the Coronagraph spacecraft would capture high-resolution images of the Sun's corona.
 - This setup will mimic a total solar eclipse which traditionally lasts only for a few minutes and does not occur frequently.
- Proba 3 will provide 6 continuous hours of observation during each orbit, equivalent to about 50 natural solar eclipses annually.
- The Proba-3 features an advanced propulsion system, enabling precise control and manoeuvring of the spacecraft and is made by ESA.
- The ESA collaborated with ISRO as it currently lacks an active launch vehicle to carry its payloads to orbit.
 - This shows the success of our space diplomacy and our capacity to provide reliable and cost-effective launches to our customers.

About Sun's Corona:

- The Sun's corona is the outermost part of the Sun's atmosphere.
- The corona is usually hidden by the bright light of the Sun's surface.
 - That makes it difficult to see without using special instruments.
 - However, the corona can be viewed during a total solar eclipse.
- During a total solar eclipse, the moon passes between Earth and the Sun.
 - When this happens, the moon blocks out the bright light of the Sun.
 - The glowing white corona can then be seen surrounding the eclipsed Sun.
- The corona is about 10 million times less dense than the Sun's surface.
 - This low density makes the corona much less bright than the surface of the Sun.
- The corona is in the outer layer of the Sun's atmosphere - far from its surface.
 - Yet the corona is hundreds of times hotter than the Sun's surface.
- A NASA mission discovered packets of very hot material called "heat bombs" that travel from the Sun into the corona.
 - In the corona, the heat bombs explode and release their energy as heat.
 - But astronomers think that this is only one of many ways in which the corona is heated.
- The Sun's magnetic fields affect charged particles in the corona to form beautiful features.
 - These include streamers, loops, and plumes.
- **Solar winds:** The corona extends far out into space.
 - From it comes the solar wind that travels through our solar system.
 - The corona's temperature causes its particles to move at very high speeds.
 - These speeds are so high that the particles can escape the Sun's gravity.



4.6 AI tool to predict IVF outcomes in men with infertility

Context:

- Indian Council of Medical Research develops AI tool to predict IVF outcomes in men with infertility

More info:

- In nearly 50 per cent of couples experiencing infertility, the problem is with the male partner, said ICMR's National Institute for Research in Reproductive and Child Health (NIRRCH).
 - There could be problems with sperm production in these cases.
 - One of the leading causes, Y chromosome microdeletion (YCMD) is observed in one in every 10 men with infertility.
 - Because of this genetic defect, the testes are unable to make enough sperm, leading to infertility.
- Men with YCMD cannot benefit from medical treatment to improve the sperm count.
 - To become fathers, such men require assisted reproductive techniques such as in-vitro fertilization (IVF) for parenthood.

- The AI-based tool -- 'Fertility Predictor' -- developed by the ICMR-NIRRH in collaboration with Amity University, Noida can predict sperm retrieval rates and success rates of assisted reproductive technology (ART) in men with this genetic problem.
 - It also predicts the rate of fertilisation, clinical pregnancy and live birth rates based on the type of Y chromosome microdeletion.
 - This helps the couples make informed decisions.
 - However, the male babies born through IVF from men with YCMD would inherit the same defect and would be infertile as it is 100 per cent transmitted from fathers to their sons.
- Developing this tool took about two years by collating data from more than 500 men with YCMD and undergoing ART.
 - After applying an AI algorithm based on machine learning on this data, the tool could predict the outcomes.
 - This was then validated on another sub-set and it was found to have accuracy of about 80 per cent.
- Fertility Predictor also provides a numerical output for the chances of clinical pregnancy and live birth in men with YCMD.
 - The validation studies indicated its robustness and high accuracy in predicting both these parameters solely based on the type of YCMD.

4.7 Multiple myeloma

Context:

- AIIMS, Delhi developing low cost adaptive cellular therapy for treatment of multiple myeloma

News:

- Doctors at AIIMS, Delhi are in the process of developing a low cost antibody-based adaptive cellular therapy for the treatment of multiple myeloma, a form of blood cancer.

More info:

- This kind of therapy is expected to make advanced treatments like CAR-T cell therapies more affordable and accessible for patients in India.
- The Chimeric antigen receptor (CAR) T-cell therapy is a form of adaptive cellular therapy in which a patient's T cells are isolated, genetically modified and infused back in the patients body to recognise and kill cancer cells.
- It is based on targeting B-cell maturation antigen (BCMA) which helps to target specific tumour antigens which are found cancer cells especially in cases multiple myeloma.
 - So the therapy developed by the AIIMS researchers recognises BCMA as a target on multiple myeloma cells to eliminate them.
- As of now, the therapy has been tested on animal models and has shown promising outcomes.
- Doctors intend to take this CAR-T cell therapy for phase-1 clinical trials on humans in the near future to collect substantial evidence regarding its safety and efficacy.
 - Their aim is to bring the cost of this therapy significantly down.
- There are other forms of CAR-T cell therapies, but the costs of these are very high.

How do cancerous cells operate?

- Cancer is characterised by the uncontrolled growth of cancerous cells.
- Generally, all cancer cells are derived from a single cell which has undergone a sequence of mutations that has converted it into a cancerous cell and these cancerous cells are involved in different symptoms associated with cancer.

- Cancer cells proliferate at a very rapid pace which deprive normal cells of nutrients resulting in cancer associated cachexia.

Multiple myeloma:

- Multiple myeloma is a form cancer of the plasma cells which are a type of white blood cell (WBC) that produces antibodies against infection.
 - When these cells become cancerous, they multiply at a rapid pace and crowd out normal blood-forming cells in the bone marrow.
 - This form of cancer is often associated with relapses.
- Traditional cancer treatments like chemotherapy/radiotherapy target rapidly-dividing cells but this approach leads to cytotoxicity in normal cells as well as leading to severe side effects associated with cancer treatment.
- The past two decades have seen the emergence of targeted therapies in cancer associated with targeting inherent vulnerabilities of cancer cells like too much dependence on one protein for cancer cells which has improved outcome in cancer treatments.
 - However, cancer cells eventually develop resistance to these agents which leads to cancer relapses.
- The past decade has also seen the emergence of immunotherapy as one of the cornerstones of cancer therapeutics with monoclonal antibodies being used to target cancer cells.
- In a classical approach often these antibodies against a cancer target are loaded with the drug of interest for targeted delivery of chemotherapeutic drugs, thereby reducing the off-target effect and improving their effectiveness.
- Antibody based therapies have ushered a new era in cancer therapeutics including development of cellular CAR-T cell therapies which include components of these antibodies to target the antigen on the cancerous cell.
 - Immunotherapies however remain expensive thereby being out of reach for majority of the population in countries like India.
- One in nine in India likely to get cancer in their lifetime
- According to latest data from the National Cancer Registry, the estimated number of incident cases of cancer in India in 2022 was found to be 14,61,427.
- The problem of delayed diagnosis combined with limited access to world-class therapies is bound to create a significant health burden on India as cases are expected to rise exponentially in coming decade.
- The research group has filed for an Indian patent for the antibody and is in process of filing a patent for their CAR-T cell therapy.
- “CAR-T cell therapies has changed the way we approach and treat cancer. Development of CAR-T cell therapy has been in a nascent state in India despite the rapid pace at which it is moving around the world.

4.8 Rooppur nuclear project

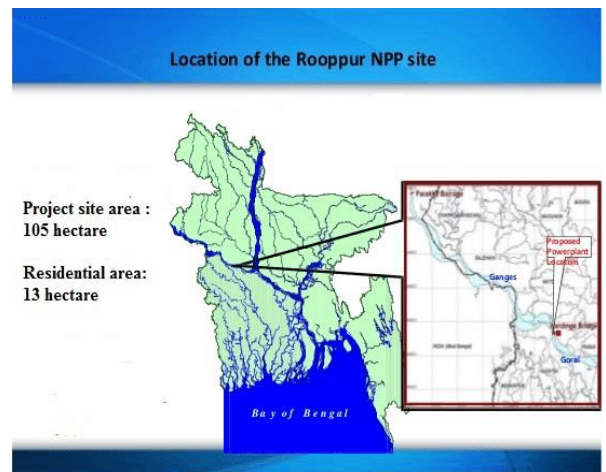
Context:

- Bangladesh initiates investigation into Russia-backed Rooppur nuclear project

About Rooppur nuclear project:

- The under construction Rooppur nuclear power plant is located 160 km from Dhaka and is one of the largest nuclear projects that Russian nuclear major Rosatom has been building.
- The project has been under construction since 2017 and the first unit of the nuclear power project is expected to be completed in 2025.
- Once fully operational the power plant will generate 2400 megawatt electricity.

- The project has been in international spotlight because of western sanctions that Russia has been facing since the beginning of the war in Ukraine.
 - Russian Foreign Minister assured in 2023 about Russia's commitment to complete the project on time.
 - Russia's flagship joint project is construction of the Rooppur nuclear power plant on the territory of Bangladesh.
 - The project is progressing smoothly in line with the schedule, and delivery and charging of first nuclear fuel are expected as early as in October.
- Rooppur power project led to a trilateral agreement among India, Bangladesh and Russia in March 2018 when India's nuclear players such as NPCIL began to assist the construction of the units.



4.9 U.S. anti-missile THAAD system

Context:

- U.S. anti-missile Terminal High Altitude Area Defense (THAAD) system in Israel used to intercept projectile from Yemen

More info:

- In October, President Biden placed the THAAD system, built by Lockheed Martin, in Israel along with about 100 U.S. soldiers to help defend the country.
- THAAD is critical to the U.S. military's layered air defence systems and added to Israel's already formidable anti-missile defenses.

About U.S. anti-missile THAAD system:

- The Terminal High Altitude Area Defense (THAAD) is a highly effective, combat-proven defense against short, medium and intermediate-range ballistic missile threats.
- THAAD is the only U.S. system designed to intercept targets outside and inside the atmosphere.
- THAAD continues incremental capability improvements within the weapon system to continually improve effectiveness against current and emerging threats.
- In 2022, the THAAD Weapon System successfully demonstrated integration with the PAC-3 Missile Segment Enhancement (MSE), providing the Warfighter with an expanded battle space and enhanced flexibility.
- It defends population centers and high value infrastructures.
- It is interoperable with other ballistic missile defense systems.
- It is highly mobile and deployable worldwide.

4.10 NASA's Parker Solar Probe

Context:

- NASA probe makes closest ever pass by the sun

News:

- NASA's pioneering Parker Solar Probe made history on December 24 when it flew closer to the sun than any other spacecraft, with its heat shield exposed to scorching temperatures topping 930 degrees Celsius.

More info:

- Launched in August 2018, the spaceship is on a seven-year mission to deepen scientific understanding of our star and help forecast space-weather events that can affect life on the earth.
- “Right now, the Parker Solar Probe is flying closer to a star than anything has ever been before,” at 6.1 million kilometers away.
 - If the distance between the earth and the sun is the equivalent to the length of an American football field, the spacecraft should have been about four metres from the end zone at the moment of closest approach, a point that scientists call perihelion.
- “This is one example of NASA’s bold missions, doing something that no one else has ever done before to answer long-standing questions about our universe.”
- So effective is the heat shield that the probe’s internal instruments remain near room temperature - around 29 degrees Celsius - as it explores the sun’s outer atmosphere, called the corona.
- The Parker Solar Probe will also be moving at a blistering pace of around 690,000 km/hr, fast enough to fly from New Delhi Chennai in around 10 seconds.
- By venturing into these extreme conditions, the Parker probe has been helping scientists tackle some of the sun’s biggest mysteries: how solar wind originates, why the corona is hotter than the surface below, and how coronal mass ejections - massive clouds of plasma that hurl through space - are formed.
- The Christmas Eve flyby was the first of three record-setting close passes.
 - The next two are set to occur on March 22 and June 19, 2025, and both are expected to bring the probe back to a similarly close distance from the sun.
- After its launch in 2018, the probe has been gradually circling closer towards the sun, using flybys of Venus to gravitationally pull it into a tighter orbit.

Mains**4.11 Did Venus ever have oceans?****Context:**

- A new study’s conclusions suggest Venus was never habitable

More info:

- Earth is an ocean world, with water covering about 71% of its surface.
- Venus, our closest planetary neighbor, is sometimes called Earth’s twin based on their similar size and rocky composition.
 - While its surface is baked and barren today, might Venus once also have been covered by oceans?
 - The answer is no, according to new research that inferred the water content of the planet’s interior - a key indicator for whether or not Venus once had oceans - based on the chemical composition of its atmosphere.
 - The researchers concluded that the planet currently has a substantially dry interior that is consistent with the idea that Venus was left desiccated after the epoch early in its history when its surface was comprised of molten rock - magma - and thereafter has had a parched surface.
- Water is considered an indispensable ingredient for life, so the study’s conclusions suggest Venus was never habitable.
- The findings offer no support for a previous hypothesis that Venus may have a reservoir of water beneath its surface, a vestige of a lost ocean.
- Volcanism, by injecting gases into a planet’s atmosphere, provides clues about the interior of rocky planets.

- As magma ascends from an intermediate planetary layer called the mantle to the surface, it unleashes gases from deeper parts of the interior.
- Volcanic gases on Earth are more than 60% water vapor, evidence of a water-rich interior.
- The researchers calculated that gases in Venusian eruptions are no more than 6% water vapor, indicative of a desiccated interior.
- Researchers suggest that a habitable past would be associated with Venus' present interior being water-rich, and a dry past with Venus' present interior being dry.
- The atmospheric chemistry suggests that volcanic eruptions on Venus release very little water, implying that the planet's interior - the source of volcanism - is equally dry.
 - This is consistent with Venus having had a long-lasting dry surface and never having been habitable.
- Venus is the second planet from the sun, and Earth the third.
- Two very different histories of water on Venus have been proposed: one where Venus had a temperate climate for billions of years, with surface liquid water, and the other where a hot early Venus was never able to condense surface liquid water.
- The Venusian diameter of about 7,500 miles (12,000 km) is just a tad smaller than Earth's 7,900 miles (12,750 km).
- Venus and Earth are often called sister planets because of their similarities in mass, radius, density and distance from the sun.
 - However, their evolutionary paths diverged dramatically.
- Venus now has surface conditions that are extreme compared to Earth, with an atmospheric pressure 90 times greater, surface temperatures soaring to around 465°C (869°F), and a toxic atmosphere with sulfuric acid clouds.
 - These stark contrasts underscore the unique challenges of understanding Venus as more than just Earth's counterpart.
- The story appears to have been different on Mars, the fourth planet from the sun.
 - Surface features on Mars indicate it had an ocean of liquid water billions of years ago.
 - No such features have been detected on Venus.
 - Mars, according to research based on seismic data obtained by NASA's robotic InSight lander, may harbor a large reservoir of liquid water deep under its surface within fractured igneous rocks, holding enough to fill an ocean that would cover its entire surface.
- While Venus has been studied less than Mars, new explorations are planned.
 - NASA's planned DAVINCI mission will examine Venus during the 2030s from its clouds down to its surface using both flybys and a descent probe.
 - Also during the 2030s, the European Space Agency's EnVision orbital mission is due to conduct radar mapping and atmospheric studies.
- Venus provides a natural laboratory for studying how habitability - or the lack of it - evolves.

4.12 Water on Mars

Context:

- 4-billion-year-old crystal offers oldest evidence of water on Mars

More info:

- Water is ubiquitous on Earth – about 70% of Earth's surface is covered by the stuff.
- Water is in the air, on the surface and inside rocks.
- Geologic evidence suggests water has been stable on Earth since about 4.3 billion years ago.
- The history of water on early Mars is less certain.

- Determining when water first appeared, where and for how long, are all burning questions that drive Mars exploration.
- If Mars was once habitable, some amount of water was required.
- Scientists studied the mineral zircon in a meteorite from Mars and found evidence that water was present when the zircon crystal formed 4.45 billion years ago.
 - These findings may represent the oldest evidence for water on Mars.

A wet red planet:

- Water has long been recognised to have played an important role in early Martian history.
- To place the results of above study in a broader context, let's first consider what "early Mars" means in terms of the Martian geological timescale, and then consider the different ways to look for water on Mars.
- Like Earth, Mars formed about 4.5 billion years ago.
- The history of Mars has four geological periods.
 - These are the Amazonian (from today back to 3 billion years), the Hesperian (3 billion to 3.7 billion years ago), the Noachian (3.7 billion to 4.1 billion years ago) and the Pre-Noachian (4.1 billion to about 4.5 billion years ago).
- Evidence for water on Mars was first reported in the 1970s when NASA's Mariner 9 spacecraft captured images of river valleys on the Martian surface.
 - Later orbital missions, including Mars Global Surveyor and Mars Express, detected the widespread presence of hydrated clay minerals on the surface.
 - These would have needed water.
- The Martian river valleys and clay minerals are mainly found in Noachian terrains, which cover about 45% of Mars.
 - In addition, orbiters also found large flood channels – called outflow channels – in Hesperian terrains.
 - These suggest the short-lived presence of water on the surface, perhaps from groundwater release.
- Most reports of water on Mars are in materials or terrains older than 3 billion years.
 - More recent than that, there isn't much evidence for stable liquid water on Mars.
 - But what about during the Pre-Noachian? When did water first show up on Mars?

A window to Pre-Noachian Mars:

- There are three ways to hunt for water on Mars.
 - The first is using observations of the surface made by orbiting spacecraft.
 - The second is using ground-based observations such as those taken by Mars rovers.
 - The third way is to study Martian meteorites that have landed on Earth, which is what the present study did.
- In fact, the only Pre-Noachian material we have available to study directly is found in meteorites from Mars.
 - A small number of all meteorites that have landed on Earth have come from our neighbouring planet.
 - An even smaller subset of those meteorites, believed to have been ejected from Mars during a single asteroid impact, contain Pre-Noachian material.
 - The "poster child" of this group is an extraordinary rock called NWA7034, or Black Beauty.
- Black Beauty is a famous Martian meteorite made up of broken-up surface material, or regolith.
 - In addition to rock fragments, it contains zircons that formed from 4.48 billion to 4.43 billion years ago.
 - These are the oldest pieces of Mars known.
- While studying trace elements in one of these ancient zircons we found evidence of hydrothermal processes – meaning they were exposed to hot water when they formed in the distant past.

Trace elements, water and a connection to ore deposits:

- The zircon scientists studied is 4.45 billion years old.
 - Within it, iron, aluminium and sodium are preserved in abundance patterns like concentric layers, similar to an onion.
 - This pattern, called oscillatory zoning, indicates that incorporation of these elements into the zircon occurred during its igneous history, in magma.
 - The problem is that iron, aluminium and sodium aren't normally found in crystalline igneous zircon – so how did these elements end up in the Martian zircon?
 - The answer is hot water.
- In Earth rocks, finding zircon with growth zoning patterns for elements like iron, aluminium and sodium is rare.
 - One of the only places where it has been described is from Olympic Dam in South Australia, a giant copper, uranium and gold deposit.
 - The metals in places like Olympic Dam were concentrated by hydrothermal (hot water) systems moving through rocks during magmatism.
- Hydrothermal systems form anywhere that hot water, heated by volcanic plumbing systems, moves through rocks.
 - Spectacular geysers at places like Yellowstone National Park in the United States form when hydrothermal water erupts at Earth's surface.
- Finding a hydrothermal Martian zircon raises the intriguing possibility of ore deposits forming on early Mars.
- Previous studies have proposed a wet Pre-Noachian Mars.
 - Unusual oxygen isotope ratios in a 4.43 billion-year-old Martian zircon were previously interpreted as evidence for an early hydrosphere.
 - It has even been suggested that Mars may have had an early global ocean 4.45 billion years ago.
- The big picture from this study is that magmatic hydrothermal systems were active during the early formation of Mars' crust 4.45 billion years ago.
 - It's not clear whether this means surface water was stable at this time, but we think it's possible.
 - What is clear is that the crust of Mars, like Earth, had water shortly after it formed – a necessary ingredient for habitability.

4.13 Hand-held 'electric labs'

Context:

- Hand-held 'electric labs' can rapidly identify pathogens

More info:

- When we think of electric fields, we likely think of electricity – the stuff that makes modern life possible by powering everything from household appliances to cellphones.
- Researchers have been studying the principles of electricity since the 1600s.
 - Benjamin Franklin, famous for his kite experiment, demonstrated that lightning was indeed electrical.
- Electricity has also enabled major advances in biology.
 - A technique called electrophoresis allows scientists to analyse the molecules of life – DNA and proteins – by separating them by their electrical charge.
 - Electrophoresis is not only commonly taught in high school biology, but it's also a workhorse of many clinical and research laboratories.
- Here is a biomedical engineering professor who works with miniaturised electrophoretic systems.

- He develops portable versions of these devices that rapidly detect pathogens and help researchers fight against them.

Electrophoresis:

- To understand how electrophoresis works, we first need to explain electric fields.
 - These are invisible forces that electrically charged particles, such as protons and electrons, exert on each other.
 - A particle with a positive electrical charge, for example, would be attracted toward a particle with a negative charge.
 - The law of “opposites attract” applies here.
 - Molecules can also have a charge; whether it’s more positive or negative depends on the types of atoms that make it up.
- In electrophoresis, an electric field is generated between two electrodes connected to a power supply.
 - One electrode has a positive charge and the other has a negative charge.
 - They are positioned on opposite sides of a container filled with water and a little bit of salt, which can conduct electricity.
 - When charged molecules such as DNA and proteins are present in the water, the electrodes create a force field between them that pushes the charged particles toward the oppositely charged electrode.
 - This process is called electrophoretic migration.
- Researchers like electrophoresis because it is fast and flexible.
- Electrophoresis can help analyse distinct types of particles, from molecules to microbes.
- Further, electrophoresis can be carried out with materials such as paper, gels and thin tubes.
- In 1972, physicist Stanislav Dukhin and his colleagues observed another type of electrophoretic migration called nonlinear electrophoresis that could separate particles not only by their electrical charge but also by their size and shape.

Electric fields and pathogens:

- Further advancements in electrophoresis have made it a useful tool to fight pathogens.
 - In particular, the microfluidics revolution made possible the tiny laboratories that allow researchers to rapidly detect pathogens.
- In 1999, researchers found that these tiny electrophoresis systems could also separate intact pathogens by differences in their electrical charge.
 - They placed a mixture of several types of bacteria in a very thin glass capillary that was then exposed to an electric field.
 - Some bacteria exited the device faster than others due to their distinct electrical charges, making it possible to separate the microbes by type.
 - Measuring their migration speeds allowed scientists to identify each species of bacteria present in the sample through a process that took less than 20 minutes.
- Microfluidics improved this process even further.
 - Microfluidic devices are small enough to fit in the palm of our hand.
 - Their miniature size allows them to perform analyses much faster than conventional laboratory equipment because particles don’t need to travel that far through the device to be analysed.
 - This means the molecules or pathogens researchers are looking for are more easily detected and less likely to be lost during analysis.
- Nonlinear electrophoresis has enabled more powerful devices by allowing researchers to separate and detect pathogens by their size and shape.
- Combining nonlinear electrophoresis with microfluidics can not only separate distinct types of bacterial cells but also live and dead bacterial cells.

Tiny electrophoresis systems in medicine:

- Microfluidic electrophoresis has the potential to be useful across industries.
 - Primarily, these small systems can replace conventional analysis methods with faster results, greater convenience and lower cost.
 - For example, when testing the efficacy of antibiotics, these tiny devices could help researchers quickly tell whether pathogens are dead after treatment.
 - It could also help doctors decide which drug is most appropriate for a patient by quickly distinguishing between normal bacteria and antibiotic-resistant bacteria.
- Developments happening that microelectrophoresis systems for purifying bacteriophage viruses that can be used to treat bacterial infections.

Conclusion:

- With further development, the power of electric fields and microfluidics can speed up how researchers detect and fight pathogens.

UPSC Mains PYQ (2021):

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

UPSC Mains PYQ (2018):

- Why is there so much activity in the field of biotechnology in our country? How has this activity benefitted the field of biopharma?

4.14 Major Atmospheric Cherenkov Experiment (MACE)

MACE in Ladakh opens its one-of-a-kind eye to cosmic gamma rays

About MACE:

- The Major Atmospheric Cherenkov Experiment (MACE) telescope is a state-of-the-art ground-based gamma-ray telescope inaugurated in Hanle, Ladakh.
- Located at around 4.3 km above sea level, it is the highest imaging Cherenkov telescope in the world.
- It boasts of a 21-metre-wide dish, the largest of its kind in Asia and second-largest in the world.
- The facility was built by the Bhabha Atomic Research Centre, the Tata Institute of Fundamental Research, the Electronics Corporation of India Ltd., and the Indian Institute of Astrophysics.

Gamma rays:

- In the electromagnetic spectrum, gamma rays have the shortest wavelength and the highest energy, with each light-particle possessing more than 100,000 electron volts. (Visible-light photons have around 1.63-3.26 eV each.)
- Gamma rays are produced by exotic energetic objects in the cosmos, including rapidly spinning pulsars, supernova explosions, hot whirlpools of matter around black holes, and gamma-ray bursts.
- Because of their high energy, gamma rays are a health hazard.
 - They can damage living cells and may even trigger deleterious mutations in DNA.
- Fortunately the earth's atmosphere blocks gamma rays from reaching the ground.
 - Thus, astronomers who want to study objects that emit gamma rays prefer using space observatories - although there are indirect techniques to detect gamma rays with very high energies from the ground.

Cherenkov radiation and the blue light:

- When a gamma ray from a cosmic source enters the atmosphere, it interacts with molecules in the air to produce a copious shower of electron-positron pairs.

- As these charged particles travel through the atmosphere at speeds greater than the speed of light in air, they emit a faint blue light, called Cherenkov radiation.
 - This radiation has wavelengths typical of violet and blue light of the visible spectrum and of the ultraviolet wavelength range.
- The light is emitted in about a fraction of a second, and the light-particles spread out evenly over a vast region on the earth's surface.
 - This region is a suitable place to locate a detector that can collect the photons and study them to indirectly understand the gamma rays.
 - Instruments used for this kind of detection are called imaging atmospheric Cherenkov telescopes (IACTs).
 - The MACE telescope is an IACT.
- The high altitude location puts the telescope above disturbances in the lower reaches of the troposphere.
- MACE is also not housed in a dome because of its large size, leaving its mirrors continuously exposed to the environment.
 - Each mirror is coated with a thin layer of silicon dioxide for protection.

WIMPs:

- MACE's main goal is to study gamma rays with more than 20 billion eV of energy.
- The telescope can examine high-energy gamma rays emitted from near black holes beyond the Milky Way and which are digesting large volumes of matter.
- Other potential astrophysical targets include gamma-ray pulsars, blazars, and gamma-ray bursts.
- One important goal is to find dark matter particles.
 - Dark matter is a type of matter believed to make up more than 85% of the total mass in our universe.
 - It is a fundamental part of the standard model of cosmology - but scientists don't know what subatomic particles it could be made of.
- One of the proposed particle constituents of dark matter is weakly interacting massive particles (WIMPs).
 - Scientists have predicted that these particles can produce high-energy gamma rays when they collide into and destroy each other.
 - These gamma rays could be produced in large galaxy clusters, small galaxies, and/or the centre of large galaxies, including the Milky Way.

India's MACE:

- Previous studies have shown that the MACE telescope can help find and measure the high-energy gamma rays produced by WIMPs.
 - This will allow astronomers to learn more about dark matter and the behaviour of WIMPs.
 - But just as likely, MACE could help verify whether WIMPs actually exist and make up dark matter or whether this hypothesis is flawed.

Conclusion:

- India has been active in gamma-ray astronomy for more than five decades now.
- The unveiling of the MACE telescope marked a significant step towards further technological and scientific advancements in the field.
- Most of MACE's subsystems were also built and designed within the country.
- With its advanced capabilities, MACE could play an important role in addressing fundamental open questions in the field of high-energy astrophysics and particle physics, and pave the way for cutting-edge research.

UPSC Mains PYQ (2022):

- Launched on 25th December, 2021, James Webb Space Telescope has been much in the news since then. What are its unique features which make it superior to its predecessor Space Telescopes? What are the key goals of this mission? What potential benefits it hold for the human race?

4.15 Infectious disease

One influenza virus is causing great concern right now and is teetering on the edge of being a serious problem in 2025: influenza a subtype H5N1, sometimes referred to as “bird flu”

- With COVID in retreat (thanks to highly effective vaccines), the three infectious diseases causing public health officials the greatest concern are malaria (a parasite), HIV (a virus) and tuberculosis (a bacterium).
 - And then there are the watchlists of priority pathogens - especially those that have become resistant to the drugs usually used to treat them, such as antibiotics and antivirals.
- Scientists must also constantly scan the horizon for the next potential problem.
 - While this could come in any form of pathogen, certain groups are more likely than others to cause swift outbreaks, and that includes influenza viruses.
- One influenza virus is causing great concern right now and is teetering on the edge of being a serious problem in 2025.
 - This is influenza A subtype H5N1, sometimes referred to as “bird flu”.
 - This virus is widely spread in both wild and domestic birds, such as poultry.
 - Recently, it has also been infecting dairy cattle in several U.S. states and found in horses in Mongolia.
- When influenza cases start increasing in animals such as birds, there is always a worry that it could jump to humans.
 - Indeed, bird flu can infect humans with 61 cases in the U.S. this year already, mostly resulting from farm workers coming into contact with infected cattle and people drinking raw milk.
 - Compared with only two cases in the Americas in the previous two years, this is quite a large increase.
 - Coupling this with a 30% mortality rate from human infections, bird flu is quickly jumping up the list of public health officials’ priorities.
- H5N1 bird flu doesn’t seem to transmit from person to person, which greatly reduces its likelihood of causing a pandemic in humans.
- Influenza viruses have to attach to molecular structures called sialic receptors on the outside of cells in order to get inside and start replicating.
- Flu viruses that are highly adapted to humans recognise these sialic receptors very well, making it easy for them to get inside our cells, which contributes to their spread between humans.
 - Bird flu, on the other hand, is highly adapted to bird sialic receptors and has some mismatches when “binding” (attaching) to human ones.
 - So, in its current form, H5N1 can’t easily spread in humans.
 - However, a recent study showed that a single mutation in the flu genome could make H5N1 adept at spreading from human to human, which could jump-start a pandemic.
 - If this strain of bird flu makes that switch and can start transmitting between humans, governments must act quickly to control the spread.
 - Centres for disease control around the world have drawn up pandemic preparedness plans for bird flu and other diseases that are on the horizon.
 - For example, the UK has bought 5 million doses of H5 vaccine that can protect against bird flu, in preparation for that risk in 2025.

- Even without the potential ability to spread between humans, bird flu is likely to affect animal health even more in 2025.
 - This not only has large animal welfare implications but also the potential to disrupt food supply and have economic effects as well.

Conclusion:

- This work all falls under the umbrella of “one health”: looking at human, animal and environmental health as interconnected entities, all with equal importance and effect on each other.
 - By understanding and preventing disease in our environment and the animals around us, we can better prepare and combat those diseases entering humans.
 - Similarly, by surveying and disrupting infectious diseases in humans, we can protect our animals and the environment’s health too.
 - However, we must not forget about the continuing “slow pandemics” in humans, such as malaria, HIV, tuberculosis and other pathogens.
 - Tackling them is paramount alongside scanning the horizon for any new diseases that might yet come.

5. Environment and Ecology

Prelims

5.1 World's rarest whale

Context:

- Scientists gather to decode puzzle of world's rarest whale
 - The spade-toothed whale has never been seen alive at sea

More info:

- It is the world's rarest whale, with only seven of its kind ever spotted.
- Almost nothing is known about the enigmatic species.
- But a small group of scientists and cultural experts in New Zealand clustered around a near-perfectly preserved spade-toothed whale hoping to decode decades of mystery.
 - New Zealand is a whale-stranding hotspot.
- Only six other spade-toothed whales have ever been found, but all those discovered intact were buried before DNA testing could verify their identification.
- The first spade-toothed whale bones were found in 1872 on New Zealand's Pitt Island.
 - Another discovery was made at an offshore island in the 1950s, and the bones of a third were found on Chile's Robinson Crusoe Island in 1986.
 - DNA sequencing in 2002 proved that all three specimens were of the same species - and that it was distinct from other beaked whales.
- It's thought that spade-toothed whales live in the vast Southern Pacific Ocean, home to some of the world's deepest ocean trenches.
- Beaked whales are the ocean's deepest divers for food, and the spade-toothed may rarely surface, adding to its mystery.

5.2 Floating vetiver islands

Context:

- Floating vetiver islands in Coimbatore lakes to purify water

News:

- Scientists installed vetiver floats at one of the lakes in Tamil Nadu, a novel experiment aimed at a solution towards clean water bodies.
 - They chose vetiver based on their research over the years on the efficacy of vetiver roots as water filter.

About Vetivar:

- Considered a green and environmental friendly wastewater treatment technology as well as a natural recycling method, vetiver when grown under land and aquatic conditions has an extremely high tolerance level for pollutants, particularly nitrate and phosphate, as well as most heavy metals that most other plants cannot tolerate.
- Vetiver's deep and massive root system takes on the job of removing pollutants from water bodies.



- Eutrophication or greening of lakes is an issue because of nitrates and phosphates in sewage that is let in.
 - Vetiver is scientifically proven to remove these chemicals making the water clean for aquatic life as well.
- The plant has long been used for various applications including the making of perfumes, soaps, and cosmetics.
- In coastal belts such as Puducherry, farmers grow vetiver in several acres of land.
 - The Indian Vetiver Network guides them on methods of extracting vetiver oil.
- The roots harvested from Periyakulam will be used to study its use as resource material to make handicraft items.
- One of the reports confirmed its efficiency in removal of heavy metals including carcinogenic chromium.
- Vetiver floats are already being used in Thailand to remove pollutants from water bodies.

5.3 GRADED RESPONSE ACTION PLAN (GRAP) FOR NCR

Context:

- **Delhi air pollution:** SC relaxes anti-pollution restrictions from GRAP IV to GRAP II in national capital region (NCR)
 - A Bench of 2 Justices said GRAP III must kick in if AQI deteriorates to 350 and GRAP IV restored if AQI crosses 400.

About GRAP:

- The GRAP for the NCR has been classified under 4 different stages of adverse air quality in Delhi viz. Stage - I 'Poor' (AQI 201 - 300), Stage - II 'Very Poor' (AQI 301-400), Stage - III 'Severe' (AQI 401-450) and Stage – IV 'Severe +' (AQI >450) respectively.
- Based on the dynamic model and weather/ meteorological forecast by IMD / IITM on a day to day basis, actions under Stages II, III and IV of the GRAP shall be invoked in advance of the AQI reaching to the projected levels of that stage, also provided that the higher projected AQI levels are likely to sustain for longer periods (say 3 days or more).
- Restrictive actions undertaken as per previous stages shall be continued, in addition to the air pollution stage under which the restrictive actions are envisaged to be taken.
 - For example, restrictive actions under the Stage III category, whenever invoked, shall be in addition to those under Stage I and II respectively and so on and so forth.
- The Sub-Committee on GRAP constituted by the Commission (Commission for Air Quality Management in National Capital Region and Adjoining Areas) shall meet frequently to plan for advance action and issue necessary orders for invoking various provisions of the GRAP, based on the prevalent air quality and the AQI forecast to be provided by IMD from time to time.
 - The Sub-Committee shall also review the actions taken by various agencies responsible towards effective implementation of the GRAP.
- The Chief Secretaries of NCR States and GNCTD (Government of the National Capital Territory of Delhi) shall frequently review the actions and implementation of the GRAP especially when the air quality falls or is likely to fall in the 'Severe' or 'Severe +'category (Stage III and beyond).
- The Commission may decide upon additional measures and exceptions to the schedule of the GRAP, under different air pollution categories i.e., Stages I to IV, as per the prevalent AQI and weather forecast.

5.4 U.N.'s highest environmental honour

Context:

- Ecologist Madhav Gadgil gets U.N.'s highest environmental honour

News:

- The United Nations recognised ecologist Madhav Gadgil with the annual Champions of the Earth award, the UN's highest environmental honour, for his seminal work in the Western Ghats, a global biodiversity hotspot.
- UNEP's 2024 Champions of the Earth recognizes six bold environmental leaders

More info:

- Mr. Gadgil, the only Indian on the list of this year's award recipients, chaired the government-constituted Western Ghats Ecology Expert Panel to study the impact of population pressure, climate change, and development activities on the ecologically fragile region in India.
 - The panel recommended in 2011 that the entire hill range be declared an Ecologically Sensitive Area (ESA) and divided into three Ecologically Sensitive Zones (ESZ 1, 2, and 3) based on their environmental sensitivity.
 - It also recommended a ban on mining, quarrying, new thermal power plants, hydropower projects, and large-scale wind energy projects in ESZ 1.
 - However, these recommendations faced opposition from State governments, industries, and local communities.
- UNESCO declared the Western Ghats a World Heritage Site in July 2012 and in 2013, the Centre formed a High-Level Working Group led by rocket scientist K Kasturirangan to propose measures for the ecological protection and sustainable development of the region.
 - This group identified 37% of the Western Ghats, covering 59,940 square km, as ecologically sensitive.
- Since March 2014, the Union environment ministry has issued five draft notifications, including one in July 2024, to declare the Western Ghats as ecologically sensitive, but the final notification is still pending due to objections from the States.
- An expert panel, established in April 2022 under former Director General of Forests Sanjay Kumar, is now working closely with the States to resolve the issue.

About Champions of the Earth award:

- The Champions of the Earth award honours individuals and organizations whose actions have a transformative impact on the environment.
- In 2024, UNEP honours individuals and organizations working on innovative and sustainable solutions to restore land, enhance drought resilience, and combat desertification.
- Established in 2005, the Champions of the Earth award is the UN's highest environmental honour.
- Every year, UNEP honours individuals and organizations working on innovative and sustainable solutions to address the triple planetary crisis of climate change, nature and biodiversity loss, and pollution and waste.
- Champions transform our economies, innovate, lead political change, fight environmental injustice, and defend our natural resources.
- Champions of the Earth are celebrated in four categories:
 - **Policy leadership:** Public sector officials leading global or national action for the environment.
 - They shape dialogue, lead commitments and act for the good of the planet.
 - **Inspiration and action:** Leaders taking bold steps to inspire positive change to protect our world.
 - They lead by example, challenge behavior and inspire millions.
 - **Entrepreneurial vision:** Visionaries challenging the status quo to build a cleaner future.
 - They build systems, create new technology and spearhead a groundbreaking vision.
 - **Science and innovation:** Trailblazers pushing the boundaries of technology for profound environmental benefit.
 - They invent possibilities for a more sustainable world.

- The Champions of the Earth has recognized 116 (excluding 2024's 6 awards) laureates, ranging from world leaders to technology inventors.
 - They include 27 world leaders, 70 individuals and 19 groups or organizations.

5.5 Delhi's poor AQI: Can air purifiers help?

- At the heart of an effective air purifier is a HEPA (High Efficiency Particulate Air) filter, capable of removing 99.97% of airborne particles as small as 0.3 microns.
- Air purifiers come in diverse forms, from portable devices for cars to high-end models with Wi-Fi integration and real-time AQI reports.
- Thousands of units have been purchased recently, as people braced for the winter's toxic mix of Diwali firecracker fumes, agricultural stubble burning, and smog.
- Air purifiers are most effective when matched to the room size.
- Air purifiers work best if the room is a closed space.
 - The moment you open the room to the balcony or other rooms, some amount of polluted air from outside will come inside.
- Experts advise using purifiers in rooms with children, the elderly, or those with lung conditions.
 - Regular maintenance, including filter replacement, is also crucial.
- Air purifiers with HEPA and activated carbon filters can capture particles, VOCs (Volatile organic compounds), bacteria, and even viruses.
- While air purifiers can help reduce pollutants indoors, they are not a one-time fix.
 - Frequent filter replacements are essential, especially in highly polluted areas.

5.6 Conservation status of great Indian bustard

Context:

- The National Compensatory Afforestation Fund Management and Planning Authority (CAMPA) has approved an amount of Rs 77.05 Cr for a period of five years for the Conservation Action Plan for the Great Indian Bustard (GIB) and Lesser Florican in 2024.

More info:

- A programme titled, 'Habitat Improvement and Conservation Breeding of the Great Indian Bustard – an Integrated Approach' was sanctioned with the funding support from the CAMPA in 2016 with an outlay of Rs. 33.85 crores. The Programme has achieved success in:
 - Establishing conservation breeding facilities for GIB at Sam and Ramdeora, Jaisalmer, in Rajasthan.
 - Securing partial founder population of GIB.
 - Commencing captive breeding of GIB from the founder population in Conservation Breeding Centre.
 - Advancing ecological knowledge on GIB with the aid of range-wide surveys, telemetry, intensive population, behavioural, and habitat monitoring, and molecular research.
 - Using this information and advocacy to guide actions for habitat improvement.
- The Conservation Action Plan for the Great Indian Bustard and Lesser Florican aims at ex-situ and in-situ conservation for Great Indian Bustard and lesser florican.
 - The action plan provides for GIB survey, development and implementation of Artificial Insemination techniques, habitat improvement, measures for protection from predators, community participation in conservation and awareness generation, Telemetry & tracking of wild populations etc.

5.7 PM2.5 pollution

Context:

- Residential sector main contributor to PM2.5 pollution in north Indian cities: Study

More info:

- Pollution in east, north and central Indian cities primarily comes from residential and transportation sectors, while in western India, industry and energy are the main contributors to local PM2.5 pollution, a study has found.
- The study also found that PM2.5 pollution in cities in south India majorly comes from the industry and residential sectors.
- Researchers from the Indian Institute of Tropical Meteorology, Maharashtra, and the Indian Institute of Technology Roorkee, analysed pollution levels in 53 cities, having more than a million population during the winter of 2015-2016.
- Residential emissions - from burning biomass for cooking and heating - were found to be the leading contributor to local PM2.5 pollution in Srinagar (68%), Varanasi (37%), Allahabad (34%) and Kanpur (33%).
- The transportation sector's contribution to local PM2.5 pollution was found to be higher in north Indian cities, especially Delhi and Ghaziabad.
- North and east Indian cities also recorded higher local pollution levels, compared to cities in central India, with the highest seen in Delhi, Ghaziabad and Kolkata, the researchers said.
- Further, pollution levels in the cities of west and south India were relatively lesser, compared to those in north and east Indian cities.
- The highest local PM2.5 pollution was, however, observed in Greater Mumbai, where absolute contributions of industrial, energy and residential sectors were also higher than those in the cities of west and south India.
- In another study, researchers from Berhampur University, Odisha, and the Indian Institute of Science, Bengaluru, analysed the transport, residential and power sectors for specific components that they contribute to PM2.5 pollution, such as nitrogen and sulphur oxides.
- Vehicular emissions remain "the dominating source" of nitrogen oxides and volatile organic compounds [gases in products like disinfectants and paints], while residential and power sectors are the highest emitters of carbon monoxide and sulphur dioxide.
- Indo-Gangetic Plain (IGP) and half of the districts contribute about 45% and 80% of carbon monoxide emission, the study found.

5.8 Slender-billed curlew

Context:

- In November 2024, the species was declared globally extinct, with the last irrefutable sighting of the slender-billed curlew identified from Morocco in 1995.
 - As of November 2024, its status on the IUCN Red List has not been updated, remaining as critically endangered.

About Slender-billed curlew:

- It is an extinct species of curlew native to Eurasia and North Africa.
- Isotope analysis suggests the majority of the former population bred in the Kazakh Steppe despite a record from the Siberian swamps, and was migratory, formerly



wintering in shallow freshwater habitats around the Mediterranean.

- This species has occurred as a vagrant in Western Europe, the Canary Islands, the Azores, Oman, Canada, and Japan.
- The only confirmed breeding records of the slender-billed curlew were a small region of raised bogs north of Omsk, Russia in a period between 1909 and 1925.
- Isotopic analysis suggests that main breeding range of the species was in a narrow belt in Kazakhstan centred around the 50th parallel north.
 - This area is predominantly steppe, with some areas of forest steppe.
- In recent history, it mostly migrated to the Mediterranean as well as southern Arabia, with claims in the northern reaches of the Persian Gulf, in Kuwait and Iraq.
- There have been historical records of the bird elsewhere, as in an ornithological dictionary of Gibraltar, written in 1895; it indirectly states that the slender-billed curlew was recorded as a passage migrant in Malaga, Spain.
- The causes of the decline of the species are uncertain, both hunting and habitat loss have been proposed as causes.

Mains

5.9 The toxins of the Bhopal disaster

Introduction:

- Forty years after the Bhopal disaster on December 2-3, 1984, several hundred tonnes of toxic waste still remain around the ill-fated Union Carbide plant.
 - Despite pleas from locals and activists - bolstered over the years by orders from the National Green Tribunal and the Supreme Court - to dispose of the waste, the Madhya Pradesh government has only been able to get rid of a small fraction.
- Chemical analyses of soil, air, and water samples collected from the area have revealed the presence of toxic compounds at elevated concentrations.
- This year, Madhya Pradesh received ₹126 crore from the Union government to incinerate around 340 tonnes of the above ground material, but others have resisted the plan saying burning the compounds will release poisonous fumes that could lead to further contamination and adverse health effects.

Toxins associated with the disaster:

- Union Carbide India, Ltd. (UCIL) built the Bhopal plant in the late 1960s to manufacture an insecticide called carbaryl using a reaction of methyl isocyanate (MIC) with 1-naphthol.
 - MIC is a highly toxic compound.
 - It reacts with water at high temperatures and its reaction with water also releases heat.
- On the night of December 2, 1984, a large quantity of water entered a tank storing MIC at the plant such that the MIC was soon boiling.
 - Facilities at the plant to cool the tank were otherwise diverted, leaving MIC vapours to escape to the environment and spread through the settlements around the plant.
 - MIC doesn't have a particular smell at concentrations at which other gases may become noticeable but it can irritate the eyes.
 - However, given the hours, most of the people exposed to the gas were asleep.
- The Union Carbide Corporation has never officially specified which gases were leaked from the plant, including MIC.

- This decision also compromised health workers' ability to respond effectively to the hordes of people who showed up in clinics and hospitals in Bhopal that night and the next day.
- Some visual cues, including the blood-red colour of the viscera of those who died, also raised concerns that hydrogen cyanide was present in the fumes.

Toxins at the plant:

- "A 2010 government-commissioned study showed that the factory premises also contain about 11 lakh tonnes of contaminated soil, one tonne of mercury, and nearly 150 tonnes of underground dumps" - in addition to the 340 metric tonnes earmarked for incineration.
- A report based on analyses of samples collected at the site reported the presence of mercury, chromium, copper, nickel, and lead.
 - The report also noted the presence of hexachlorobutadiene, chloroform, carbon tetrachloride, and trichlorobenzene, among other compounds.
- Reports from the area have also said the plant was disposing of untreated liquid effluent before the events of 1984.
- In 2004, the Supreme Court ordered Madhya Pradesh to supply drinking water from tankers to 14 communities around the plant; by 2013 this exercise had expanded to encompass 22 communities.
- In 2017, in response to a plea from an NGO, the court ordered the Indian Institute of Toxicology Research (IITR) to test water samples in 20 more communities.
 - In 2018, the IITR reported higher than permitted concentrations of nitrate and chloride compounds and heavy metals.
 - The court subsequently ordered Madhya Pradesh to expand its water-supply operations to 42 communities overall.
 - Since then, according to Amnesty International, the same NGO and others have identified persistent organic pollutants in 29 more communities and have described it as evidence of contamination still spreading from the plant.

Heavy metals and Toxicity:

- Chromium, copper, lead, mercury, and nickel are classified as heavy metals because their density is at least 5x that of water.
 - Mercury has been known to damage multiple organs even at low concentrations by accumulating in soft tissue and preventing normal cellular function.
 - The International Agency for Research on Cancer (IARC) has said there is "sufficient evidence" for arsenic and its compounds being able to cause cancers of the urinary bladder and the lungs.
 - For hexavalent chromium to cause cancers of the lungs.
 - For nickel and its mixtures to cause cancers of the lungs, nose, nasal cavity, and the paranasal sinuses.
 - According to a 2002 paper, Chromium is an essential nutrient required by the human body to promote the action of insulin for the utilisation of sugars, proteins and fats.
 - But high doses of chromium and long term exposure can give rise to various cytotoxic and genotoxic reactions that affect the immune system of the body.
 - Lead is capable of damaging chlorophyll and disrupting photosynthesis in plants and rendering structural damage to cells and hampering their ability to produce energy in animals.
 - Also, lead from inorganic compounds has been correlated with stomach cancer and to a lesser degree with cancers of the lungs, kidneys, and the brain.
 - High levels of copper in the body have been known to damage the liver, the kidneys, and the gastrointestinal system.

Harmfulness of organic compounds:

- According to the U.S. Environmental Protection Agency, hexachlorobutadiene is a possible carcinogen in humans.
 - When inhaled, ingested, or brought in contact with skin, this compound can cause the liver to store too much fat (hepatic steatosis), destroy cells in the kidneys involved in producing urine, and inhibit brain activity, among other effects.
 - It is also corrosive.
- Chloroform by another name is trichloromethane, and is infamous for its effects on the central nervous system.
 - At a sufficient concentration, it can cause an adult to faint, but at even higher ones it can cause death.
 - The IARC has classified chloroform as “possibly carcinogenic” on the back of limited evidence of cancer-causing potential in humans but more reliable evidence in animals.
- Carbon tetrachloride, a.k.a. carbon tet, is classified as an “acute toxin” and a “health hazard”.
 - It is notorious for its ability to damage the liver, including causing cancer.
 - At present, a common way to be exposed to carbon tet is via contaminated groundwater.
 - According to at least one review, ingesting 1 ml of carbon tet can also blur vision, damage nerves, and/or cause heartbeat to become irregular.
- Trichlorobenzene can take three chemical forms, or isomers, but all of them are volatile and spread easily through the air, although they have also been found in groundwater and in surface water bodies like lakes.
 - These compounds build up in the body’s fatty tissues and at high concentrations can damage the liver and the kidneys.
- Finally, persistent organic pollutants (POPs) refer to organic compounds that don’t break down easily and thus last for many years in the environment once they enter it.
 - According to the Stockholm Convention on POPs, their effects include “cancer, allergies and hypersensitivity, damage to the central and peripheral nervous systems, reproductive disorders, and disruption of the immune system.”
 - Some POPs have also been associated with developmental disorders and worse outcomes in cancers of the liver, breasts, pancreas, and the prostate.
- **Note:** The toxicity also depends on the demographic, physiological, and genetic characteristics of the exposed individual.

UPSC Mains PYQs (2018):

- What are the impediments in disposing the huge quantities of discarded solid wastes which are continuously being generated? How do we remove safely the toxic wastes that have been accumulating in our habitable environment?
- With growing energy needs should India keep on expanding its nuclear energy programme? Discuss the facts and fears associated with nuclear energy.

5.10 Global drylands

Context:

- More than 77% of earth's land became drier in last 30 years: United Nations report

News:

- More than 77% of Earth’s land experienced a drier climate during the three decades leading up to 2020, compared to the previous 30-year period, according to a report released by the U.N. Convention to Combat Desertification (UNCCD).

More info:

- During the same period, global drylands expanded by approximately 4.3 million square kilometres - an area nearly a third larger than India - now covering more than 40% of the Earth's land.
- The report, launched at the 16th conference of the UNCCD in Riyadh, Saudi Arabia, warned that if efforts to curb greenhouse gas emissions fail, another 3% of the world's humid areas are projected to transform into drylands by the end of this century.
- Meanwhile, the number of people living in drylands has doubled to 2.3 billion over the past three decades.
- Models suggest that as many as five billion could inhabit drylands by 2100 in a worst-case climate change scenario.
- These billions of people face even greater threats to their lives and livelihoods from climate-related increases in aridification and desertification," the report said.
- Areas particularly hard-hit by the drying trend include around 96% of Europe, parts of the western U.S., Brazil, Asia and central Africa.
- "South Sudan and Tanzania have the largest percentage of land transitioning to drylands, with China experiencing the largest total area shifting from non-drylands to drylands," the report said.
- About half of the world's dryland inhabitants are located in Asia and Africa.
- The most densely populated drylands are in California, Egypt, eastern and northern Pakistan, large parts of India and northeastern China.
- In high greenhouse gas emissions scenarios, dryland expansion is forecast for the Midwestern United States, central Mexico, northern Venezuela, northeastern Brazil, southeastern Argentina, the entire Mediterranean region, the Black Sea coast, large parts of southern Africa and southern Australia.
- This analysis finally dispels an uncertainty that has long surrounded global drying trends.
 - For the first time, the aridity crisis has been documented with scientific clarity, revealing an existential threat affecting billions around the globe.
 - Unlike droughts - temporary periods of low rainfall - aridity represents a permanent, unrelenting transformation.
 - Droughts end. When an area's climate becomes drier, however, the ability to return to previous conditions is lost.
 - The drier climates now affecting vast areas across the globe will not return to how they were, and this change is redefining life on Earth.

5.11 India State of Forest Report 2023

Context:

- Union Minister Bhupender Yadav Releases India State of Forest Report 2023

About India State of Forest Report 2023:

- Minister for Environment, Forest and Climate Change, Shri Bhupender Yadav released the 'India State of Forest Report 2023 (ISFR 2023)' at Forest Research Institute, Dehradun.
- The ISFR is brought out by the Forest Survey of India (FSI) on a biennial basis since 1987.
- FSI carries out in-depth assessment of the forest and tree resources of the country based on interpretation of Remote Sensing satellite data and field based National Forest Inventory (NFI), and the results are published in the ISFR.
- The India State of Forest Report 2023 is 18th such report in the series.
- The report contains information on forest cover, tree cover, mangrove cover, growing stock, carbon stock in India's forests, instances of forest fire, Agroforestry, etc.
- To present a detailed picture of the forest health at country level, special thematic information on forest cover and important characteristics of forests have been reported in the ISFR.

- As per the present assessment, the total Forest and Tree cover is 8,27,357sq km, which is 25.17 percent of the geographical area of the country.
- The Forest Cover has an area of about 7,15,343sq km (21.76%) whereas the Tree Cover has an area of 1,12,014 sq km (3.41%).
- The Minister expressed happiness over the fact that as compared to 2021, there is an increase of 1445 sq km in the total forest and tree cover of the country.
 - He also highlighted the near real time fire alerts and forest fire services provided by FSI using advance technology.

Major Findings:

- The Forest and Tree cover of the country is 8,27,357 sq km which is 25.17 percent of the geographical area of the country, consisting of 7,15,343 sq km (21.76%) as forest cover and 1,12,014 sq km (3.41%) as tree cover.
- As compared to assessment of 2021, there is an increase of 1445 sq km in the forest and tree cover of the country which includes 156 sq km increase in the forest cover and 1289 sq km increase in tree cover.
- Top four states showing maximum increase in forest and tree cover are Chhattisgarh (684 sq km) followed by Uttar Pradesh (559 sq km), Odisha (559 sq km) and Rajasthan (394 sq km).
- Top three states showing maximum increase in forest cover are Mizoram (242 sq km) followed by Gujarat (180 sq km) and Odisha (152 sq km).
- Area wise top three states having largest forest and tree cover are Madhya Pradesh (85,724 sq km) followed by Arunachal Pradesh (67,083 sq km) and Maharashtra (65,383 sq km).
- Area wise top three states having largest forest cover are Madhya Pradesh (77,073 sq km) followed by Arunachal Pradesh (65,882 sq km) and Chhattisgarh (55,812 sq km).
- In terms of percentage of forest cover with respect to total geographical area, Lakshadweep (91.33 percent) has the highest forest cover followed by Mizoram (85.34 percent) and Andaman & Nicobar Island (81.62 percent).
- The present assessment also reveals that 19 states/UTs have above 33 percent of the geographical area under forest cover.
- Out of these, eight states/UTs namely Mizoram, Lakshadweep, A & N Island, Arunachal Pradesh, Nagaland, Meghalaya, Tripura, and Manipur have forest cover above 75 percent.
- The total mangrove cover is 4,992 sq km in the country.
- The total growing stock of India's forest and trees is estimated as 6430 million cum, of which 4479 million cum is inside the forests and 1951 million cum outside the forest area.
- There is an increase of 262 million cum of total growing stock as compared to the previous assessment which includes an increase of 91 million cum inside the forest and 171 million cum outside the forest area.
- The extent of bamboo bearing area for the country has been estimated as 1,54,670 sq km.
- As compared to the last assessment done in 2021 there is an increase of 5,227 sq km in bamboo area.
- The total annual potential production of timber from trees outside forest has been estimated as 91.51 million cum.
- In the present assessment total carbon stock in country's forest is estimated to be 7,285.5 million tonnes.
- There is an increase of 81.5 million tonnes in the carbon stock of country as compared to the last assessment.
- Regarding status on achievement of target under NDC related to carbon sequestration, the current assessment shows that India's carbon stock has reached 30.43 billion tonnes of CO2 equivalent; which indicates that as compared to the base year of 2005, India has already reached 2.29 billion tonnes of additional carbon sink as against the target of 2.5 to 3.0 billion tonnes by 2030.

- Besides providing vital information for monitoring the country's forest and tree resources, the data given in the ISFR serves as a useful source of information for the policy makers, planners, State Forest Departments, research organisation, line agencies involved in various developmental works, academicians, civil society and others interested in natural resource conservation and management.

UPSC Mains PYQ (2018):

- Examine the status of forest resources of India and its resultant impact on climate change.

5.12 Green Skills

By equipping young people with green skills, India can chart a course toward a more sustainable and equitable future

Introduction:

- India, known for its rich and diverse ecosystems, is facing severe environmental challenges due to rapid urbanisation and development.
- Pollution, deforestation, loss of biodiversity, and the looming impacts of climate change are taking a toll on the balance of fragile natural ecosystems.
- While this year has presented a multitude of climate challenges, each with far-reaching consequences, 2023 was the warmest year on record, and 2025 is projected to be even hotter.
- India has observed a significant mean temperature increase of 0.15°C per decade since 1950, according to a 2020 assessment by the Ministry of Earth Sciences.
 - This has dire implications for ecosystems, agriculture, and human health.

Build resilience:

- The brunt of these environmental challenges is felt by the youth, who have to deal with not only the immediate effects but also the long-term consequences.
- Thus, for India's younger generation, building resilience against these crises is vital, as they will inherit and shape the planet's future.
- In this context, green skills have emerged as an essential tool in mitigating and adapting to the rapidly changing climate.
- These skills encompass technical knowledge, practical competencies, and mindsets required to implement sustainable practices, environmentally friendly technologies, and resource-efficient solutions across various sectors.
- Green skills empower individuals to make sustainable choices, address pressing environmental concerns and are especially crucial for youngsters, who will drive the global shift towards sustainability.
- In India, approximately 20% of the workforce is already employed in green jobs, a number expected to double by 2030.
 - This growing demand for green-skilled workers presents a unique opportunity to harness the country's demographic dividend.
- The range of green skills needed spans (but is not limited to) renewable energy, sustainable agriculture, water resource management, climate change adaptation, and waste management.
 - For example, skilling in solar panel installation, wind turbine maintenance, or hydroelectric power plant operations can significantly contribute to India's renewable energy transition.
 - Expertise in sustainable farming practices, such as organic agriculture and water conservation, can strengthen food security while protecting the environment.
 - Similarly, skills in urban planning, pollution control, and waste management are critical to create sustainable cities and reduce the ecological footprint of urban areas.

- Green skills are not only about adopting new technologies but also include efficient management of existing infrastructure, services, and systems.
- India's continued growth relies on sustainable operations across sectors, from energy to agriculture, to ensure that economic expansion does not come at the cost of the environment.

Pivotal role:

- The role of the youth in the green transition is paramount.
- Youngsters are already at the forefront of the net zero transition with climate action and spearheading sustainability initiatives.
 - But, to effectively lead this charge, they need access to training and upskilling opportunities.
 - Whether through formal education, vocational training, or informal programmes, acquiring green skills is essential to tackle climate challenges and lead communities in climate adaptation efforts.
- Youth-led green businesses and start-ups are already emerging across India, introducing innovative solutions to environmental issues.
- By leveraging their creativity, digital expertise, and future-oriented thinking, youngsters are playing a pivotal role in reshaping the green economy.
- As leaders in green entrepreneurship, they are laying the groundwork for a sustainable future, driving economic and environmental progress.
- The government has recognised the need to invest in green skills and the Green Skill Development Programme, for instance, aims to skill youth in fields related to the environment, renewable energy, forestry, wildlife conservation, and climate change.
 - Such programmes are essential to ensure that India's future workforce is equipped to handle the demands of a green economy.
- There is also a growing shift in academic curricula, with an increasing emphasis on environmental education and sustainability.
 - However, there is still a need to align skilling courses and academic programmes with the specific needs of the green economy.

Conclusion:

- This is a pivotal moment for India, as the youth have the potential not only to transform industries but also to drive a broader cultural shift towards sustainability in business, employment, and everyday life.

UPSC Mains PYQ (2016):

- "Demographic Dividend in India will remain only theoretical unless our manpower becomes more educated, aware, skilled and creative." What measures have been taken by the government to enhance the capacity of our population to be more productive and employable?

6. Social Issues

6.1 Transwomen in India

Context:

- Transwomen in India face discrimination, stigma, contributing to their mental health struggles: study
- A new study has found that entrenched inter-personal and structural stigma, including amongst law enforcement and healthcare professionals, deeply impacts the mental health of transwomen.

Introduction:

- Despite the passage of The Transgender Persons (Protection of Rights) Act, in 2019, multiple Supreme Court and High Court judgements as well as protection provided by some State governments, transwomen in India continue to face stigma, discrimination and violence, deeply impacting their mental health, a new study has found.
- The exploratory study used focused group discussions and in-depth interviews with 30 transwoman in Kolkata to gather data.
- Three types of stigma were looked at: self-directed (internal), discrimination, violence and hatred directed towards them by others, mostly cis-gender persons (interpersonal stigma) and discrimination faced at the level of institutional arrangements (structural stigma).
- The study found that stigma begins early in life, within families where transwomen are often rejected, leading to a loss of self-esteem.
 - In schools, bullying and harassment force many to drop out, leaving them without education or stable employment.
 - Many transwomen are therefore left with limited options, often turning to begging or sex work to survive.
 - The study participants also faced harassment at the hands of the police and from hospital staff, making them reluctant to approach law enforcement officials for help and seek treatment from health providers for their physical as well as mental health concerns.
- One of the ways in which participants were able to come to terms with their identity was through connecting with other transwomen.
 - Some participants spoke of support groups (community) that helped them to build a sense of identity, confidence and empowerment, which has enabled many transwomen to discover themselves and stand up for their rights.

The Hijra gharana scenario:

- Study participants who were members of a hijragharana in the past spoke of the benefits associated with being a member, related to old age security -- when the guru becomes old, the chelas look after their guru.
 - But these participants also spoke of the existence of a hierarchy within the gharana based on differential power.
 - Hijras higher up in the hierarchy have certain privileges including being paid a share of the earnings.
 - Both these were identified as sources of mental stress for those lower in the hierarchy.
 - Giving up a share of their earnings meant that the chelas are left with meagre portion of their earnings after a hard day's work in the sun and on the streets.
- When it came to society and public spaces, transwomen who were part of the study said they felt that society did not accept them, and they were subjected to discrimination in many places.
 - Discrimination in public transportation was common.

- Stigma also manifested itself in ways such as lack of basic facilities for transgender people in public places (no separate toilets, no dedicated beds in hospitals).
- It also manifested itself in the way in which people working in public institutions responded to transwomen and the perceptions that these providers had of transwomen.
- The transwomen in the study mentioned that the police did not treat them with respect and even harassed them.
- The police would not be willing to register complaints brought to them by the transwomen and would believe that transwomen themselves were the ones at fault.

Healthcare discrimination:

- Healthcare discrimination also emerged as a major issue.
- Mistreatment by hospital staff and lack of understanding from healthcare providers discouraged many transwomen from seeking medical help.
 - As a result, their physical and mental health needs often go unmet, the study found.
 - These experiences take a significant toll on mental well-being, contributing to high rates of depression, anxiety, and suicidal thoughts among transwomen.
- Transwomen felt that it was important for transgender representatives to be part of the process of policy formulation so that their concerns are included when policies are designed; they also highlighted the importance of creating safe spaces for the community to enable them to freely discuss problems and interact with each other without any fear.
- One of the most pressing revelations from the study is the lack of mental health research focusing on transwomen, especially in low- and middle-income countries like India.
 - While global studies often focus on HIV-related issues, mental health needs of transgender communities remain largely unaddressed.
 - This research highlights the urgent need for interventions to address stigma and its impact on their lives.

Conclusion:

- The study pointed out that it was important for researchers to be cognisant of the challenges faced by transwomen/transgender people while designing and conducting research.
- The authors are of the opinion that besides teachers, health personnel and the police, a whole range of other stakeholders such as counsellors, government officials and policy makers need to be sensitised to make them empathic towards transgender persons and to overcome preconceived notions and biases that influences the ways in which they respond to transgender people.

6.2 Ayushman Vay Vandana Card (AVVC)

News:

- Enrolment for the Ayushman Vay Vandana Card (AVVC), launched on October 29, has reached 25 lakh.

AB PM-JAY:

- Prime Minister Modi had announced the expansion of the Ayushman Bharat Pradhan Mantri Jan Arogya Yojana (AB PM-JAY) to include all senior citizens aged 70 years and above.
 - Senior citizens in this age group belonging to families already covered under AB PM-JAY get an additional top-up cover up to ₹5 lakh per year for themselves.
 - Senior citizens already availing the benefits of various government schemes, including the Central Government Health Scheme, the Ex-Servicemen Contributory Health Scheme, and the Ayushman Central Armed Police Force must choose between their existing scheme or opt for the AB PM-JAY.

- People covered by private health insurance or members of the Employees' State Insurance Scheme are eligible to benefit from the AB PM-JAY.

AVVC:

- The AVVC provides ₹5 lakh free health cover to all senior citizens aged 70 years and above, irrespective of their socio-economic status.
- The card covers treatment for about 2,000 medical procedures and includes all pre-existing diseases from the first day, without any waiting period.
- Eligible senior citizens can register via multiple channels.

6.3 WHO's latest World Malaria Report (2024)

India accounts for half of all estimates Malaria cases in 2023 in South-East Asia Region

Introduction:

- The World Health Organisation's South East Asia Region contributes about 1.5% of the burden of malaria cases globally and India accounted for about half of all estimated cases in 2023, followed by Indonesia, which carried just under one-third.
 - Estimated malaria deaths in the region fell by 82.9%, from 35,000 in 2000 to 6,000 in 2023.
 - Together, India and Indonesia accounted for about 88% of malaria deaths in the Region.
 - This according to the WHO's latest World Malaria Report (2024) released recently.
 - The report notes that since 2000 the WHO South-East Asia Region has made remarkable progress against malaria and estimated malaria cases in the region fell from 22.8 million in 2000 to 4 million in 2023 – a reduction of 82.4%.

India reported significant reduction in malaria caseload:

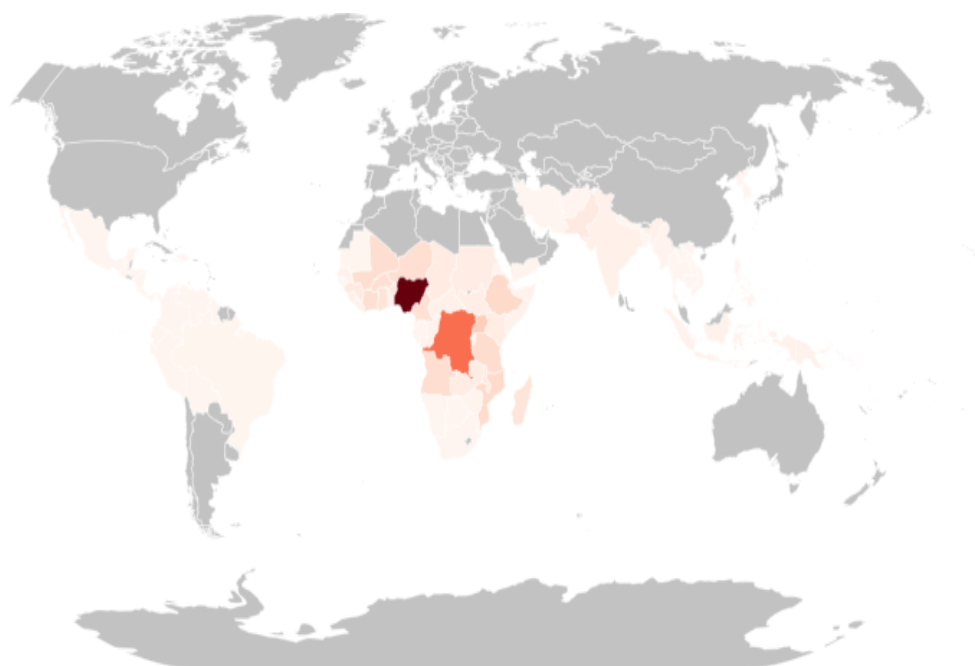
- In the period 2022-2023, four countries achieved reductions in their malaria caseload - Bangladesh (-9.2%), India (-9.6%), Indonesia (-5.7%) and Nepal (-58.3%).
 - Meanwhile, three countries saw case increases - Democratic People's Republic of Korea (+47.9%), Thailand (+46.4%) and Myanmar (45.1%).
- In 2023, both Timor-Leste and Bhutan reported zero indigenous cases of malaria.
 - With the exception of Myanmar and Thailand, all countries reported either a decline in their malaria mortality rate or zero malaria deaths.
- A reduction in case incidence of 87% was achieved between 2000 and 2023, from 17.7 to 2.3 per 1000 population at risk.
 - These gains have been largely attributed to progress in India, which saw 17.7 million fewer estimated cases and a 93% decrease in case incidence since 2000.
- Meanwhile, new data from the WHO revealed that an estimated 2.2 billion cases of malaria and 12.7 million deaths have been averted since 2000, but the disease remains a serious global health threat, particularly in the WHO African Region.
- According to WHO's latest World malaria report, there were an estimated 263 million cases and 597,000 malaria deaths worldwide in 2023.
 - This represents about 11 million more cases in 2023 compared to 2022, and nearly the same number of deaths.
 - Approximately 95% of the deaths occurred in the WHO African Region, where many at risk still lack access to the services they need to prevent, detect and treat the disease.
- "No one should die of malaria; yet the disease continues to disproportionately harm people living in the African region, especially young children and pregnant women," said Dr Tedros Adhanom Ghebreyesus, WHO Director-General.

- He added that an expanded package of lifesaving tools now offers better protection against the disease, but stepped-up investments and action in high-burden African countries are needed to curb the threat.

44 countries and one territory declared malaria-free:

- As of November 2024, 44 countries and one territory had been certified malaria-free by WHO, and many more are steadily progressing towards the goal.
 - Of the 83 malaria-endemic countries, 25 countries now report fewer than 10 cases of malaria a year, an increase from 4 countries in 2000.
- WHO adds that funding remains a major barrier to future progress.
 - In 2023, total funding reached an estimated US\$ 4 billion, falling far short of the year's funding target of US\$ 8.3 billion set by the Global technical strategy.
 - Insufficient funding has led to major gaps in coverage of insecticide-treated nets, medicines, and other life-saving tools, particularly for those most vulnerable to the disease.
- Beyond funding, malaria-endemic countries continue to grapple with fragile health systems, weak surveillance, and rising biological threats, such as drug and insecticide resistance.
- In many areas, conflict, violence, natural disasters, climate change and population displacement are exacerbating already pervasive health inequities faced by people at higher risk of malaria, including pregnant women and girls, children aged under 5 years, Indigenous Peoples, migrants, persons with disabilities, and people in remote areas with limited healthcare access.
- WHO is now calling for investments in robust data systems that are capable of monitoring health inequalities, including through the collection and analysis of data disaggregated by sex, age and other social stratifiers.
- Equity, gender equality and human rights should be the cornerstones of antimalarial innovation, with people most impacted by the disease engaged in the design and evaluation of new tools and approaches.

Fig: Global Malaria cases in 2023



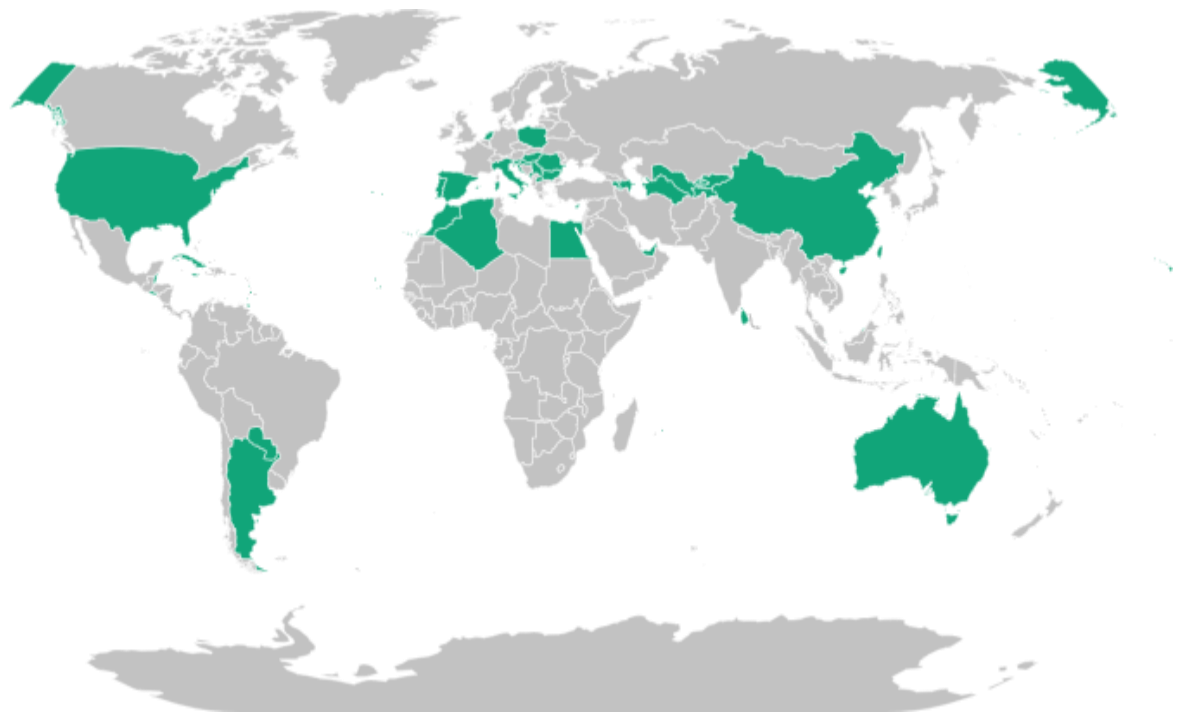


Fig: Countries certified as Malaria-free by WHO since 1960

7. Miscellaneous

7.1 UNESCO 'City of Literature'

Context:

- Kozhikode seeks collaborations with key institutions to enhance its literary scene, aiming to leverage the UNESCO 'City of Literature' recognition for sustainable cultural development.
 - Kozhikode City was accorded the prestigious tag on October 31, 2023, and it is India's first 'Creative City' to join the network of Literature in the UNESCO Creative Cities Network (UCCN).
 - The aim would be to showcase Kozhikode's potential as a platform for the advancement of literature and culture among the 55 cities that were included in the UCCN in 2023.

UNESCO's City of Literature:

- UNESCO's City of Literature programme is part of a wider Creative Cities Network which was launched in 2004 and is currently made up of 350 UNESCO Creative Cities globally.
- Members are drawn from more than 90 countries and cover seven creative fields: Crafts & Folk Art, Design, Film, Gastronomy, Literature, Music, and Media Arts.
- The Network was born out of UNESCO's Global Alliance for Cultural Diversity initiative, which was created in 2002.

About The Cities of Literature:

- The Creative Cities Network's aim is to "promote the social, economic and cultural development of cities in both the developed and the developing world."
- The cities in the network promote their local creative scene and conform to UNESCO's goal of fostering cultural diversity.
 - They recognise past, present and future: a strong cultural heritage, a vibrant and diverse contemporary cultural scene, and aspirations to extend culture to the next generation at home and to other cities in a global partnership.
- The UNESCO Cities of Literature network of 53 cities represents 6 continents and 39 countries, and a combined population of over 26 million.
- To be approved as a City of Literature, cities need to meet a number of criteria set by UNESCO.
- Designated UNESCO Cities of Literature share similar characteristics:
 - Quality, quantity and diversity of publishing in the city
 - Quality and quantity of educational programmes focusing on domestic or foreign literature at primary, secondary and tertiary levels
 - Literature, drama and/or poetry playing an important role in the city
 - Hosting literary events and festivals which promote domestic and foreign literature
 - Existence of libraries, bookstores and public or private cultural centres which preserve, promote and disseminate domestic and foreign literature
 - Involvement by the publishing sector in translating literary works from diverse national languages and foreign literature
 - Active involvement of traditional and new media in promoting literature and strengthening the market for literary products
- Cities submit bids to UNESCO to be designated a City of Literature.
- The designations are monitored and reviewed every four years by the organization.

About Kozhikode:

- **Kozhikode, the first UNESCO City of Literature in India**, is located on the Malabar coast of Kerala, India.
- Kozhikode is a city vibrant in its literary wealth, gaining the esteemed UNESCO tag on October 31, 2023, thus becoming India's first UNESCO City of Literature.
- This UNESCO designation recognises the city's creative potential owed to its rich literary history, diverse linguistic traditions, thriving community of writers, poets, and scholars, and enthusiastic public engagement.
- Kozhikode, with its literary roots reaching back to the 14th century, is home to several libraries, writers, publishers, and printing presses, all intertwined with its vibrant tourism, cuisine, and music.

7.2 IIT Delhi, IISc lead in QS sustainability rankings 2025

Context:

- Indian Institute of Technology (IIT), Delhi is at the top among universities in India for sustainability, jumping 255 places to reach 171 globally, according to QS Rankings announced recently.

More info:

- IIT-Delhi and IIT-Kanpur have been ranked among the world's top 100 for environmental impact.
- Indian Institute of Science (IISc), Bengaluru has been ranked among the world's top 50 for environmental education.
- Of the 78 Indian universities featured in the 2025 QS Sustainability Rankings, 34 have improved on last year's placing and eight have maintained their positions.
 - This is an excellent achievement for the Indian higher education ecosystem and shows that Indian universities are forging ahead with their sustainability initiatives.
- Within the Social Impact category, Indian universities can look to improve their indicator scores in the Health and Wellbeing, Impact of Education and Equality lenses, where no institutions from the country feature in the top 350.
- Universities from India scored better in the Knowledge Exchange and Employability and Outcomes lenses.
- The progress reflected in this year's QS Sustainability Rankings highlights the growing global efforts by higher education institutions to address sustainability challenges.

Note:

- QS' methodology for the 'World University Rankings: Sustainability 2025' is based on university performance across three assessment categories: Environmental Impact, Social Impact and Governance.

7.3 Notre-Dame de Paris

Context:

- France's Notre Dame holds first mass after five-year restoration

About Notre-Dame de Paris:

- It is a cathedral church in Paris.
- It is the most famous of the Gothic cathedrals of the Middle Ages and is distinguished for its size, antiquity, and architectural interest.
- The cathedral was initiated by Maurice de Sully, bishop of Paris, who about 1160 conceived the idea of converting into a single building, on a larger scale, the ruins of the two earlier basilicas.
 - The foundation stone was laid by Pope Alexander III in 1163, and the high altar was consecrated in 1189.
- Notre-Dame Cathedral suffered damage and deterioration through the centuries.

- The massive blaze destroyed most of the roof, Viollet-le-Duc's 19th-century spire, and some of the rib vaulting.
 - Pres. Emmanuel Macron immediately promised that the cathedral would be rebuilt - ultimately setting a timetable of five years.
 - Notre-Dame reopened to the public on December 8, 2024, to much fanfare following.

Gothic architecture:

- Gothic architecture, architectural style in Europe that lasted from the mid-12th century to the 16th century, particularly a style of masonry building characterized by cavernous spaces with the expanse of walls broken up by overlaid tracery.
 - Britain, Germany, and Spain produced variations of this style, while Italian Gothic stood apart in its use of brick and marble rather than stone.
- Late Gothic (15th-century) architecture reached its height in Germany's vaulted hall churches.
 - Other late Gothic styles include the British Perpendicular style and the French and Spanish Flamboyant style.

7.4 National Maritime Heritage Complex (NMHC)

Context:

- Lothal to become global hub for maritime heritage with National Maritime Heritage Complex, says Shipping Minister

More info:

- Under the Sagarmala Programme, the Ministry of Ports, Shipping, and Waterways is developing the NMHC at Lothal in Gujarat.
- This world-class facility will showcase India's maritime heritage from ancient to modern times, adopting an "edutainment" approach.
- Lothal, a prominent city of the ancient Indus Valley Civilisation dating back to 2400 BCE, holds historical significance for its advanced dockyard, thriving trade, and renowned bead-making industry.
 - Artifacts such as seals, tools, and pottery unearthed by archaeologists reveal a rich cultural and economic history, making it a pivotal site of the Harappan civilisation.
- NMHC project will boost tourism, provide a platform for maritime education, and foster collaboration between India's maritime community and the global industry.
- This project will create employment, foster skill development, and empower the youth of Gujarat.
- The NMHC is poised to become a cornerstone of India's maritime legacy, harmonising cultural and historical significance with economic and educational development.

7.5 Ken-Betwa river-linking project

Context:

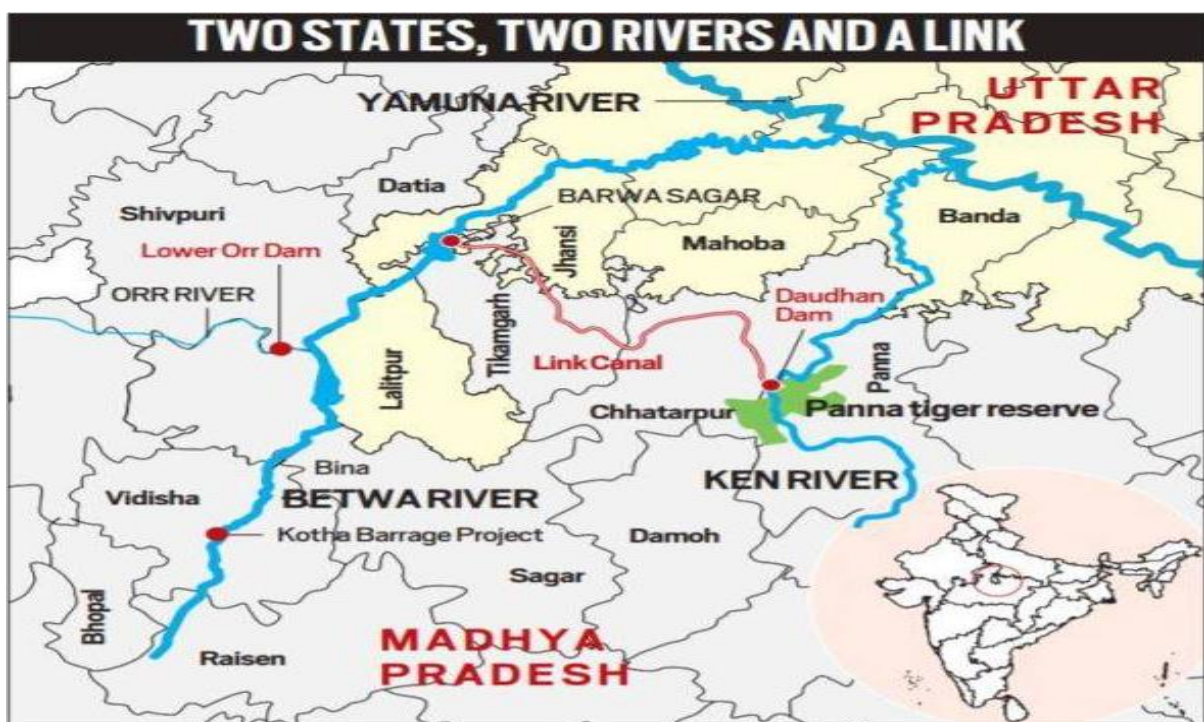
- PM Modi lays foundation for Ken-Betwa river-linking project to solve water woes of Bundelkhand
 - It is country's first interlinking of rivers project under national perspective plan.

News:

- Prime Minister laid the foundation stone for the Ken-Betwa river-linking project in Madhya Pradesh's Khajuraho, aimed at solving the water woes of the Bundelkhand region, spread across parts of Uttar Pradesh and Madhya Pradesh.

More info:

- Spread between the northern parts of Madhya Pradesh and southern Uttar Pradesh, the partly-hilly region has for long suffered droughts and water shortages, prompting locals to move to other cities for employment.
- The Ken-Betwa link project envisages diversion of surplus water of Ken basin to water short areas of Betwa basin by substitution.
- The Ken-Betwa river linking project is expected to address drinking and irrigation water needs of at least 10 districts of Madhya Pradesh and various districts of Uttar Pradesh.
- The project is also aimed at generating more than 100 MW of hydropower and 27 MW of solar energy.
- The project will also create many employment opportunities as well as strengthen the rural economy.
- KBLP mainly envisages to provide irrigation and domestic water supply facilities to drought prone areas namely Chhatarpur, Tikamgarh, Panna, Damoh, Vidisha, Sagar, Shivpuri, Datia & Raisen districts of MP and Mahoba, Banda, Jhansi & Lalitpur districts of UP.
- The Prime Minister also laid foundation for the Daudhan dam irrigation project, which is expected to address irrigation needs of 11 lakh hectares of land in the region.
- Madhya Pradesh has become the first State in the country with two river-linking projects under way at the moment.
- Recently, the PM had also launched the Parbati-Kalisindh-Chambal river-linking project that spreads between Rajasthan and Madhya Pradesh.
- Apart from the Ken-Betwa project, the Prime Minister also virtually inaugurated a floating solar energy project in Madhya Pradesh's Omkareshwar, the State's first solar power plant.
- Speaking about concerns that the river-linking project may cause harm to the animals at the Panna Tiger Reserve, Mr. Modi said the animals at the reserve will be kept in mind while building the canal for the project.
- Jairam Ramesh said that the project will "submerge over 10 percent of the core area of the tiger reserve".
 - Not only prime tiger habitats - but also those of other species like vultures - will be lost.
 - The ecosystem will be bifurcated.
 - More than 23 lakh trees are to be felled.
 - Construction activities will be a severe disturbance.



7.6 Kurubas of Karnataka

Context:

- Bhed Chal (Herd Walk) film was recently screened at Kurubkii, a three-day-long event showcasing the lives, livelihood and culture of the Kurubas, one of the oldest pastoralist communities in the Deccan region.

About Kuruba:

- Kuruba is a Hindu caste native to the Indian state of Karnataka, Tamil Nadu, Andhra Pradesh and Telangana.
- They are the third-largest caste group in Karnataka.
- Traditionally, these are shepherds who used to do the work of sheep/goat and animal husbandry and agriculture, in which they especially raised mixed herds of sheep and goats and cattle.
- It is believed that Kurubas are ethnically related to the Kuruvars of Sangam literature.
- Traditional sources claim that the Kurumas or Kurubas founded the Sangama dynasty, the founding dynasty of the Vijayanagara Empire.
- The Kurubas traditionally practiced transhumance pastoralism: moving with large flocks of sheep from one pasture to the other.
 - A secondary source of livelihood was once weaving kambli, but that had mostly disappeared by the 20th century.
- Although the Kurubas are traditionally Saivites, they worship a variety of deities.
- Many dynasties in South India, from the Pallavas to the Yadavarayas, were originally members of pastoralist, cowherd groups and belonged to Kuruba lineages.

8. Mapping

8.1 Bangladesh

Context:

- Bangladesh's leading political parties have called for calm following widespread unrest in the country triggered by the killing of a lawyer during clashes between Hindu protesters and security forces.

About Bangladesh:

- Bangladesh, country of South Asia, located in the delta of the Padma (Ganges [Ganga]) and Jamuna (Brahmaputra) rivers in the northeastern part of the Indian subcontinent.
- The riverine country of Bangladesh (Land of the Bengals) is one of the most densely populated countries in the world, and its people are predominantly Muslim.
- As the eastern portion of the historical region of Bengal, the area once formed, along with what is now the Indian state of West Bengal, the province of Bengal in British India.
- With the partition of India in 1947, it became the Pakistani province of East Bengal (later renamed East Pakistan), one of five provinces of Pakistan, separated from the other four by 1,800 km of Indian territory.
- In 1971 it became the independent country of Bangladesh, with its capital at Dhaka.

Land:

- Bangladesh is bordered by the Indian states of West Bengal to the west and north, Assam to the north, Meghalaya to the north and northeast, and Tripura and Mizoram to the east.
- To the southeast, it shares a boundary with Myanmar.
- The southern part of Bangladesh opens into the Bay of Bengal.

Relief:

- Stretching northward from the Bay of Bengal, Bangladesh constitutes roughly the eastern two-thirds of the deltaic plain of the Padma (Ganges [Ganga]) and Jamuna (Brahmaputra) rivers.

Bangladesh–India border:

- The Bangladesh–India border, known locally as the Radcliffe line (IB), is an international border running between the republics of Bangladesh and India that demarcates the six divisions of Bangladesh and the Indian states.
- Bangladesh and India share a 4,096-kilometre-long international border, the fifth-longest land border in the world, including 262 km in Assam, 856 km in Tripura, 318 km in Mizoram, 443 km in Meghalaya and 2,217 km in West Bengal.
- The Bangladeshi divisions of Mymensingh, Khulna, Rajshahi, Rangpur, Sylhet, and Chittagong are situated along the border.
- The Radcliffe Line was published on 17 August 1947 as a boundary demarcation line between the dominions of India and Pakistan upon the partition of India.



- It was named after its architect, Sir Cyril Radcliffe, who, as chairman of the Border Commissions.



8.2 Aleppo and Idlib

Context:

- Insurgents in Syria push their advance to Aleppo
- Syrian military launches offensive against insurgents in Idlib and Aleppo

About Aleppo:

- Aleppo, principal city of northern Syria.
- It is situated in the northwestern part of the country, about 50 km south of the Turkish border.
- Aleppo is located at the crossroads of great commercial routes and lies some 100 km from both the Mediterranean Sea (west) and the Euphrates River (east).
- The old city of Aleppo was designated a UNESCO World Heritage site in 1986.

About Idlib:

- It is a town in northwestern Syria.
- During the Syrian Civil War, the town grew in importance when the surrounding region became the last stronghold of the various Syrian rebel groups in 2018.

Rebel forces sweep into Aleppo and make rapid progress south of Idlib



8.3 U.S. territory Guam and Island chains

Context:

- Taiwan President Lai Ching-te says Taiwan and the U.S. territory Guam should defend freedom in region

About Guam:

- Guam, island and unincorporated territory of the United States in the North Pacific Ocean, the largest, most populous, and southernmost of the Mariana Islands.
- It lies about 9,300 km west of San Francisco and 2,600 km east of Manila.
- Guam has a pleasant tropical climate tempered by the northeast trade winds and the north equatorial ocean current that flows west across the Pacific.
- The development of Guam into an important U.S. military base brought about profound changes in the island's agricultural patterns after World War II.
- Guam is an unincorporated territory of the United States governed under the Organic Act of Guam, passed by the U.S. Congress and approved by the president in 1950.
 - The Organic Act made all Chamorros U.S. citizens.

Island chain strategy of USA:

- The island chain strategy is a strategic maritime containment plan first conceived by American foreign policy statesman John Foster Dulles in 1951, during the Korean War.
- It proposed surrounding the Soviet Union and China with naval bases in the West Pacific to project power and restrict sea access.

First island chain:

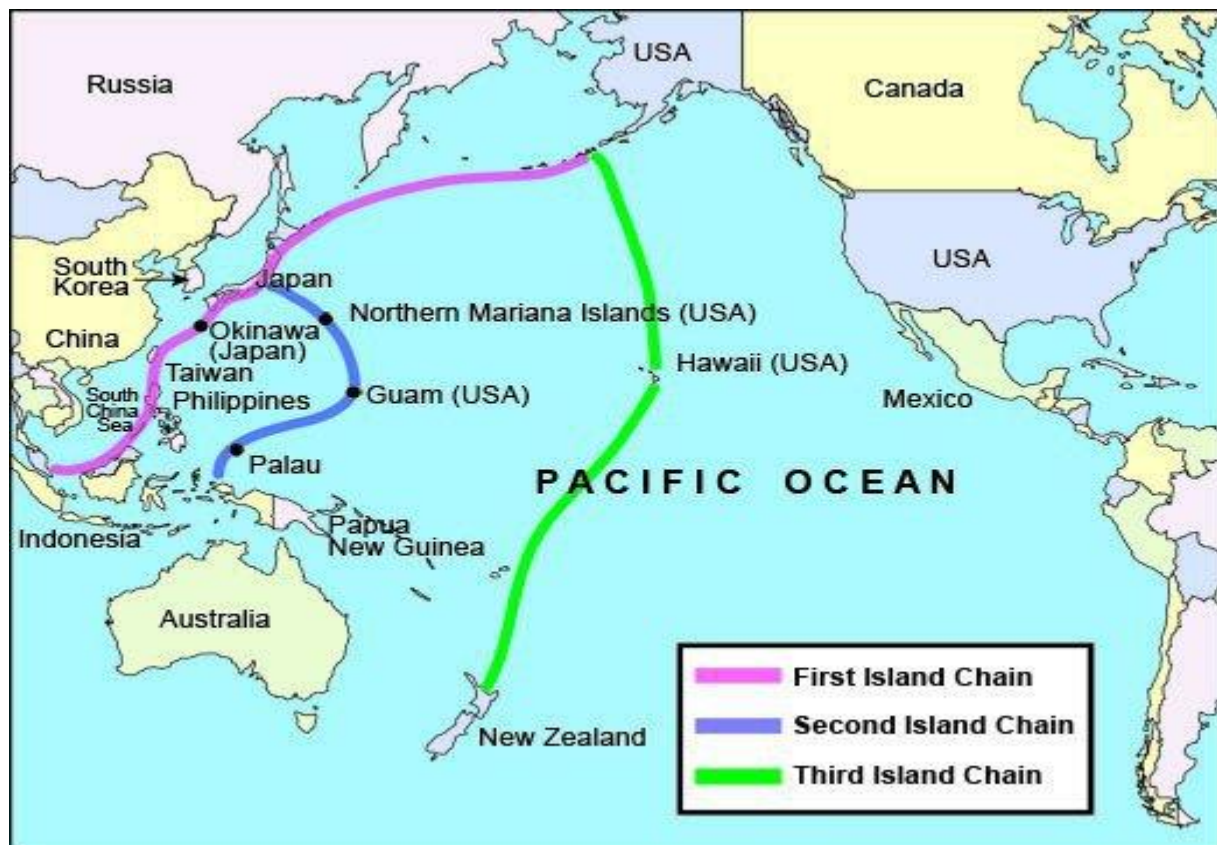
- The first island chain refers to the first chain of major Pacific archipelagos out from the East Asian continental mainland coast.
- It is principally composed of the Kuril Islands, the Japanese archipelago, the Ryukyu Islands, Taiwan (Formosa), the northern Philippines, and Borneo, hence extending all the way from the Kamchatka Peninsula in the northeast to the Malay Peninsula in the southwest.
- The first island chain forms one of three island chain doctrines within the island chain strategy in the U.S. foreign policy.
- Much of the first island chain is roughly situated in waters claimed by China.
- These include the South China Sea, within the nine-dash line, as well as the East China Sea west of the Okinawa Trough.

Second island chain:

- It refers to the island chain which is formed by Japan's Bonin Islands and Volcano Islands, in addition to the Mariana Islands (most notably Guam, an unincorporated American overseas territory with a heavily fortified military base), western Caroline Islands (Yap and Palau), and extends to Western New Guinea.
- The chain serves as the eastern maritime boundary of the Philippine Sea.

Third island chain:

- This island chain begins at the Aleutian Islands and runs south across the center of the Pacific Ocean towards Oceania, through the Hawaiian Islands, American Samoa and Fiji, to reach New Zealand.
- Australia serves as the staple between the second and third chains.



8.4 Syria

Context:

- The regime of Bashar al-Assad has fallen in Syria.
- The Islamist Hayat Tahrir al-Sham (HTS), a former arm of al-Qaeda that had rebranded itself, is now the most powerful force in the country.

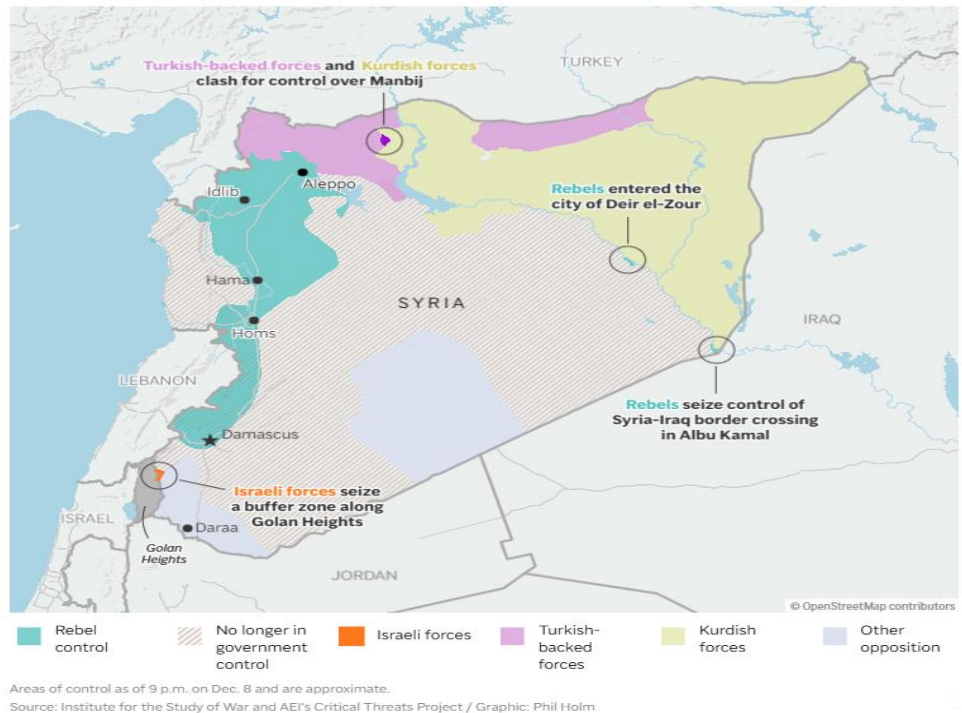
About Syria:

- It is a country located on the east coast of the Mediterranean Sea in southwestern Asia.
- Its area includes territory in the Golan Heights that has been occupied by Israel since 1967.
- The capital is Damascus, on the Barada River, situated in an oasis at the foot of Mount Qasioun.
- Syria is bounded by Turkey to the north, by Iraq to the east and southeast, by Jordan to the south, and by Lebanon and Israel to the southwest.
- Syria has a relatively short coastline, which stretches for about 180 km along the Mediterranean Sea between the countries of Turkey and Lebanon.
- The Anti-Lebanon Mountains mark Syria's border with Lebanon.
- The Euphrates River is the most important water source and the only navigable river in Syria.
 - It originates in Turkey and flows southeastward across the eastern part of Syria.
- A Kurdish minority resides in Syria; much of the Kurdish population is Arabic-speaking and largely resides in the country's northeast.



Political instability:

- After Syria gained its independence in 1946, political life in the country was highly unstable, owing in large measure to intense friction between the country's social, religious, and political groups.
- In 1970 Syria came under the authoritarian rule of Pres. Hafez al-Assad, whose foremost goals included achieving national security and domestic stability and recovering the Syrian territory lost to Israel in 1967.
 - Assad committed his country to an enormous arms buildup, which put severe strains on the national budget, leaving little for development.
- After Assad's death in 2000, his son Bashar al-Assad became president.
- Despite some early steps toward political reform, Bashar al-Assad ultimately continued his father's authoritarian style of government, using Syria's powerful military and security services to quash political dissent.
- Long-suppressed internal tensions led to the outbreak of the Syrian Civil War in 2011.
 - Assad's brutal response to the civil war failed to keep him in power and, after a tremendous amount of death and destruction; he was finally deposed in December 2024.



Important Syrian cities:

- Damascus, Aleppo, Idlib, Homs, and Hama.

8.5 Moldova

Context:

- Moldova declares state of emergency over energy as fears of Russian gas shortage loom

News:

- Moldova's parliament voted in favour of imposing a state of emergency in the energy sector over fears that Russia could leave the European Union candidate country without sufficient natural gas supplies this winter.

More info:

- A special commission will urgently adopt measures to manage "imminent risks" if Moscow fails to supply gas to the Kuciurgan power plant, the country's largest, which is situated in the separatist pro-Russian Transnistria region.
- Transnistria, which broke away after a short war in 1992 and is not recognised by most countries, also declared its own state of emergency this week in case the region does not receive gas supplies.

- When Russia fully invaded Ukraine in 2022, Moldova, a former Soviet republic of about 2.5 million people, was entirely dependent on Moscow for natural gas but has since pushed to diversify and expand its energy sources.
- Romania has the resources to support Moldova “if the situation demands it,” saying it would be “a duty ... in the face of the aggressions coming from the east.”
- In October, Moldova’s pro-Western President Maia Sandu won a second term in office, and a referendum voted in favour of securing the country’s path toward the EU, in two votes overshadowed by ongoing claims of Russian interference to derail the country’s westward shift in recent years.

About Moldova:

- Moldova, landlocked country lying in the northeastern corner of the Balkan region of Europe.
- Upon the collapse of the Soviet Union in August 1991, Bessarabia republic declared its independence and took the name Moldova.
- Much of Moldovan industry was located in the separatist region of Transnistria, which had proclaimed independence from Moldova in 1990, resulting in a brief civil war.
- Although a cease-fire was declared in 1992, relations remained tense between Moldova and Transnistria, and Russian troops are still present in the security zone.
- Transnistria is also the source of much of Moldova’s electricity, which has been cut off at various times.
- Moldova is bounded by Ukraine to the north, east, and south and by Romania to the west.
- The bulk of the republic lies between the great meandering Prut and Dniester rivers.
- Moldova lies to the east of the great arc of the Carpathian Mountains.
- Moldova has a well-developed network of rivers and streams, all draining south to the Black Sea.



8.6 Mount Hermon

Context:

- Defence Minister of Israel orders Israeli troops to prepare to spend winter on Mount Hermon

News:

- Israeli Defence Minister has ordered Israeli troops to prepare to stay over the winter on Mount Hermon, a strategic location overlooking Damascus.

- Mount Hermon, a peak of 2,800 metres that straddles the border between Syria and Lebanon

About Mount Hermon:

- Mount Hermon, snowcapped ridge on the Lebanon-Syria border west of Damascus.
- It rises to 2,814 meters and is the highest point on the east coast of the Mediterranean Sea.
- At its foot rise the two major sources of the Jordan River.
- Since the Arab-Israeli war of June 1967, about 40 square miles (100 square km) of Mount Hermon's southern and western slopes have been part of the Israeli-administered Golan Heights.



8.7 Panama Canal

Context:

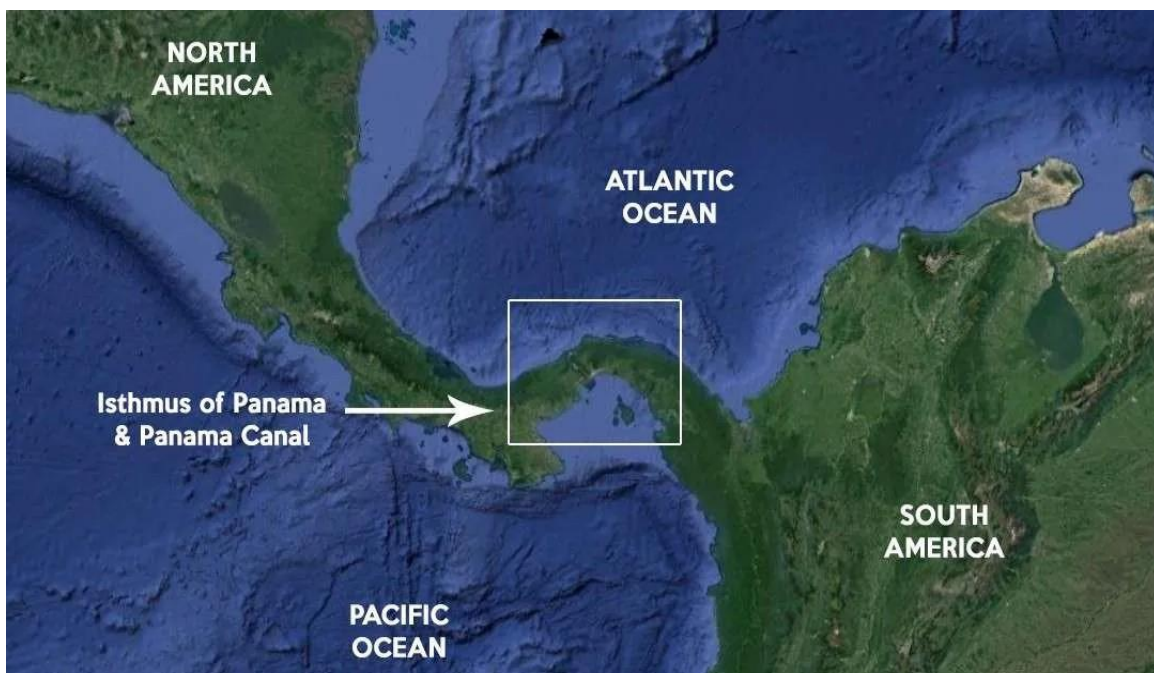
- The 82-km-long strategic waterway that connects the Pacific and Atlantic Oceans is in the spotlight after U.S. President-elect Donald Trump threatened to retake its control

More info:

- Panama Canal is an 82-km-long strategic waterway that connects the Pacific and Atlantic Oceans.
- It helps ships do away with the need to go around the South American tip of Cape Horn, saving 13,000 km and days of journey.
 - Consequently, the canal facilitates the passage of over 14,000 ships a year.
- Trump said that it was given to Panama and the people of Panama, but it has provisions.
 - If the principles, both moral and legal, of this magnanimous gesture of giving are not followed, then we will demand that the Panama Canal be returned to us, in full, quickly and without question.
- U.S ships constitute 74% of the traffic in the canal, is its biggest benefactor, followed by China at 21%.
- If not for the canal, ships traversing the east and west coasts of the U.S. would have to undertake an additional 22 days of voyage.
- In historical context, the canal also came to the aid of the Allies during the Second World War.
- What began as a French project in 1880 under the leadership of Ferdinand de Lesseps, who had built the Suez Canal, soon fell apart due to unforeseen difficulties.
- Americans stepped in to complete the canal but Colombia, which ruled over Panama, did not favour the idea.
- By orchestrating independence from Colombia, then U.S. President Theodore Roosevelt secured a deal whereby Panama gave his country control over a 16-km wide strip of land to build the canal in exchange for monetary compensation.

Lock technology:

- The canal entered into operation in 1914.
 - By using a technology comprising a series of locks, it revolutionised shipping.
 - However, a dispute over the ownership and administration soon broke out between the U.S. and Panama, which eventually led to a direct clash in 1964.
- In 1977, then President Jimmy Carter (despite opposition from the Senate) and Panama's military leader Omar Torrijos signed two treaties - the Permanent Neutrality Treaty and the Panama Canal treaty that saw the U.S. hand over the control of the canal to Panama in 1999.
 - The former agreement grants the U.S. the authority to ensure the canal remains free and open without giving it the power to interfere in Panama.
 - The latter ensured that Washington transferred the canal to Panama by December 31, 1999.
- Since 2000, Panama has overseen the administration of the canal.
 - However, the region, one of the wettest until recently, experienced a rainfall deficit in 2022.
- Gatun Lake, which provides the 200 million litres of water needed for each ship to transit the canal, experienced a drop in water levels, prompting authorities to increase shipping charges starting in 2025.
 - Mr. Trump has objected to this.
- Trump's allegation of Chinese influence pertains to the Hong Kong-based company C.K. Hutchison Holdings, which manages two of the five ports in the region - one on each side of the canal.
 - Bolstering his claim further was Panama's 2017 decision to cut ties with Taiwan.
- Growing tensions between the U.S. and Panama might not align with Mr. Trump's top policy priorities such as stopping illegal migration from South America, warn experts.



8.8 Black Sea and Kerch Strait

Context:

- Russia warned of severe environmental damage from a huge oil spill in the Black Sea caused when two tankers collided in a storm near Crimea, which declared a state of emergency.
 - One tanker sank and another ran aground in the Kerch Strait between Russia and the annexed Crimean peninsula.
 - President Vladimir Putin earlier this month called the oil spill an "ecological disaster".

About Black Sea:

- Black Sea, large inland sea situated at the southeastern extremity of Europe.
- It is bordered by Ukraine to the north, Russia to the northeast, Georgia to the east, Turkey to the south, and Bulgaria and Romania to the west.
- The roughly oval-shaped Black Sea occupies a large basin strategically situated at the southeastern extremity of Europe but connected to the distant waters of the Atlantic Ocean by the Bosphorus (which emerges from the sea's southwestern corner), the Sea of Marmara, the Dardanelles, the Aegean Sea, and the Mediterranean Sea.
- The Crimean Peninsula thrusts into the Black Sea from the north, and just to its east the narrow Kerch Strait links the sea to the smaller Sea of Azov.
 - The Black Sea coastline is otherwise fairly regular.
- To the countries of the region, the Black Sea has been of immense strategic importance over the centuries; the advent of more-settled conditions has brought its economic importance to the fore.



8.9 Mediterranean Sea

Context:

- Cargo ship blast in Mediterranean was a 'terrorist attack', says Russia

About Mediterranean Sea:

- Mediterranean Sea, an intercontinental sea that stretches from the Atlantic Ocean on the west to Asia on the east and separates Europe from Africa.
- Its west-east extent - from the Strait of Gibraltar between Spain and Morocco to the shores of the Gulf of Iskenderun on the southwestern coast of Turkey - is approximately 4,000 km, and its average north-south extent, between Croatia's southernmost shores and Libya, is about 800 km.

- The Mediterranean Sea, including the Sea of Marmara, occupies an area of approximately 2,510,000 square km.
- The western extremity of the Mediterranean Sea connects with the Atlantic Ocean by the narrow and shallow channel of the Strait of Gibraltar, which is roughly 13 km wide at its narrowest point; and the depth of the sill, or submarine ridge separating the Atlantic from the Alborán Sea, is about 320 metres.
- To the northeast the Mediterranean is connected with the Black Sea through the Dardanelles, the Sea of Marmara, and the strait of the Bosphorus.
 - To the southeast it is connected with the Red Sea by the Suez Canal.



Salient Features

- Personal Mentoring 1 to 1
- Small Batch Size
- Offline/Hybrid Classes with recorded lectures
- NCERT Based Lectures - extra module
- UPSC Aligned Test Series
- Special Classes - Essay and Answer Writing
- Structured Class Schedule (Time Bound)
- Support till Selection



**India's only classroom
programme with complete
online backup and support**



**57/17 - 2nd Floor, Bada Bazar Rd
Old Rajinder Nagar, Delhi-110060**



www.iasedge.in



Edge IAS

**Call for more Details : -
9910922241 / 9999114095 / 8595326982**