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DECEMBER 2024

1. IMPORTANT TOPICS OF THE MONTH

1.1 Key Outcomes of COP 29

Why in news?

Recently the COP 29 was concluded in Baku Azerbaijan and has adopted various strategies to mitigate climate change.

What is COP?

- **About** – The COP is the *main decision-making body* of the United Nations Framework Convention on Climate Change (UNFCCC).
- **Members** – It brings together the **198 Parties** (including the European Union) to negotiate and agree on how to tackle climate change, reduce emissions and limit global warming.
- **Headquarters** – The COP secretariat is headquartered in **Bonn**.
- **Presidency** – The COP Presidency rotates among the *5 recognized UN regions* - Africa, Asia, Latin America and the Caribbean, Central and Eastern Europe and Western Europe and others.

To know about COP 28, click [here](#)

What is COP 29?

- **About** – It is the *29th session* of the United Nations Climate Change Conference.
- **Host** – Baku, Azerbaijan.
- **President** – Azerbaijan's Minister of Ecology and Natural Resources **Mukhtar Babayan**.
- **Finance COP** – COP 29 is considered as the **finance COP** as it focuses on adopting new finance goal as a major topic of discussion.

What are the goals of COP – 29?

- **New Collective Quantified Goal (NCQG)** – COP 29 aims to replace the current 100 billion dollars per year goal and mobilize higher funding to address climate change.
- **Implementing the Global Stocktake** – To **review the stocktake** report which was published in COP 28 which provides the report on collective progress towards the Paris Agreement goals to guide future climate policies and strengthen global efforts.
- **Just energy transition** – COP29 will focus on **advancing the energy transition agenda**, with particular emphasis on reducing global reliance on fossil fuels and scaling up renewable energy deployment.
- **Updated nationally determined commitments** – NDCs are **voluntary commitments** pledged by the countries to reduce emissions and adapt to climate impacts under the Paris Agreement framework.
- **Carbon markets** – To provide rules and a UN registry framework on carbon market to enable countries to trade carbon credits.
- **Cooperative initiatives** – Collaborative efforts among countries, organizations and stakeholders to enhance global climate action through partnerships and shared goals.

What are the outcomes of COP 29?

- **New climate finance goal** – The New Collective Quantified Goal (NCQG) is a new climate finance target that will replace the USD 100 billion goal that was set to expire in 2025.
- The NCQG **aims to triple climate finance** for developing countries from USD 100 billion annually to USD 300 billion annually by 2035
- The parties were able to agree on a new goal consisting of *two parts*:
 - **Core financing** of at least USD 300 billion annually by 2035.
 - **Additional layer** of up to USD 1.3 trillion primarily encompassing private financing.

- **Carbon market framework** – Countries finalized the rules for carbon trading under the Paris Agreement, operationalizing mechanisms like the Paris Agreement Crediting Mechanism (PACM).
- **Article 6** – Under this article, **COP 29 approved two pathways** for countries and companies to trade carbon offsets.
 - **Article 6.2** – Direct country-to-country trading (bilaterally trade).
 - **Article 6.4** – Separate UN-backed marketplace.
- **UN trading system for green credits** – A centralized UN trading system was agreed to be launched for the operationalization of carbon markets. This will allow countries to trade in carbon credits.

To know more about *Carbon market framework*, click [here](#)

- **Baku Adaptation Roadmap** – It was adopted at COP29, which provides a **structured framework** for advancing the **Global Goal on Adaptation (GGA)** under the Paris Agreement.
- **Indicators and Metrics** – Development of *ecosystem-specific indicators* such as indicators for marine and mountain ecosystems.
- **Inclusion of enabling factors** – Like governance, transparency, and financial support.
- **Means of Implementation (MOI)** – The roadmap includes MOI as enabling factors to track how adaptation actions are financed and implemented.
- Experts will finalize a consolidated list of indicators by mid-2025 for formal adoption at *COP 30 in Brazil*.
- **Global Methane Pledge (GMP)** – Initially *launched at COP26*, the pledge aims to *cut methane emissions by 30% by 2030* and pledged 500 million dollars for methane reduction.
 - It has now had 159 signatories and **India has not signed the Global Methane Pledge.**
- **UAE Dialogue and Global Stocktake (GST)** – COP29 served as a follow-up to the first-ever comprehensive assessment of global progress under the Paris Agreement, completed at COP28.
- The dialogue aimed to translate the findings of the GST into *actionable strategies for climate action*.
- For the first time, the GST linked the **zero-deforestation by 2030 target** (voluntarily pledged at COP26) to achieving the Paris Agreement goals.
- **Indigenous Peoples and Local Communities** – COP29 adopted the *Baku Work plan* to elevate voices of indigenous peoples and local communities in climate action.
- **Baku Harmoniya Climate Initiative** – It was launched at COP29, to focus on empowering farmers and transforming agricultural practices to enhance resilience against climate change.
- It aims to create a more sustainable and inclusive agricultural sector worldwide.
- Promoting climate-resilient farming practices that align with global food security and climate goals.
- The initiative emphasized integrating food systems into Nationally Determined Contributions (NDCs) and adaptation plans.
- **Extension of Lima Work Programme** – Lima Work programme which emphasized on gender mainstreaming in climate actions, was extended by COP 29.
- **Climate Finance Action Fund (CFAF)** – To catalyze the public and private sectors across mitigation, adaptation and research and development by voluntary contributions from fossil fuel producing countries and companies.
- **Global Energy Storage and Grids Pledge** – To increase global energy storage capacity 6 times above 2022 levels, reaching 1,500 gigawatts by 2030.
- **Hydrogen Declaration** – A declaration for both the public and private sectors to unlock the potential of a global market for green hydrogen and its derivatives.
- **Green Digital Action Declaration** – To accelerate climate-positive digitalization and emission reductions in the Information and Communication Technology sector and enhance accessibility of green digital technologies.

Global Goal on Adaptation (GGA) was established in the 2015 Paris Agreement, under Article 7 to make roadmaps on global adaptation efforts, with attention to equitable finance and practical implementation.

The Baku Work-plan focuses on three key areas on promoting knowledge exchange, building capacity for engagement and incorporating knowledge systems into climate policies and actions.

- **Declaration on Enhanced Action in Tourism** – To include sectoral targets for tourism in NDCs and promote sustainable practices by reducing emissions and increasing resilience in the sector.
- **Declaration on Water for Climate Action** – To take integrated approaches to combat impacts of climate change on water-related ecosystems.

What are the India's initiatives in COP 29?

- **Disaster Resilient Infrastructure** – Integrating Disaster Resilient Infrastructure into the Adaptation Strategies offering a pathway toward more resilient and sustainable development.
- **Lead-IT Summit** – India co-hosted Lead-IT Member Meet with Sweden.
 - The summit focusses on de-carbonization of heavy industry.
- It also formed the India-Sweden Industry Transition Partnership (ITP) as part of the Lead-IT initiative.
- **SIDS Adaptation Finance** – India has advocated finance unlocking and disaster-resilient support for Sustainable Infrastructure in Small Island Developing (SIDS).

The Lima Work Programme (LWPG)

- **Launch** – It was established in **2014** to *advance gender balance and integrate gender considerations* in implementing the Convention and the Paris Agreement to achieve gender responsive climate policy and action.
- **COP23** – Adopted the **first gender action plan (GAP)**.
- **COP25** – Adopted a five-year enhanced program and GAP.
- The Enhanced Lima Work Programme on Gender (LWPG) and its Gender Action Plan (GAP) aim to embed gender considerations into global climate policies.
- They work to ensure balanced representation and empower women as leaders and stakeholders in climate resilience and policy.

- **Energy Transitions for the Global South** – Role of solar energy in addressing the challenges of energy security and climate change, with a special emphasis on its significance for the Global South.
- **Women-led Climate Action** – It will strengthen adaptation, unlocking finance and create jobs by women-led solarizing communities.

What are the shortcomings of COP 29?

- The 300-billion-dollar funding falls short of proposed 1.3 trillion dollars annually by 2025 to meet climate changes mitigation by 2030.
- Concerns about greenwashing by large meat and dairy industries, which contribute significantly to methane emissions.
- No significant new financial pledges or concrete commitments to fund adaptation and resilience efforts, especially for vulnerable countries *like SIDS and LDCs*.
- COP29 failed to reach consensus on integrating zero-deforestation targets and biodiversity into the global stocktake, postponing decisions until COP30.
- Rules for carbon markets (Article 6) raised concerns about human rights and environmental integrity, with activists arguing that markets might harm vulnerable communities without sufficient safeguards.

1.2 Empowering Annadatas for a Prosperous Nation

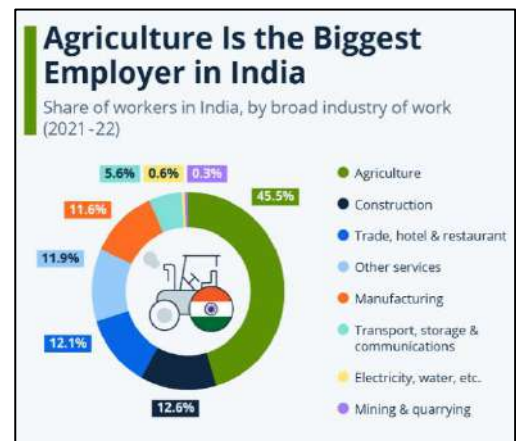
Why in News?

National Farmers' Day is observed on 23rd December.

What are the contributions of Charan Singh to farmer welfare?

- **National Farmers' Day** - Birth anniversary of Shri Chaudhary Charan Singh, India's fifth Prime Minister from 1979 -80, is observed as National Farmers' Day.
- **Champion of the peasants** – He emphasised on rural development, agricultural reforms and the uplift of marginalised communities.
- **UP zamindari abolition** - As the Revenue Minister of Uttar Pradesh in 1949, he introduced the landmark Zamindari Abolition Act to dismantle feudal landholding systems and empower small farmers.
- **UP land holdings consolidation** – The law enabled every landowner in UP to have his scattered plots consolidated by swapping parcels of equivalent quality with other farmers in the same village.

- **His books:**
 - Abolition of Zamindari (1947)
 - Whither Co-operative Farming (1956)
 - Agrarian Revolution in Uttar Pradesh (1957)
 - Joint Farming X-rayed (1959)
 - India's Poverty and Its Solution (1964)
 - India's Economic Policy – The Gandhian Blueprint (1978)
 - Economic Nightmare of India: Its Cause and Cure (1981)
- **Lucknow airport** - To honor him the Lucknow airport was named as Chaudhary Charan Singh International Airport by the Indian Government.
- **Bharat Ratna** – He was awarded Bharat Ratna in 2024.



What is the role of farmers in nation building?

- **Farm land** - About 54.8% of the country's 328.7 million hectares is classified as agricultural land and a cropping intensity of 155.4% (as per the Land Use Statistics for 2021-22).
- **Agri labour force** - India's agricultural sector, employing nearly half of the nation's population, remains a cornerstone of the country's economy.
- **Economic contribution** - Agriculture contributes about 14% to India's GDP.
- **Contribution to GVA** - It contributes 17.7% to the Gross Value Added (GVA) at current prices in FY 2023-24.
- **Food grain production** - In 2023-24, the country achieved a record total foodgrain production of **332.2 million tonnes**, surpassing the previous year's output of 329.7 million tonnes.
- The success of Indian agriculture is deeply intertwined with the wellbeing of these 'Annadatas', who embody the spirit of hard work, innovation, and sacrifice.

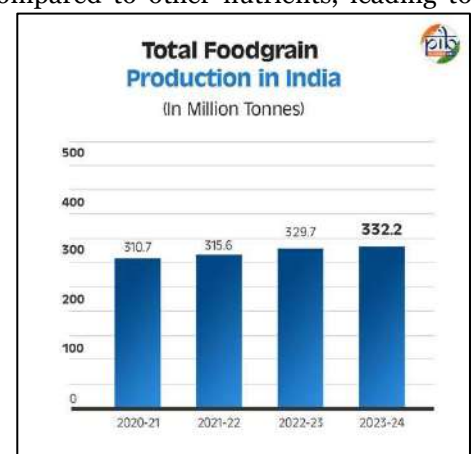
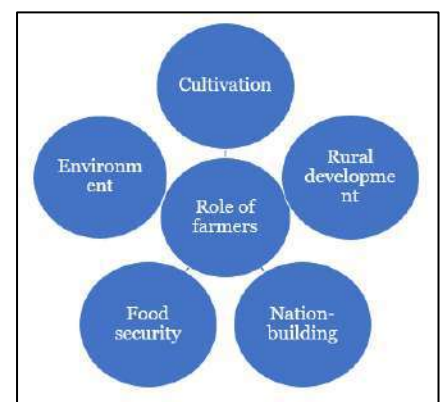
According to the **Periodic Labour Force Survey (PLFS) 2022-23**, about 45.76% of the total workforce is engaged in agriculture & allied sector during 2022-23.

What are the challenges faced by agriculture?

- **Global warming** - In India, temperatures have risen by 0.7 degrees Celsius compared to 1951, and precipitation (July to September) has fallen by 6 %.
- **Low Agri R&D fund** - Developing climate-resilient agriculture will need more resources for Agri-R&D which is currently less than 0.5 % of Agri-GDP, and needs to be doubled to at least 1%.
- **Indiscriminate fertilizer usage** - Urea is massively subsidized compared to other nutrients, leading to overuse of N and underuse of P, K, and other micronutrients.
- **Inadequate support of technological innovations** - Products such as nano-urea and nano-DAP, or Single or Triple Superphosphates, etc., have limited penetration in the backdrop of the highly skewed subsidy policy in favour of granular urea.

What are the initiatives by the government for farmers welfare?

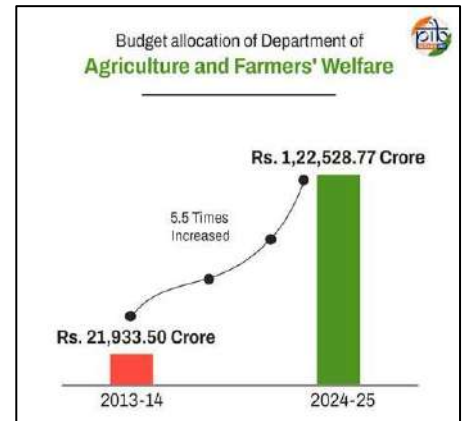
- **Financial assistance** - Pradhan Mantri Kisan Samman Nidhi is a central sector scheme by the government of India that give farmers up to Rs.6, 000 per year as minimum income support.
- **Insurance** - Pradhan Mantri Fasal Bima Yojna (PMFBY) aims to provide a comprehensive insurance cover against failure of the crop.
- **Social security** - Pradhan Mantri Kisan Maandhan Yojna (PM-KMY) provides pension for small and marginal farmers.



- **Increased budget allocation** – About Rs. 1.2 lakh crore has been allocated to agriculture sector for the fiscal year 2024-25.
- **INamo Drone Didi** - It aims to empower 15,000 Women Self-Help Groups (SHGs) by providing drones for agricultural rental services, including fertiliser and pesticide application.

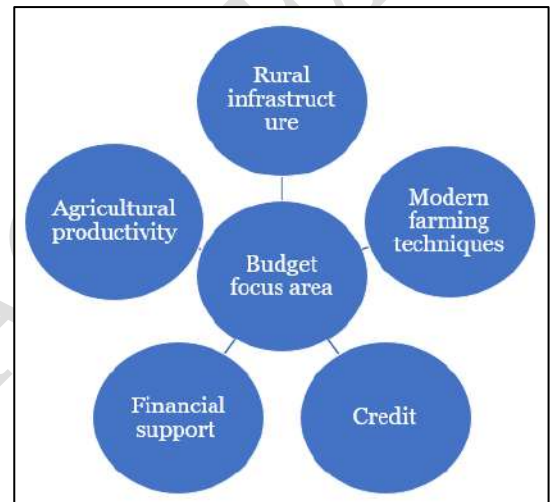
Pradhan Mantri Kisan Samman Nidhi (PM-KISAN)	Launched on 24th February 2019, PM-KISAN aims to supplement the financial needs of landholding farmers across the country. Under this scheme, ₹6,000 is transferred directly into the bank accounts of farmers in three equal, four-monthly installments through the DBT mode. Since its inception, the Government of India has disbursed over ₹3.46 lakh crore in 18 installments, benefitting more than 11 crore farmers.
Pradhan Mantri Fasal Bima Yojana (PMFBY)	Launched in 2016, the Pradhan Mantri Fasal Bima Yojana (PMFBY) aims to provide farmers with affordable crop insurance, covering risks from pre-sowing to post-harvest stages against natural adversities, ensuring prompt and adequate compensation. Since its inception, the scheme has insured 68.85 crore farmer applications and disbursed ₹1,65,966 crore in claims.
Pradhan Mantri Kisan MaanDhan Yojana (PM-KMY)	Launched on 12th September 2019, PM-KMY provides security to vulnerable farmer families by offering a monthly pension. Farmers between the ages of 18 to 40 contribute monthly to the scheme, which is matched by the government. The Life Insurance Corporation (LIC) manages the pension fund. As of 25th November 2024, over 24.66 lakh farmers have enrolled in the scheme, offering a financial safeguard during their old age.
Modified Interest Subvention Scheme (MISS)	The Modified Interest Subvention Scheme (MISS) provides concessional short-term agri-loans with a 7% interest rate on loans up to ₹3.00 lakh, plus an additional 3% subvention for timely repayment, reducing the effective rate to 4%. Since 2014-15, institutional credit flow to agriculture has nearly tripled from ₹8.5 lakh crore to ₹25.48 lakh crore by 2023-24. The disbursement of easy and concessional crop loans has more than doubled, with the interest subsidy through KCC increasing 2.4 times to ₹14,252 crore in 2023-24.
Kisan Credit Card (KCC)	Introduced in 1998, the Kisan Credit Card (KCC) scheme provides farmers with easy access to agricultural inputs and cash for their production needs. In February 2019, RBI extended the KCC facility to Animal Husbandry and Fisheries for their working capital requirements. As of 31st March 2024, there are 7.75 crore operative KCC accounts .
Agriculture Infrastructure Fund (AIF)	The Agriculture Infrastructure Fund (AIF) Scheme, launched in 2020 under the Atmanirbhar Bharat Package, supports sustainable agriculture by financing infrastructure projects across India. It provides loans up to ₹2 crore with a capped interest rate of 9%, along with a 3% annual interest subvention and reimbursement of credit guarantee fees for up to seven years, ensuring affordability for beneficiaries. As of 24th November 2024, ₹51,448 crore has been sanctioned for 84,333 projects under AIF.

- **Soil Health Card Scheme** - Launched in 2015, the scheme aims to improve soil health and promote efficient fertiliser use.
- **Formation & Promotion of 10,000 FPOs** - In 2020, the government launched the scheme to form and promote 10,000 Farmer Producer Organizations (FPOs).
- **Kisan Kavach** - Bharat's first anti-pesticide bodysuit, designed to protect farmers from the harmful effects of pesticide exposure.
- It ensures farmer safety and empowers the agricultural community through science and technology.
- **Clean Plant Programme** – It aims to enhance the quality and productivity of horticulture crops by providing disease-free planting material, and climate-resilient varieties with yield enhancement.
- **Digital Agriculture Mission** – It is an umbrella scheme to support digital agriculture initiatives, like Digital Public Infrastructure, implementing the Digital General Crop Estimation Survey (DGCES).
- **Credit Guarantee Scheme for e-NWR** - Under this scheme, farmers can access credit by pledging the electronic negotiable warehouse receipts (e-NWRs).
- **National Mission on Edible Oils – Oilseeds** - The mission aims to boost domestic oilseed production and achieve self-reliance in edible oils, to be implemented over a seven-year period from 2024-25 to 2030-31.
- **National Mission on Natural Farming** - It focuses on promoting chemical-free, farming practices across the country.



What can be done to improve farming system?

- Treat agriculture as a food system, from production to marketing to consumption.
- Build value chains of agri-commodities on the lines of milk, where farmers get 75 to 80 % of what the consumer pays.
- Creating a separate board on the lines of NDDB, to bring about revolutionary changes in fruits and vegetables.



1.3 Constitution on Minority Rights

Why in news?

Minorities Rights Day is observed on December 18.

What was the origin of minority rights?

- **Austrian constitution** – In 1867, Austrian Constitutional Law acknowledged that ethnic minorities have an absolute right to maintain and develop their nationality and languages.
- **Hungary & Swiss** - Hungary's Act XLIV of 1868 and the Constitution of the Swiss Confederation of 1874, granted the three languages of the country equal rights in civil services, legislation and in courts.
- **WWI peace treaty** - The provisions of the peace treaties after the First World War, focused particularly on the status of minorities.
- **UDHR** - Article 27 of the Universal Declaration of Human Rights gives every individual a right to community, that is the right to enjoy their own culture and to participate in cultural forums, associations etc.
- **UN declaration** - UN General Assembly adopted a declaration on the 'Rights of Persons Belonging to National, or Ethnic, Religious and Linguistic Minorities' on December 18, 1992.

"No democracy can long survive which does not accept as fundamental to its very existence the recognition of the rights of minorities" - Franklin Roosevelt

What were the debates in the Constituent Assembly?

- **Constitution committee** - The Advisory Committee on Fundamental Rights, Minorities, and Tribal and Excluded Areas, chaired by Sardar Vallabhbhai Patel, was formed in 1947.

- **Sub committees** - The problems and safeguards for minorities were discussed, debated and settled mainly by the sub-Committee on Minorities and the Sub-Committee on Fundamental Rights
- **Sub-Committee on Minorities** - It was entrusted with the specific task of considering and suggesting about the rights and safeguards proposed to be incorporated in the Constitution.
- **Objectives Resolution** – It stated that adequate safeguards shall be provided for minorities, backward and tribal areas, and depressed and other backward classes.

*Sub-Committee on Minorities was headed by **H.C. Mookherjee** and the Sub-Committee on Fundamental Rights headed by **J.B. Kripalani**.*

What are the minority rights enshrined in the Constitution?

- **No constitutional definition** - Though the term 'minority' has been used in four places in the Constitution, no definition of the term 'minority' has been given.
- **Minority population** - Muslims, Sikhs, Christians, Buddhists, Jain and Zoroastrians (Parsis) have been notified as minority communities under Section 2 (c) of the National Commission for Minorities Act, 1992.
- **State level minorities** - In the *TMA Pai Foundation (2002)* case, Supreme Court held that only the State can determine the status of a religious or linguistic minority.

*As per the Census 2011, the percentage of minorities in the country is about **19.3%** of the total population of the country.*

*Hindus are a religious minority in **Punjab, Kashmir** and in the northeastern States and there are hundreds of Hindu minority institutions in India.*

Fundamental Rights of Minorities

Right to freedom of religion (Articles 25–28)

- **Article 25** - Freedom of conscience and free profession, practice and propagation of religion.
- **Article 26** - Freedom to manage religious affairs.
- **Article 27** - Freedom from payment of taxes for promotion of any religion.
- **Article 28** - Freedom from attending religious instruction or worship in certain educational institutions.

Cultural and educational rights (Articles 29–30)

- **Article 29(1)** - 'Any section of the citizens residing in the territory of India or any part thereof having a distinct language script or culture of its own shall have the right to conserve the same'.
 - **Significance** - It concedes that different groups do have different cultures and that all people may not have just one culture.
 - It accepts that the right to culture is an individualistic right, and individuals have been given the right to preserve their distinctive culture.
- **Article 30** - It guarantees that all religious and linguistic minorities shall have the right to establish and administer educational institutions of 'their choice'.

Linguistic Rights

- **Article 350 A** - It provides for instruction in the primary stages of education in the mother tongue
- **Article 350 B** - It provides for the appointment of a special officer for linguistic minorities.

- **Personal laws** - Religion based personal laws have also been constitutionally protected.
 - **For example**, the customary law of Nagas.
- **Institutional protection** - National Commission for Minorities and National Commission for Minority Educational Institutions deal with the problems of minorities.

*In **Aligarh Muslim University (2024) case**, Supreme Court held even an institution of national importance can claim minority character.*

What is the rationale behind minority rights?

- **Principles of minority rights** - Multiculturalism, differences, diversity and the rights of minorities that mark contemporary political theory.
- **Preservation of diversity** - Protecting the diverse socio-cultural elements and people of the diverse country.

- **Inadequacy of individual rights** - Individualistic rights under Articles 14-18 (equality), 19 (free speech) & 25 (freedom of religion) are not enough for the conservation of language, script or culture which comes under Article 29.
- **Group discrimination** - One may not be individually unjustly treated but it hurts, if the group to which one belongs is subjected to ridicule or denied any value.
- An individual's right to culture holds little meaning or significance, unless the community of which a person is a member of, or is identified with, is accorded the right to exist in a viable form.
- **Cultural conservation** - Linguistic and religious cultures are valuable for their member and they need to be given explicit rights to conserve their own culture.
- **Conducive environment** - Cultural conservation requires not only the presence of a group that shares a common culture but a conducive environment in which such cultures can flourish.
- **Ensuring equality** - Conferring the right on minorities under Article 30 is to ensure that there will be equality between the majority and the minority.
 - A seven judge Bench in **Aligarh Muslim University (2024)** in unequivocal terms described **Article 30** as a 'facet of equality and non-discrimination'.
- **Prevent majoritarian domination** - Minority cultures face disadvantages in a majoritarian society and special rights are need to balance the strength of majoritarianism.
- **Basic structure** - In *Keshavananda Bharati (1973)*, rights under Article 30 were held to be part of the basic structure which even Parliament cannot change through a constitutional amendment.

1.4 India State of Forest Report 2023

Why in News?

Recently, India State of Forest Report 2023 (ISFR 2023) has been released.

What is ISFR 2023 Report?

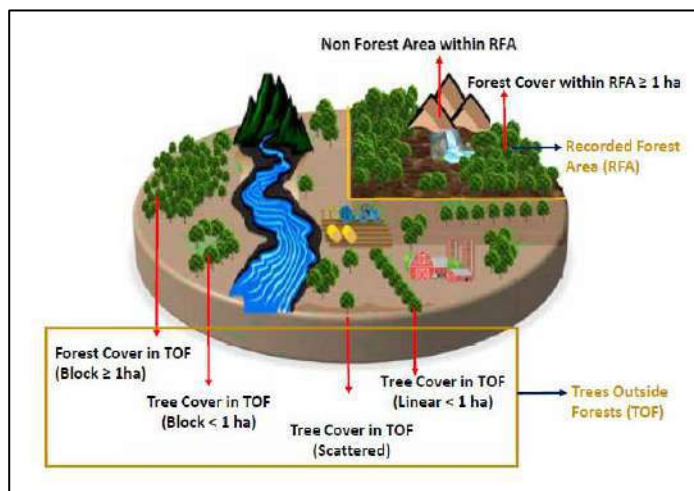
- **ISFR Report** - India State of Forest Report is an assessment of the forest and tree resources of the country.
- **Author** - Forest Survey of India (FSI)
- **Period** - Biennial basis
- It is the 18th cycle of report since 1987.
- **Information Sources** - Remote Sensing satellite data and field based National Forest Inventory (NFI).

*FSI launched a **National Forest Inventory in 2002**, with the onset of the 10th five-year plan.*

- Satellite data gives forest cover
 - Satellite data period - October 2021 to December 2021
- NFI provides Growing Stock and Carbon.
 - NFI assessment is 2017-22.
- **Report Information** - 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.
- For the first time, the trees with 5-10 cm have been included in the analysis for Tree Cover and Growing stock as they are a major contributor to paper and pulp industry.
- **Forest cover degradation** - Analysis on Forest cover degradation between 2011-2021 has been carried out for identifying 93,000 km² potential areas for upgradation of density and additionally sequestering 636 Mt of Carbon.
- **Forest fire** - Information on forest fires in 705 protected areas is given for the first time.
 - Burnt area assessment as part of forest fire assessment has been done for the first time at national level
- **Significance of the report:**

Classification of forest cover	
Types	Canopy density
Very Dense Forest (VDF)	Equal to or more than 70%
Moderately Dense Forest (MDF)	40-70%
Open Forest (OF)	10-40%

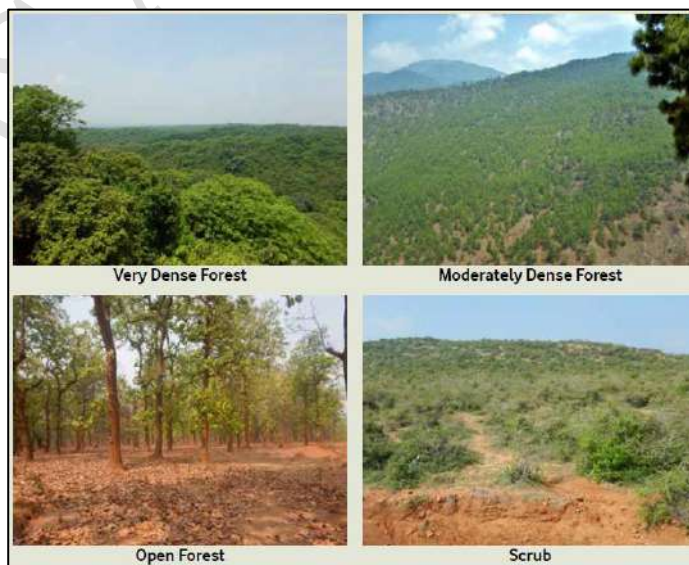
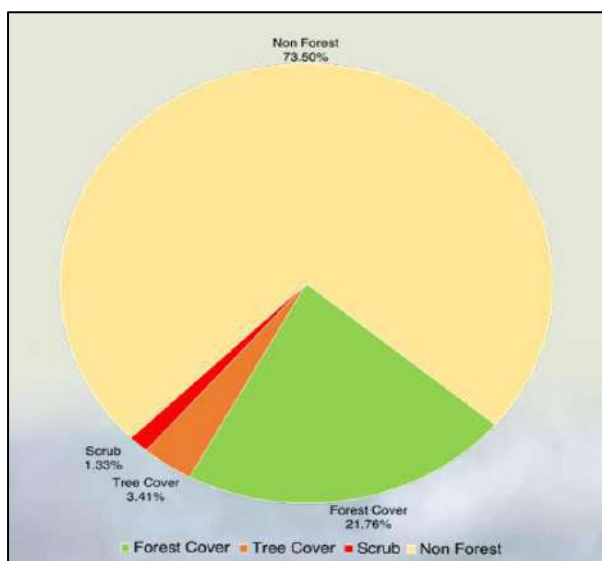
- Providing vital information for monitoring the country's forest and tree resources
- Useful source of information for the policy makers, planners, State Forest Departments, and others interested in natural resource conservation and management.
- Digitized forest boundaries of 25 States and UTs have been used in the current ISFR to assess the extent of forest cover within the recorded forest areas.
- Monitoring of NDC targets
- Reporting of Greenhouse Gas (GHG) inventory to UNFCCC for the forest land under the LULUCF sector
- Reporting to FAO for the Global Assessment of Forest Resources.



What is the state of Tree and Forest cover of India in 2023?

- **Forest cover** - All lands, more than one hectare with a tree canopy density of more than or equal to **10% irrespective of ownership**, legal status and land use.
- Such lands may not necessarily be a recorded forest area and it also includes orchards, bamboo and palm.

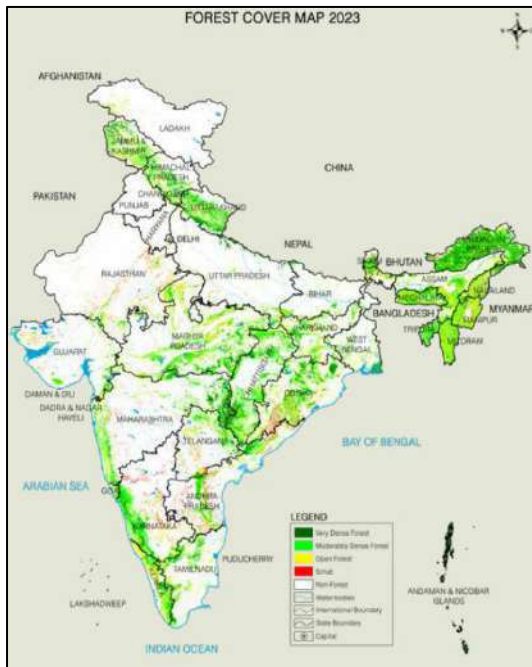
Forest and Tree Cover of India		
	in km ²	
Class	Area	Percentage of GA
Forest Cover	7,15,342.61	21.76
Tree Cover	1,12,014.34	3.41
Total Forest and Tree Cover	8,27,356.95	25.17
Scrub	43,622.64	1.33
Non Forest	24,16,489.29	73.50
Geographical Area of the country	32,87,468.88	100.00



- **Total Tree and Forest Cover in 2023** - As per the present assessment, the total Forest and Tree cover is **8,27,357sq km**, which is **25.17%** of the geographical area of the country.
 - **Forest Cover** - 7, 15,343sq km (**21.76%**)
 - **Tree Cover** - 1, 12,014 sq. km (**3.41%**).
- **The extent of Trees Outside Forest** - 30.70 M ha (37.11% of the total forest and tree cover)
 - TOF is the extent of forest cover outside the Recorded Forest Area (RFA) & Green Wash (GW) and tree cover.
- **Number of States/UTs having above 33 % of forest cover** – 19.
- **States with more than 75% forest cover**
 - Lakshadweep, Mizoram, A & N Island, Arunachal Pradesh, Nagaland, Meghalaya, Tripura, Manipur.

21 States and UTs have shown an **increasing trend** in tree cover, which indicates that **agroforestry**, is being promoted in these States.

- **Total growing stock of forests** - 6430 million cum (cubic meter).
 - Inside the forests - 4479 million cum (cubic meter)
 - Outside the forest - 1951 million cum
- Arunachal Pradesh has maximum growing stock (457.83 M m³) in forests, followed by Uttarakhand (400.02 M m³), Chhattisgarh (398.54 M m³) and Madhya Pradesh (387.18 M m³)

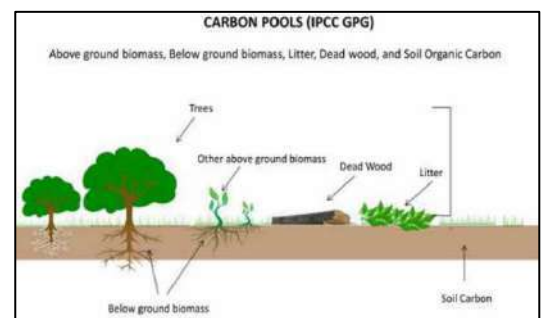


Largest forest and tree cover states (Area wise)	<ul style="list-style-type: none"> ○ Madhya Pradesh (85,724 sq km) ○ Arunachal Pradesh (67,083 sq km) ○ Maharashtra (65,383 sq km)
Largest forest cover states (Area wise)	<ul style="list-style-type: none"> ○ Madhya Pradesh (77,073 sq km) ○ Arunachal Pradesh (65,882 sq km) ○ Chhattisgarh (55,812 sq km)
Largest tree cover states (Area wise)	<ul style="list-style-type: none"> ○ Maharashtra (14,524.88 sq km) ○ Rajasthan (10,841.12 sq km) ○ Uttar Pradesh (8,950.92 sq km)
Largest forest cover states (percentage wise)	<ul style="list-style-type: none"> ○ Lakshadweep (91.33 %) ○ Mizoram (85.34 %) ○ Andaman & Nicobar Island (81.62 %)

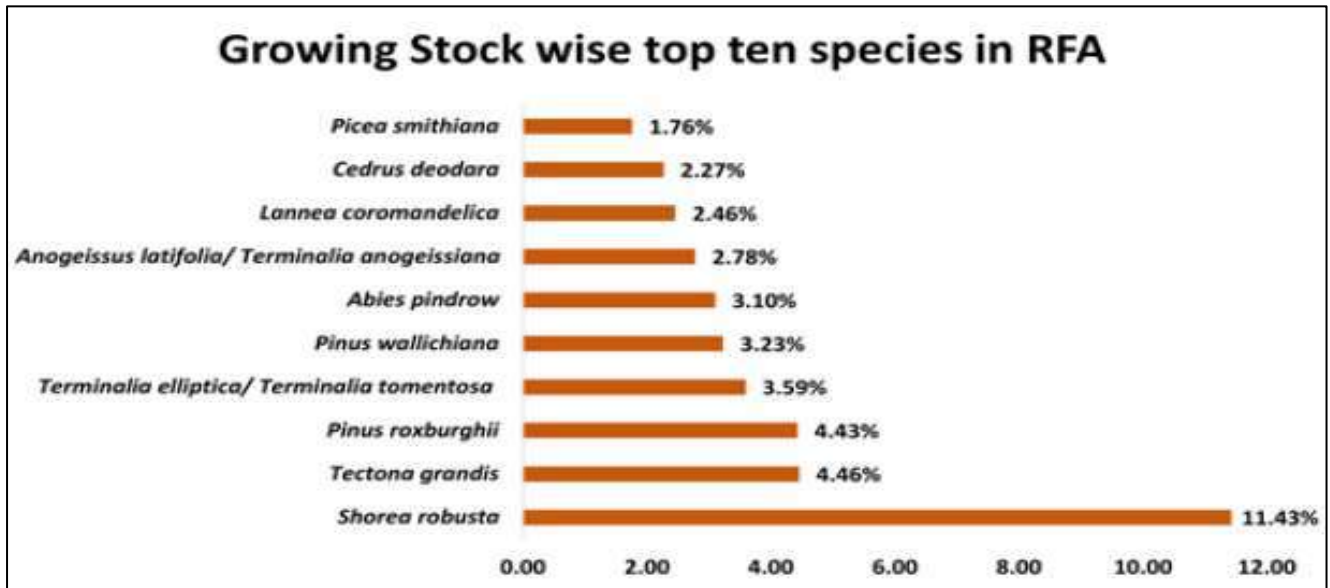
- **Total increase in forest stock** - 262 million cum Increase in inside the forest - 91 million cum
- Increase in outside the forest - 171 million cum
- **India's total carbon stock** - 30.43 billion tonnes of CO₂ equivalent
- **Total carbon stock in country's forest** – **7.2 billion tonnes.**
 - Increase in carbon stock - 81.5 million tonnes.
- **States with largest carbon stock**
 - Arunachal Pradesh has maximum carbon stock of 1,021 Mt
 - Madhya Pradesh (608 Mt)
 - Chhattisgarh (505 Mt)
 - Maharashtra (465 Mt).
- As compared to base year of 2005, India has already reached 2.29 billion tonnes of carbon sink against the target of 2.5 to 3.0 billion tonnes by 2030.
- **Major Trees inside the forest (Volume wise)**
 - Shorea robusta (11.43%)
 - Tectona grandis (4.46%)
 - Pinus roxburghii (4.43%)
 - Terminalia tomentosa (3.59%).
- **Major trees outside the forest**
 - Mangifera indica (13.25%)
 - Azadirachta indica (7.00%)



Soil organic carbon is the largest pool of forest carbon accounting for (55.06%) followed by Above Ground Biomass (AGB) (32.69%), Below Ground Biomass (BGB) (10.09%), Litter (1.48%) and Dead Wood (0.78%).



- Madhuca latifolia / Madhuca longifolia / Madhuca indica (4.37 %)
- Cocos nucifera (4.16 %).



- **Total mangrove cover - 4,992 sq km (0.15%).**
 - Net **decrease** (from 2021) in mangrove cover - 7.43 km²
 - Gujarat has a notable decrease of 36.39 km²
 - Notable increase in Andhra Pradesh (13.01 km²) and Maharashtra (12.39 km²).



Bamboo cover has been estimated for the first time and included in Tree cover.

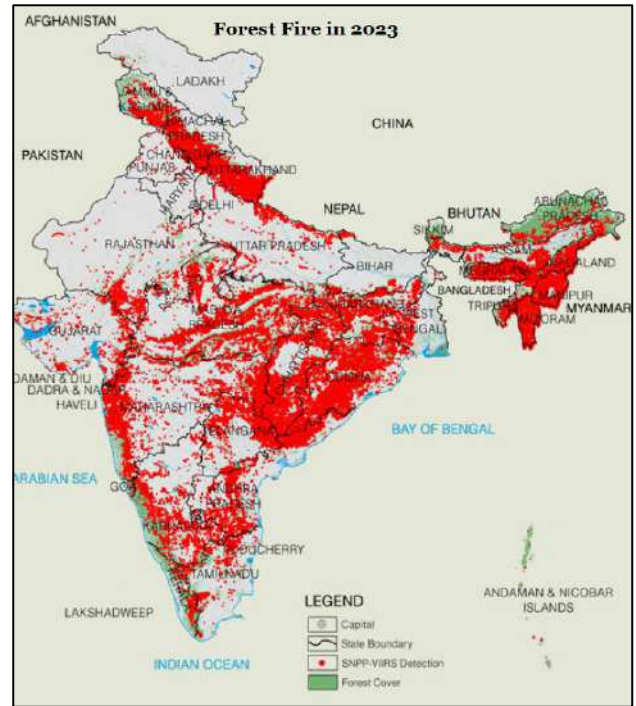
- **Total bamboo bearing area - 1,54,670sq km.**
 - Increase in bamboo cover - 5,227 sq km
- **States with largest bamboo cover**
 - Madhya Pradesh - 20,421 km²
 - Arunachal Pradesh - 18,424 km²
 - Odisha - 12,328 km²
- The total annual potential production of timber from trees outside forest - 91.51 million cum.
- **Agroforestry** - It accounts for 1, 27,590 km² of tree cover and 1,292 million m³ of Growing stock.
- **Area of Western Ghats Eco-Sensitive Areas (WGESA) - 60,285.61 km².**
 - Forest cover in all districts under WGESA - 44,043.99 km² (73%).
 - Loss of forest cover in WGESA - 58.22 km² (During the last 10 years).
 - Very Dense Forest increased by 3,465.12 km².
 - Moderately Dense Forest and Open Forest decreased by 1,043.23 km² and 2,480.11 km².
- **The total forest and tree cover in the North Eastern - 1, 74,394.70 km²** which is 67% of geographical area of these states.
 - Decrease of forest cover in the north eastern region - 327.30 km²
- **Forest fire** - Top three States with fire incidences 2023-24 season - Uttrarakhand, Odisha and Chhattisgarh.

In 2019, National Disaster Management Plan (NDMP) by National Disaster Management Authority (NDMA) recognised forest fires as one of the national disasters.

How much has the forest and tree ecosystem changed?

- **Increase total forest and tree cover** - There is an increase of **1445 sq km** from 2021.
 - Increase in forest cover - 156 sq km.
 - Increase in tree cover - 1289 sq km.

- **Maximum increase in forest and tree cover**
 - Chhattisgarh (684 sq km)
 - Uttar Pradesh (559 sq km)
 - Odisha (559 sq km)
 - Rajasthan (394 sq km).
- **The maximum decrease in forest and tree cover**
 - Madhya Pradesh (612.41 km²)
 - Karnataka (459.36 km²)
 - Ladakh (159.26 km²)
 - Nagaland (125.22 km²).
- **Changes in last decade (2013-2023)**
 - Increase in forest cover - 16,630.25 km²
 - Increase in tree cover - 20,747.34 km².
 - Increase in mangrove cover - 296.33 km²
 - Increase in agroforestry tree green cover - 21,286.57 km²
- **Improvement in soil health**
 - Changes in shallow to deep soil - 87.16% (as against 83.53% in 2013)
 - Improvement in medium to deep humus - 18.04% (as against 11.43% in 2013)
 - Improvement in grass cover - 17.21% (15.64% in 2013)
 - Increase in soil organic carbon - 56.08 tonnes per hectare (55.85 in 2013)



1.5 India's Pharma Industry Growth

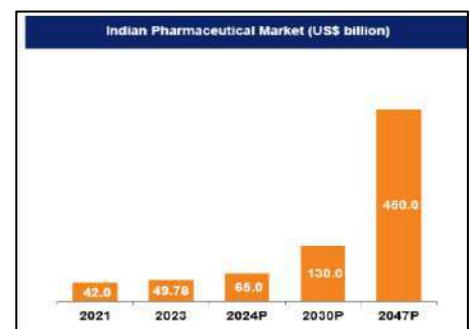
Why in news?

The Indian pharmaceutical sector, currently valued at \$55 billion, is expected to reach \$130 billion by 2030 and \$450 billion by 2047.

How India became the pharmacy of the world?

- **Historical journey** - From being a net importer of pharmaceutical products in the late 1980s, India has transformed into a major supplier of generics worldwide.
- **India's pharma growth** - Pharmaceutical sector has grown nearly 20-fold in the past 20 years, from \$3 billion in 1999 to an estimated \$58-59 billion in 2024.
- **Global Player** – India now ranks **3rd world wide** by volume of production and **14th by value**, thereby accounting for around 10% of world's production by volume and 1.5% by value.
- India's share of pharmaceuticals & drugs in global market is 5.71%, supplying 20% of global medicines by volume and 60% of vaccine demand.

WHO sources **65-70%** of the vaccine it needs from India.

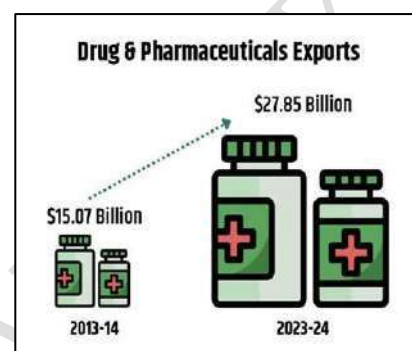


- **Generic medicine** - India is the largest supplier of low-cost generics, vaccines and affordable medicines.
 - About 8 out of 20 global generic companies are from India.
- India supplies 40% of US generic drugs and 25% of UK medicinal supplies, is expected to grow from \$50-plus billion to \$130 billion by 2030, requiring innovation to enhance its size and capabilities.
- **Export growth** - Pharmaceutical exports reached \$504 million in 1995 and to \$27.9 billion in 2023-2024.
 - It is projected to increase to \$31 billion in 2024-25.

- Formulations & biologics dominate exports, at 72.54%, followed by drug intermediates & bulk drugs.
- **Growth projection** - Growth is expected to exceed \$130 billion by 2030, potentially \$400 billion by 2047.

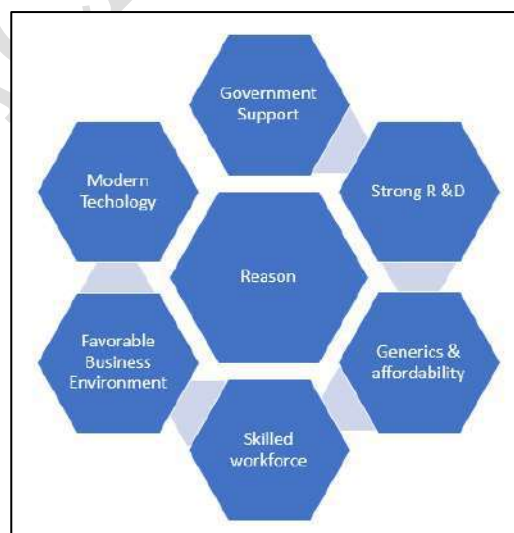
What factors led to the growth of Indian pharma sector?

- **Overhauling of Patent law** - India's Patents Act has been instrumental in shaping the country's pharma landscape.
- India had a product patent regime for all inventions under the Patents and Designs Act 1911.
- In 1970, the government introduced the new Patents Act, which excluded pharmaceuticals and agrochemical products from eligibility for patents.
 - Patent rights were introduced in India for the first time in 1856 and, in 1970, the Patent Act 1970 ("the Patents Act") was passed, repealing all previous legislations.
- **Reverse engineering** – The lack of protection for product patents enabled Indian companies to produce the same drugs through reverse engineering.
- **Research and development** - the patent era in Pharma industry, with 60-65% of R&D budget allocated to process engineering and reverse engineering until the 2000s. After 2005, 30-35% is now focused on innovative research.



What are the impacts of COVID 19 pandemic on Indian pharma?

- **Vaccine supplier** - India was at the forefront of the global vaccine, drug and supportive materials like PPE during COVID 19.
- **Vaccine Achievements:**
 - First indigenous DNA vaccine, ZyCoV-D (Zydu Lifesciences).
 - First protein sub-unit vaccine, Corbevax (Biological E).
 - First mRNA vaccine, Gemcovac (Gennova Biopharma)
 - World's first intranasal Covid-19 vaccine, iNCOVACC (Bharat Biotech).
- **Rapid response** – Indian pharma companies showcased their ability to produce vaccines and repurpose drugs at fast pace and high volume.
- **Rise of Indian pharma companies** – Serum Institute of India has become the largest player vaccine producer, and became part of Coalition for Epidemic Preparedness Innovations (CEPI) network.



What are the challenges facing Indian pharma?

- **Enforcement of intellectual property rights** - Draft Patents (Amendment) Rules, 2023, have raised concerns among experts, fearing they may hinder the timely availability of affordable, high-quality generic drugs.
- **Quality assurance** - Maintaining uniform quality throughout the pharmaceutical supply chain poses a significant challenge for India.
- **Regulatory adherence** - Managing intricate regulatory demands can be a heavy burden for pharmaceutical firms, especially for small and medium-sized enterprises.
- **Shortage of skilled talent** - There is an increasing need for qualified professionals in the pharmaceutical sector, which proves difficult to satisfy."

*After the WTO Trade-Related Aspects of Intellectual Property Rights (TRIPS), in January 1, 1995, **India amended patent laws** to introduce product patents for pharmaceuticals, providing 20 years protection to inventions.*

What are the growth opportunities?

- **Future technologies** - Artificial intelligence (AI), internet of things (IoT) and big data analytics will bring significant improvements in manufacturing, quality, and research in pharma sector.

- **Biologics** - India's emerging biopharma sector aims to emulate the global leadership of generic drugs and vaccines with Biosimilar Biologics.
- **Advanced treatments** - Precision medicine and personalised treatments like CAR-T cell therapy will create demand for diverse range of drugs and medicine.
- **Expanding health coverage** - Emergence of healthcare tools like telemedicine, and AI are enhancing diagnostics, replacing traditional paper files, and expanding access to healthcare.
 - In 2001, ISRO facilitated medical consultations between rural hospitals in Andhra Pradesh and Chennai.
- **Growth of medical tourism** – India's medical tourism is valued at around Rs 1 trillion in 2024, with a projected CAGR of 17.2%, which will create demand for pharma goods.
 - Currently, 7.3 million tourists annually from West Asia, Africa, Southeast Asia.
- **Expanding middle class** - By 2030, 140 million additional households will be classified as middle-class, driving a 3-4x increase in healthcare spending.
- **Digitization** - Hospitals are increasingly using digital platforms like Ayushman Bharat Digital Health Mission to cover a larger population and provide more personalised services through data-driven insights.
- **Increasing investment** - India's healthcare sector, which now attracts \$5-6 billion in annual investment, is projected to reach \$285 billion by 2028, implying growth at twice the pace of GDP.
- **Improved insurance penetration** - India's health insurance coverage has increased from around 25 % in 2013 to 65 % in 2023, but 35 per cent of the population (around 500 million people) remain uninsured.
- **Increasing in NCD burden** - The burden of diseases such as diabetes, cardiovascular conditions, and cancer is projected to rise from 169 million today to 226 million by 2030.

In 2023, the **telemedicine market** in India was valued at \$2.5 billion. By 2032, it is expected to reach \$16.9 billion, with a compound annual growth rate (CAGR) of 23.88%.

What are the government initiatives for Pharma sector?

- **Medical device parks** - Budget for the promotion of medical device parks was raised to Rs. 150 crore (US\$ 18 million) for FY25.
- **PLI scheme for pharmaceuticals** - Production Linked Incentive is given for pharma industry with Rs. 15,000 crore (US\$ 2.04 billion) from 2020-21 to 2028-29.
- **Pradhan Mantri Bhartiya Janaushadhi Pariyojana (PMBJP)** - Quality generic medicines at affordable prices through Pradhan Mantri Bhartiya Janaushadhi Kendras (PMBJK).
- **Strengthening of pharmaceutical industry (SPI)** -Support for existing Pharma clusters and MSMEs to improve productivity, quality, and sustainability.
- **Promotion of bulk drug parks** - World-class infrastructure to reduce manufacturing costs and make India self-reliant.
- **FDI liberalization** - 100% FDI is allowed under automatic route for greenfield pharmaceuticals.

What lies ahead?

- Standardisation of technology and digitisation of records will be significant to aid the growing pharma sector.
- Innovation will be the key, to grow from its current \$50-odd billion value to \$130 billion by 2030.

G.S PAPER I

2. GEOGRAPHY

2.1 Transformation of Tsunami Science

Why in News?

December 26, 2024, marks the 20th year since the 2004 Indian Ocean earthquake and tsunami.

What was the 2004 Tsunami?

- **Tsunami** – Seismic Sea waves are massive ocean waves that are typically caused by underwater earthquakes, volcanic eruptions, or landslides.
- **2004 Tsunami** – It was generated by the quake of magnitude 9.1 created off the Sumatran coast.
- It was the third largest (by magnitude) in the world since 1900.
- **Hypocentre** - The source was 30 km below the ocean floor, in the Sunda trench, where part of the Indo-Australian plate subducts beneath the Burma microplate, which is a part of the Eurasian plate.
- **Effect** -The 2004 earthquake ripped through 1,300 km of the plate boundary, the fault tearing from Sumatra in the south to Coco Islands in the north.
- **Impact** - The quake was felt in Indonesia, Bangladesh, India, Malaysia, the Maldives, Myanmar, Singapore, Sri Lanka, and Thailand.
- **Tsunami impact** - The tsunami was most impactful on distant shores, affecting 17 countries lining the Indian Ocean.
- **Toll** – Tsunami had caused astounding death toll of around 227,000 plus 1.7 million more displaced.
- **Japan 2011 tsunami** - In 2011, a magnitude 9.1 earthquake hit the east coast of Japan, the largest ever recorded in that country.

How these events transformed the disaster risk management?

- The two decades since 2004, researchers have made tremendous leaps in the scientific understanding of tsunami generation and the technical aspects of earthquake monitoring.
- **ITEWC** - Union Ministry of the Earth Sciences had established Indian Tsunami Early Warning Centre (ITEWC) in 2007 to issue tsunami advisories for India.
- **INCOIS** - ITEWC is operated from the Indian National Centre for Ocean Information Services (INCOIS) at Hyderabad.
- **Features of ITEWC** - It operates seismological stations as well as bottom pressure recorders and tidal stations across the Indian Ocean basin.
- **Functions** -ITEWC functions as an approved Tsunami Service Provider of the Indian Ocean Tsunami Warning & Mitigation System (IOTWMS) that is an integral part of the Global Tsunami Warning and Mitigation System, established and coordinated by the Intergovernmental Oceanographic Commission (IOC) of UNESCO.
- **IMD** - Earthquake data from the stations operated by the India Meteorological Department (IMD) and 350 global stations are also available at INCOIS.
- **Ocean monitoring systems** - In about 10 minutes the system can identify a potential tsunami-producing earthquake and issue tsunami alerts or warnings for countries bordering the Indian Ocean.
- **Use of technology** - The demand for more knowledge about tsunamis also facilitated quantum leaps in the use of GPS systems and earthquake instrumentation.
 - Kalpakkam nuclear power plant can withstood the giant waves and shut down automatically after the rising water levels tripped the detectors.
- **Strengthening seismic observations and geodetic studies** – Several earth quake monitoring stations are established along the Andaman and Nicobar Islands.
- **Tsunami modelling** - Mathematical tools are used to determine inundation limits.
- **Nuclear disaster warning** - The disaster provided a stark reminder that nuclear power plants established along Indian coasts could be vulnerable to a hitherto underestimated risk.
- **Fukushima Incident** - 2011 Tohoku earthquake affected the Fukushima facility & its radiation had entered the human food chain.

India is the **fifth country** in the world, after the U.S., Japan, Chile, and Australia, to have an advanced tsunami warning system of this kind.

Researchers even found **radioactive caesium** in the breast milk of some women tested near **Fukushima prefecture** three months after the disaster.

What is Tsunami geology?

- **Tsunami geology** – It was pioneered by Brian Atwater of the U.S. Geological Survey.
- His works prompted researchers in Asian countries including India to search for evidence of tsunamis in history.

- **Use of land elevation changes** – Atwater had used the imprints of earthquakes to determine when some piece of land had been deformed
- **Use of sedimentary deposits** – Sedimentary deposits along the islands and coastal areas of the mainland are used to find evidence of other ancient tsunamis.
- **Pre-2004 tsunami** - Excavations at Mahabalipuram, a port of the Pallava dynasty, unearthed evidence of a tsunami of the same vintage.
 - 2004 earthquake had rendered changes in elevation of up to 3.5 metres at some places along the Andaman and Nicobar Islands.

How vulnerable the Indian Ocean region is to Tsunami?

- **Unexamined regions** - The crust between Great Nicobar and Car Nicobar is still unexplored and its geological features are unknown.
- **Potential tsunami regions** - Makran Coast in the northern Arabian Sea and the Myanmar coast adjoining the Northern Indian Ocean have the potential to produce large tsunamis.
 - The Makran Coast cuts through Iran and Pakistan.
- **Nuclear reactor** – Earthquake in makran coast could direct a tsunami's energy towards India's west coast, which also hosts nuclear reactors and the city of Mumbai.

What are the major developments in Tsunami prediction?

- **Zone of importance** - Subduction zones like the Andaman-Sumatra region are becoming significant as they provide clues to earthquake generation.
- **Discovery of slow slips** – Researchers have been studying seismic slips at plate boundaries to understand the processes that occur before and after major earthquakes.
- They have elucidated the occurrence of premonitory and post-seismic slip transients using laboratory experiments and numerical simulations.
- These studies indicate a creative process that initially involves stable, slow rupture growth within a confined zone on a fault just before unstable, high-speed rupture.
 - One paper published in 2015 indicated a perceptible downward ground movement in South Andaman between 2003 and 2004, before the 2004 earthquake.

Slow Slips are tectonic faults that move many orders of magnitude slower and generally just a bit deeper, has also added a new dimension to tsunami studies.

What lies ahead?

- Focus on problem spots, like the Makran Coast in the northern Arabian Sea and the Myanmar coast adjoining the Northern Indian Ocean, that have the potential to produce large tsunamis.
- Studying seismic slips at plate boundaries to understand the processes that occur before and after major earthquakes.

3. SOCIAL ISSUES

3.1 Impact of Water Crisis on Global Economy

Why in news?

Recent report by Global Commission on the Economics of Water, predicts that by 2050, the lower-income countries will suffer GDP losses due to water crisis.

What is the status of global water crisis?

- **Water crisis** – Annual per-capita water availability of less than 1700 cubic meter is considered as water stress condition.
- Whereas annual per-capita water availability below 1000 cubic meters is considered as a water scarcity condition.
- **UN report** – By 2050 nearly 4 billion people could live in areas under severe water stress.
- **Status in India** – The average annual per capita water availability for year 2021 and 2031 has been assessed as 1486 cubic meter and 1367 cubic meter respectively.

The Global Commission on the Economics of Water was launched in 2022 by the Government of the Netherlands and facilitated by the OECD.

- **SDG 6** – It seeks to ensure the availability and sustainable management of water and sanitation for all.

What are the factors leading to global water crisis?

- **Weak economic practices** – Over-exploitation of water resources in manufacturing & infrastructure sector.
- **Unsustainable land use** – Deforestation, urban sprawl, and improper agricultural practices disrupt water cycles, reduce groundwater recharge, and increase water scarcity.
- **Persistent mismanagement of water resources** – Over-extraction, inefficient irrigation, and pollution worsen water availability, depleting clean water sources.
- **Adversely changing climate** – Rising temperatures, changing rainfall patterns, and melting glaciers intensify droughts, floods, and water shortages.

Agriculture accounts for roughly 70% of freshwater withdrawals, followed by industry (about 15%) and domestic (or municipal) uses (about 12%).

What are the impacts of waters crisis?

- **Imbalance in global water cycle** – It is vital for generating rainfall, as well as for mitigating climate change and ensuring economic stability.
- **Agricultural loss** – More than half the world's food production will be at risk of failure in the next 25 years.
- **Impact on human development** – Water scarcity directly affects health, food security & poverty alleviation.
 - Increases the vulnerability of communities to health issues due to lack of clean water.
- **Hindrance to SDG** – Without sufficient water, efforts to achieve key SDGs are compromised.
- **Affects economic growth** – The combined effects of climate change and water scarcity could account for 15% GDP loss in lower-income countries and 8% in higher income countries by 2050.

What are suggested measure by the report to tackle water crisis?

- **Redefine water governance** – The report offered a new perspective on just access to water for dignified life, adequate nutrition and consumption requires a minimum of about 4,000 liters per person per day.
- According to the WHO, 50- 100 liters per day is required to meet essential health, hygiene needs.
- **Shift in perspective** – To properly recognize water scarcity and take water as public commodity rather than a personally owned commodity
- **Revolutionizing the food systems** – Increase agricultural productivity using regenerative agriculture to reduce water usage by one-third.
 - Shifting 50% of global cropland to regenerative agriculture by 2050.
- **Conserving natural habitats** – Act seriously to meet the 30% target for the restoration of degraded forests and inland water ecosystems
- **Establishing a circular water economy** – Reduce the strain on natural water resources by recycling wastewater to make it up 8% of freshwater annually.
- **Enabling sustainable innovation** – Such as precision irrigation, to improve efficiency and reduce waste.
- **Payment for Ecosystem Services (PES)** – Which provides a monetary value to ecosystem services such as water purification and climate regulation.
- PES provides incentives for conserving ecosystems that play a vital role in maintaining water cycles
- **Establishment of a Global Water Pact** – To promote international cooperation and innovative financing for water management.

Green Water Conservation

- Fresh water is classified into blue water and green water,
- **Blue water** – Encompassing surface and groundwater.
- **Green water** – Refers to moisture in soils and vegetation.
- **Part of hydrological cycle** – Green water flows into the soil, runs into rivers, lakes, and the ocean and evaporated to atmosphere.

- This is important since almost half of the rain falling over land originates from green water.
- A stable supply of green water is linked to stable patterns of rainfall, itself critical to economies and livelihoods.
- Deforestation, agricultural or urban expansion in one area can disrupt rainfall in another.
- It also helps in carbon sequestration and mitigation of climate change.
- So, it is essential to conserve regeneration of green water.

What are the measures taken by Indian government?

- **Jal Jeevan Mission** – Aimed at providing tap water to every rural household by 2024.
- **AMRUT 2.0** – To ensure water supply in statutory towns across the country.
- **Pradhan Mantri Krishi Sinchayee Yojna** – For optimal usage of water in agricultural irrigation.
- **Atal Bhujal Yojna** – Sustainable management of groundwater resources in water stressed blocks.
- **National Perspective Plan** – To improve water availability by transferring water from surplus basins to deficit basins.
- **Sahi Fasal** – Encouraging farmers to grow water efficient crops.
- **Mission Amrit Sarovar** – Developing and rejuvenating 75 water bodies in each district.
- **Catch the Rain** – Water conservation and rainwater harvesting to improve ground water table.

What lies ahead?

- To create a Global data infrastructure for better predictions of water-related risks and enabling informed policy decision.
- Mission-driven approach that engages all stakeholders to work in achieving common goal to tackle water crisis.
- Restoring Ecosystems by investment in green water conservation.

3.2 Social disparities in IT sector

Why In news

Recent, NSSO survey uncovers significant caste-based inequalities in employment rates and wages within the IT sector.

What are the recent findings about social disparities in IT sector?

- **Disparities in employment probabilities** - Probability of Scheduled Castes (SC) and Scheduled Tribes (ST) to be engaged in the IT sector is only 10% in comparison to upper castes (27%).
- **Widening disparity** - The deficit of lower castes in IT sector went up from 11% in 2011-12 to 17% in 2020-21.
- **Labour segmentation** - Backward and scheduled castes are relegated to the lower segments of the job market.
- **Structural barriers** - Workers in the lower segment facing structural barriers in upward mobility.
- **Disparities in wage earnings** - SC & OBC workers in IT sector earns 24.9% and 22.5% less than their upper caste counterparts, despite considering education & employment types.
- **Gender inequality** - Female workers in IT earn 26.2% lower than males, irrespective of their caste, though their employment probabilities are closer to that of men.

The study utilises two rounds of NSSO surveys NSS 78th (2020-21) and NSS 68th rounds (2011-12).

What are the factors causing these disparities?

- **Social inequality** - Caste inequalities are rooted in historical, social, economic & cultural influences, perpetuated by long-standing beliefs and generational transmission.
- **Discrimination** - based on caste permeates the job market, limiting employment chances and professional growth for marginalized sections.
- **India's economic liberalization** - since 1990 has created growth opportunities, especially in technology and services, but caste-based inequality remains.
- **Globalization** - It has created new jobs in cities, but these are mostly in fields needing advanced education and technical skills, which many lower-caste people lack.

- **Digital divide** – It has disproportionately affected rural & lower-caste populations and has limited their ability to participate in the global economy.

What are the impacts of these disparities?

- **Loss of economic efficiency** – According to a report by the International Labour Organization in 2022, higher levels of diversity at the workplace are associated with greater productivity and innovations.
- **Undermines social justice** - it discourages the marginalised sections from investing in skill development, trapping them in a vicious circle of poverty.
- **Affects national progress** - By marginalizing a considerable segment of the population from equal economic engagement, the nation cannot fully utilize its productive capabilities.
- **Unsustainable development** - Absence of inclusivity also breeds social tensions, resulting in a climate unfavourable to sustainable development.

Each 1% increase in racial diversity in upper and lower management is associated with a yearly firm **productivity gain** between \$729 and \$1,590 per worker.

What can be done to address these disparities?

- Requiring all companies to publicly disclose their workforce diversity matrix, and make it public on their website.
- Such transparency can encourage accountability and motivate employers to prioritise diversity, without imposing specific quotas.
- Provide backward-caste and scheduled caste entrepreneurs greater incentives and training for entrepreneurship in high productivity sectors to boost their economic participation.
- Bridging the skill gap among the marginalized sections to bring more equitable and inclusive job market.

G. S. PAPER II

4. INDIAN POLITY

4.1 Right to Disconnect

Why in News?

Recently there is a discussion about recognizing the right to disconnect to increase productivity and ensure the overall growth and well-being of employees and employers.

What is right to disconnect?

- **Right to disconnect** – It refers to employee right to disconnect from work-related communications outside of official working hours.
- **Objectives** – Defining a boundary line between work and home life to:
 - Improve work-life balance
 - Reduce burnout
 - Increase employee satisfaction
- **Employee right** – Employees can decline work-related communications outside of regular hours without facing negative consequences.
- It includes not being obligated to monitor, read or respond to work emails, phone calls, text messages or other forms of communication once their workday has officially ended.
- **Exceptions** – In Situations such as critical business needs, pre-agreed arrangements and immediate risk to health, safety may require contacting employees outside regular hours.
- **Constitutional safeguards** – In India, to protect workers from overexploitation is mandated in directive principles of state policy.
- **Article 38** – Encourages the state to promote the welfare of the people, underlining the broader societal and workplace ethos.

In India, MP **Supriya Sule** introduced a Private Member Bill in 2018 that included the **right to disconnect** from work after working hours. It proposed a penalty for companies that didn't comply with it.

- **Article 39(e)** – Aims to secure health and strength of workers, directing state policy to prevent exploitation.

Which countries have recognized the right to disconnect as a law?

Country	Provisions
France – 2017	Companies with 50 or more employees must negotiate guidelines allowing workers to disconnect from emails and other work-related communications after working hours.
Italy – 2017	Employees have right to disconnect during rest periods, <u>especially in remote working arrangements</u> .
Spain – 2018	The law is enacted as a part of the Data Protection and Digital Rights Law, 2018 and it mandates <u>employers to develop policies</u> on right to disconnect.
Ireland – 2021	Introduced a Code of Practice in 2021, which <u>protects employees from penalization</u> for not being available after hours.
Belgium – 2022	It promotes mental well-being and work-life balance. Initially enforced for federal civil servants, with a similar push for private-sector employees.
Australia – 2024	The law allows employees to ignore communications after working hours if they choose to, without fear of being punished

Why India needs right to disconnect?

- **Improved work-life balance** – Employees can devote more time to personal pursuits, family, and rest, fostering healthier relationships and personal development.
- **Reduced stress and burnout** – Disconnecting from work after hours prevents excessive stress, helping maintain mental and physical health.
- **Enhanced productivity** – Employees who enjoy downtime are more likely to return to work refreshed and motivated, enhancing overall efficiency.
 - A British multinational telecoms firm found a conclusive link between happiness and productivity.
- **Protection of privacy** – Employees retain control over their non-working hours, safeguarding their personal time from unnecessary intrusions.
- **Optimized resource use** – Better utilization in working hours could reduce unwanted expense which could lead to cost savings.
- **Healthier communities** – Working prolonged hours causes stress, coronary heart diseases and improves overall health.
- **Economic benefits** – Healthier and more satisfied workers reduce the economic burden on healthcare systems caused by stress-related illnesses.

According to the report released by the World Economic Forum, the proportion of mobile workers who could work from any location is expected to rise above 70%.

What are the challenges of right to disconnect in India?

- **Economic challenges** - Sectors like IT, customer service, and finance require round-the-clock availability to meet global demands.
- A strict right to disconnect could hinder operations and client satisfaction.
- **Growth-oriented economy** – India is focused on rapid economic growth and development measures.
- The law will limit work output and may not align with national priorities.
- **Global competitiveness** – As Indian businesses compete on a global stage, availability and responsiveness outside working hours are often seen as advantages.
- **Dependence on hustle culture** – Many companies rely on employees' willingness to go beyond standard hours to maintain competitiveness, particularly in startups and high-growth businesses.
 - It will hinder promotion and incentive for employees who are eager to work.
- **Large informal sector** – A significant portion of India's workforce is in the informal sector, where labor laws are not strictly enforced.

- Extending such rights to this segment would be complex.
- **Cultural and social factors** – Many Indians view work as *integral to their identity and success*, making the concept of disconnecting potentially reduce their growth in a competitive job market.
- **Enforcement difficulties** – Monitoring and enforcing after-hours disconnection in diverse workplace settings could pose significant challenges.
- **Impact on small businesses** – Small and medium enterprises (SMEs) may struggle to adapt to such policies *due to limited workforce and reliance on flexible work hours*.
- **Younger workforce** – India's growing young population values opportunities for advancement, often requires extended engagement.

What lies ahead?

- Balance between maintaining high productivity and protecting employees' mental and physical health.
- Gradual evolution of Work-life balance policies for implementation of the Right to Disconnect may start with select industries, focusing on sectors with high digital connectivity.
- Collaborative efforts will be necessary to shape flexible, effective policies professional growth.

4.2 Impeachment of Vice President

Why in news?

The opposition parties to submit a no-confidence motion against vice president of India for the partisan manner in conducting the proceedings of the council of states.

Why opposition is moving no confidence motion on vice president?

- The *independence and neutrality* of parliamentary presiding officers are critical for the *smooth functioning of democracy*.
- **Partisan perception** – Opposition claims that decisions regarding procedural matters, debates or disciplinary actions are biased, especially during legislative sessions.
- Accusations of favoritism or selective enforcement of rules undermines the Vice President's as a neutral arbiter.
- **Preserving democratic integrity** – Neutrality ensures that the Rajya Sabha functions as a deliberative body that represents the states and regions of India.
- It protects the *sanctity of debates and decision-making processes*.
- **Lack of trust among members** – Partiality shown by Vice President makes procedural disruptions and walkouts in Rajya Sabha.

What are the Constitutional provisions of vice president?

- **Office of vice president** – **Article 63** provides that there shall be a Vice-President of India.
 - Jagdeep Dhankhar serves as the 14th Vice President of India.
- **Qualifications** – To be eligible for the Vice Presidency, a candidate must:
 - Be a citizen of India.
 - Be at least 35 years old.
 - Qualify for election as a member of the Rajya Sabha.
- **Election process** – **Article 66** details the election process of Vice President, who is elected by an electoral college *comprising members of both Houses of Parliament through a system of proportional representation* by means of a **single transferable vote**.
- **Article 324** vests the superintendence of the conduct of election to the office of the Vice-President of India in the *Election Commission of India*.
- **Oath of office** – The Vice President takes an oath or affirmation before the President of India or someone appointed by the President.
- **Term of office** – **Article 67** specifies a *five-year term* for the Vice President.

What are the powers and functions of the vice president?

- **Ex Officio chairman of rajya sabha** – Articles 64 and article 89 designates that the Vice-President of India shall *be exofficio Chairman* of the Council of States.
- In the constitutional set-up, the holder of the office of Vice President is part of the Executive but as Chairman of the Rajya Sabha he is a part of Parliament.
- Presides over Rajya Sabha sessions and *maintains order and decorum during debates.*
- Ensures that parliamentary rules and procedures are followed.
- In the event of a tie in the Rajya Sabha, the Vice President *exercises the casting vote.*
- **Acting president** – In the absence of the President due to death, resignation, removal or incapacity, the Vice President assumes the duties of the President.
- Acts as the President until a new President is elected within six months.
- **Legislative functions** – Presides over Rajya Sabha, address issues & enable discussions on legislative matters.
- Plays a neutral role, ensuring that all members have the opportunity to express their views.
- **Diplomatic and Ceremonial Roles** – Represents India at various state functions and ceremonies, both domestically and internationally, as needed.
- **Advisory role** – Advises the President and other government authorities in matters of governance and administration, though this is not a formal constitutional duty.

What is the procedure for impeaching the Vice President?

- **Initiation of the motion** – A resolution to remove the Vice President can be initiated *only in the Rajya Sabha* (the Vice President is the ex officio Chairman of this House).
- The resolution must be initiated in *at least 14 days' notice*, signed by a prescribed number of Rajya Sabha members.
- **Approval in the rajya sabha** – The resolution is debated and voted upon in the Rajya Sabha.
- It must be passed by a *majority of all the then members* of the Rajya Sabha.
- **Approval in the lok sabha** – After being passed in the Rajya Sabha, the resolution moves to the Lok Sabha.
- It must also be approved by a *majority of all the then members* of the Lok Sabha.
- **Final outcome** – If both Houses pass the resolution by the required majority, the Vice President is considered removed from office.
- **Ensuring fairness in removal** – The Vice President cannot preside as Chairman of the Rajya Sabha, during discussions on removal.
 - The Deputy Chairman or any another member of rajya sabha presides.
- **Comparison with the president's impeachment** – The President's impeachment process requires a *special majority* (two-thirds of members present and voting in both Houses).
- The Vice President's removal requires only a *simple majority* of all members in both Houses.

*Vice-President may resign his office by **hand written resignation** to the President.*

What lies ahead?

- Balancing neutrality as political divisions intensify, the Vice President must maintain impartiality by ensuring fair treatment of all members to uphold democratic integrity.
- Strengthening institutional credibility by demonstrating transparency, fairness and adherence to constitutional principles.
- Ensure the efficient functioning of parliamentary proceedings to discuss the public issues.

Quick facts

Electoral college of President	Electoral college of Vice president
<ul style="list-style-type: none"> • Elected members of the Rajya Sabha • Elected members of the Lok Sabha 	<ul style="list-style-type: none"> • Elected members of Lok Sabha • Elected members of Rajya Sabha

<ul style="list-style-type: none">• Elected members of State Legislative Assembly• Elected members of each union territory possessing a legislative assembly (Delhi, Jammu and Kashmir and Puducherry)	<ul style="list-style-type: none">• Nominated members of Rajya Sabha
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4.3 Impeachment of High Court Judge

Why in news?

The Opposition INDIA bloc parties in Rajya Sabha are preparing to give notice to move a motion to impeach Allahabad High Court judge for his remarks at an event organized by the Vishwa Hindu Parishad last week.

Why is the opposition planning to move a motion for impeachment?

- **Allegations of judicial misconduct** – Remarks at the Vishwa Hindu Parishad event were reportedly inflammatory and targeted on minority communities.
- **Breach of judicial code of conduct** – Judges are expected to refrain from making public statements or engaging in activities that could compromise their neutrality or reflect personal biases.
- **Perception of partiality** – Statements favoring specific ideologies can create a perception of bias, especially when the judge is tasked with ruling on matters of public or constitutional significance.
- **Undermining judicial integrity** – When a judge publicly aligns with political or ideological stances, it risks blurring the separation between judiciary and politics.
 - The Opposition argues that initiating this process is essential to ensure that judges adhere to the highest ethical standards.

What are the constitutional provisions for high court judges?

- **Establishment and Composition** – Article 214 establishes a ***High Court for each state*** or a group of states.
- **Article 216** provides the composition of the High Court, including the Chief Justice and other judges as deemed necessary.
- **Article 217** deals with the ***appointment, qualifications, conditions of office, and tenure*** of High Court judges.
- **Appointment** – The President appoints High Court Judges in consultation with the following
 - Chief Justice of India
 - Governor of the State
 - Chief Justice of the High Court
- **Qualifications** – Must be an Indian citizen and,
 - Have at least ***10 years of experience*** as an ***advocate of a High Court*** of India
 - Have at least ***10 years of experience*** as a ***judicial officer***
- **Tenure** – High court judges serve until the age of 62 unless impeached.
- **Removal** – **Article 124(4)** specifies grounds for removal, including "***proved misbehavior***" or "***incapacity***."
- Article 218 applies provisions of **Article 124, clauses (4) and (5), to High Courts**.
- These provisions detail the process for removing a Supreme Court judge, including an inquiry and a two-thirds majority vote in Parliament.
- Article 218 applies equally to High Court and Supreme Court judges.
- **Article 215** – Gives every High Court the ***power to punish for contempt of itself***.
- **Article 50** – States that the state must take steps to separate the judiciary from the executive in the public services of the state.
- **Article 221** – Provides for the salaries and allowances of High Court judges, ensuring they cannot be reduced during their term except during a financial emergency.

What are the roles and responsibilities of a judge?

- **Delivering justice** – A judge must ensure fair and unbiased adjudication based on facts, evidence, and the law.
 - Upholding constitutional morality and the rule of law is a key responsibility.

- **Interpreting laws** – Judges interpret statutory & constitutional provisions to address legal disputes.
 - Their rulings often create precedents, shaping the legal framework of the country.
- **Protecting fundamental rights** – Judges act as custodians of citizens’ fundamental rights, often intervening when these rights are violated.
- **Maintaining judicial integrity** – They must conduct themselves in a manner that reinforces public confidence in the judiciary, avoiding controversies or conflicts of interest.

What is the procedure for impeachment of judges?

- While **the Constitution does not use the word ‘impeachment’**, it is colloquially used to refer to the proceedings under Article 218 Article 124(4).
- The procedure for removal of judges is elaborated in the **Judges Inquiry Act, 1968**.
- **Initiation of the motion** – Requires **at least 100 members’** signatures in Lok Sabha or **50 members in** Rajya Sabha.
 - This motion is then submitted to the Speaker (Lok Sabha) or the Chairman (Rajya Sabha).
 - Based on this, he or she may decide to either admit the motion or refuse to admit it.
- **Formation of an inquiry committee** – If the motion is admitted, a three-member committee is constituted by the presiding officer. The committee includes:
 - Chief Justice of India or a Supreme Court judge.
 - A High Court Chief Justice.
 - A distinguished jurist nominated by the Speaker/Chairman.
- **Committee’s role** – The committee investigates the allegations and frames charges against the judge.
- If the judge is found guilty, the report is submitted and takes up for debate in the House where the motion is originated and if found not guilty, the process ends.
- **Parliamentary voting** – For removal, both Houses must approve the motion with:
 - **A majority of the total membership and**
 - **A two-thirds majority of members present and voting.**
- **Presidential approval** – Following approval by Parliament, the President issues an order for the judge’s removal.

What are the instances of impeachment?

- While **no judge has been successfully impeached** so far in India’s but there are many instance impeachment motions are initiated in the parliament.

Instance	Remarks
Justice V. Ramaswami (1993) – Charged with financial impropriety.	Despite evidence, the motion failed as some MPs abstained from voting.
Justice Soumitra Sen (2011) – Accused of misappropriating funds as a court-appointed receiver.	Resigned after the Rajya Sabha passed the motion but before Lok Sabha debated it.
Justice Gangele (2015) – Alleged to have sexually harassed a woman judge.	Cleared by the inquiry committee.
Justice Pardiwala (2015) – Faced impeachment for controversial remarks on reservations.	Dropped after he expunged the remarks from his judgment.
Justice Nagarjuna (2017) – Accused of victimizing a Dalit judge and financial impropriety	The motion fell short of required signatures as some MPs withdrew their names.
CJI Dipak Misra (2018) – Faced accusations of judicial impropriety and political bias.	The motion was dismissed by the Rajya Sabha Chairman at the preliminary stage.

What lies ahead?

- Ensuring a fair inquiry is critical to balance judicial independence with accountability.
- Strengthen internal ethics committees within the judiciary.
- The controversy highlights the need for judges to remain impartial and avoid engaging in any activity that might cast doubt on their neutrality.

4.4 One Candidate One Constituency

Why in news?

With the demand for One Nation One Election, the issue of one nation multiple constituencies has also been raised.

What are the current electoral contesting provisions?

- **Election** - The Constitution of India provides for regular *elections every 5 years* to the Legislative Assembly and the lower House of Parliament.
- **Parliamentary legislation** – *Article 327* of Constitution empowers Parliament to regulate the manner of conducting the elections.
- **Two constituency contest** - Representation of the People Act 1951 permits a candidate to contest any election (parliamentary, assembly, biennial council, or by-elections) from up to two constituencies.
- **Safety net for candidates** - Contesting multiple seats provides a safety net for candidates, especially in tightly contested constituencies.
- **Seat retainment** - Section 70 of RPA stipulates that a candidate can hold only one seat at a time, regardless of whether they have been elected to more than one seat.
- If a person is elected to two seats in a House should exercise option for one. Otherwise, both seats become vacant.

Till 1996, a candidate can contest from any number of constituencies and it was limited to 2 constituencies by amending the 1951 RPA act.

What are the impacts of one candidate multiple constituencies?

- **Frequent by-elections** - There were 44 by-elections for State Assemblies in November 2024 due to the resignation of sitting legislators.
- **Wastage of financial resources** - The extra cost of holding a by-election falls on the government.
- **Financial burden for political parties** - Financial burden of organising a by-election disproportionately falls on the already defeated candidate and their party, forcing them to spend resources once again.
- **Favours ruling party** - The by-election necessitated by the vacation of a winning candidate within an initial six months tends to favour the ruling party.
- **Undermines democratic principles** - A candidate contesting from multiple seats serves as a hedging mechanism against uncertainties and often prioritises the leader's interests, not the people.
- **Against freedom of speech** - Contesting multiple constituencies, winning them, and vacating one for a by-election violates freedom of speech and expression under Article 19(1) (a) of the Constitution.
- **Reduced voter turnout** - This practice causes voter confusion, leading to decline in voter turnout.

In the 2014 general election, the administrative cost of the Lok Sabha elections borne by the central government and Legislative Assemblies by the State governments amounted to ₹6,931 crore (₹12.76 crore per seat).

Political parties have spent almost ₹1,35,000 crores for the recent general election, or about ₹250 crore per constituency.

What lies ahead?

- Amend Representation of People Act 1951 to ban one candidate contesting from multiple constituencies for the same office as recommended by Election Commission of India and 255th Law Commission.
- Recover the full cost of by-elections from the candidate vacating a seat to discourage candidates from contesting simultaneously.
- Hold the by-elections after a year, allowing voters ample time to make an informed decision and giving the defeated candidate sufficient time to recover and prepare.

4.5 Electoral Transparency

Why in news?

Recently, The Centre has amended the Conduct of Election Rules to restrict access for the public to a section of poll documents.

What is the recent amendment to Conduct of Election Rules?

- **Conduct of Election Rules 1961** - It is a set of rules which provide for provisions on how to conduct the elections as per the Representation of People Act, 1951.
- **Provisions of conduct of election rules**
 - **General provisions** - Public Notice of Intended Election, Nomination Papers, Symbols for Elections.
 - **Election Process** - List of Validly Nominated Candidates, Withdrawal of Candidature.
 - **Polling Procedures** - Appointment of Election Agents, Publication of Polling Hours, Voting in Person, Postal Ballots
 - **Declaration of Results**
- **Recent amendment** – Rule 93(2) (a) of the 1961 Conduct of Election Rules was amended.
 - **Original provision** - All other papers relating to the election shall be open to public inspection.
 - **Amended provision** - All other papers as specified in these rules relating to the election shall be open to public inspection.
- **Purpose** – To restrict the access to electronic records, such as CCTV video footage of election process.
- **Need for the amendment:**
 - To prevent violation of secrecy of vote.
 - To prevent potential misuse of CCTV footage of inside of the polling station.
 - Sharing of CCTV footage may have serious repercussions, especially in sensitive regions like Jammu and Kashmir, naxal- affected regions, etc.
- Many documents are mentioned in the handbooks and manuals published by the Election Commission from time to time, such as

Electronic documents such as CCTV camera footage, webcasting footage and video recording of candidates during the Model Code of Conduct period are not covered in the Conduct of Election Rules.

What is the significance of transparency in electoral process?

- **Transparent electoral process** – Openness of electoral activities to scrutiny by stakeholders (political parties, election observers and voters alike), who are able to independently verify the process.
- **Building confidence** - Transparency fosters trust among voters, candidates, and political parties in the electoral process.
- **Enhances accountability** - Transparent electoral processes hold election management bodies (EMBs) accountable to the public.
- **Promotes participation** - When voters understand how elections are conducted and see that processes are transparent, they are more likely to participate actively in elections.
- **Reduces electoral fraud** - Open procedures and clear guidelines minimize opportunities for misconduct.
- **Equal access to information** - Transparency ensures that all candidates and voters have equal access to information regarding the electoral process.
- **Informed electorate** - Transparent processes provide voters with the information they need to make informed choices, enhancing the quality of democratic participation.
- **Assess the fairness of elections** - Access to electoral documents is crucial to assess the fairness of elections.

What are the issues with the recent amendment?

- **Restricts citizen-voters' right to Information** - It prevents access a large number of electoral documents which are not specifically mentioned in the Conduct of Election Rules such as
 - Reports submitted by Election Observers
 - Scrutiny reports submitted by Returning Officers after polling day

- Index Cards sent to the EC after the declaration of results which contain detailed statistics relating to the elections.
- CCTV footage of election process
- **Erodes integrity of the electoral process** – It reduces the public confidence on the election commission and creates trust issues in the electoral process.
- **Imbalance in access to information** – Enables the ruling party to have access to information that others may not have.

What lies ahead?

- Balancing the electoral transparency and administration is essential for a successful electoral democracy.
- Sunlight is the best disinfectant, and information will restore faith in the process.
- Curated contents can be shared with the public to ensure transparency and privacy.
- Judiciary monitored access to sensitive information on case-by-case basis can be provide.

5. GOVERNMENT POLICIES AND INTERVENTIONS

5.1 Project INROAD (Indian Natural Rubber Operations for Assisted Development)

Why in the news?

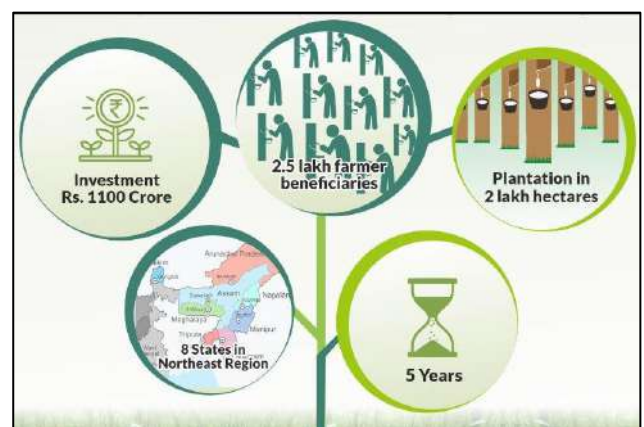
The coverage of natural rubber plantations in the North-Eastern States under the Project INROAD for the Financial Year, 2025 has been completed recently.

What is Project INROAD?

- Project INROAD (Indian Natural Rubber Operations for Assisted Development) aims to develop 2 lakh hectares of Natural Rubber (NR) plantations in North East and West Bengal besides improving quality of processed forms of rubber.
- The duration of the projects is 5 years.
- **Public Private Partnership** – This collaborative project in **Public Private Partnership mode** involves tyre majors, Rubber Board and Government of India.
- **ATMA and Rubber Board** – Automotive Tyre Manufacturers Association (ATMA), a body of tyre manufacturers in the country, has collaborated with the Rubber Board for the project.
- **Industry in plantation development** – It is the first-of-its-kind in the world where the tyre industry directly invests in plantation development, transforming the region's agricultural landscape.

What is the need for the project?

- **Immense potential for rubber plantation** – The North East (NE) region holds immense potential for rubber plantation in view of availability of land and suitable agro-climatic conditions.
- At present NE states account for about 23% of the area and 15.7% of the production.
- **Tyre industry** – being the major consumer of Natural Rubber in India as it utilizes over 70% of the total Natural Rubber produced in the country.
- **Natural Rubber (NR) value chain** – India is one of the few countries which has a complete NR value chain, since it produces NR as well as its value-added products.

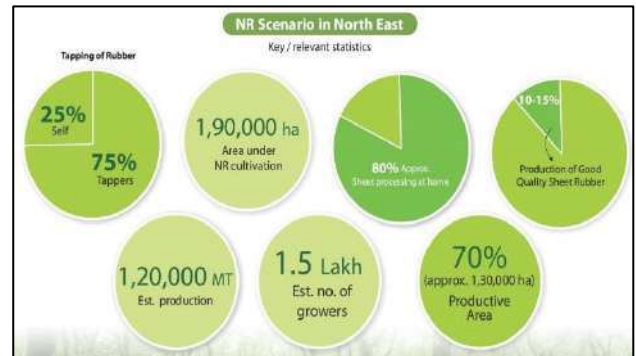


- It is estimated that by 2030, the country will require about 20 Lakh tonnes of NR per year.
- **NR demand & supply gap** – To meet the increasing demand of the Natural Rubber (NR).

What are the components under the Project INROAD?

- **Financial inclusion** – Interest Subvention for loans availed by farmers and assistance in loan syndication.

- **Training and capacity building** – Creating infrastructure for training facilities and capacity building of sector stakeholders.
- Conducting training programmes for farmers, tappers, etc. practices and technologies.
- **Quality and productivity** – Enhancement of quality and productivity of rubber by taking appropriate initiatives in all rubber growing regions.
- **Support for primary inputs** – Supporting pre-planting operations (land preparation) and providing irrigation facilities.
- Providing good quality planting material and farm inputs (fertilizers, fungicide, pesticide) to the farmers.
- Building water conservation pits, gully plugging, cover crop planting and so on.
- **Quality improvement program** – Creation of Model smoke houses & training staff to manage smoke houses.
- Upgradation and repairs of the existing smoke house.
- Creation of crop weighing and related infrastructure.
- **Project management support** – Coordination with various agencies / partners.
- Physical and financial monitoring of the project.



What are the benefits of the Project INROAD?

- **Increased production** – The project will lead to increased production of Natural Rubber for the industry.
- **Generate direct employment** – Around 825 person per hectare during immature phase and provide permanent job opportunity for 0.5 persons per hectare in matured phase.
- **Development of nurseries** – Production of other plantation inputs such as intercropping, more business or work for rubber dealers, processors and so on.
- **Local small-scale industry** – Development of local small-scale industry such as wood cutting & processing, furniture making and so on.
- **Livelihood opportunities** – Additional Income opportunities through other on farm activities like Bee keeping and so on.
- **Infrastructure Development** – Development of infrastructure including road infrastructure besides creation of Model smoke houses and creation of crop weighing infrastructure besides new practices.
- **Tribal settlement** – The project contributes towards tribal settlement.
- **Green leguminous ground cover** – Provides green leguminous ground cover above the soil.
- **Green Funding** – Rubber tree has almost all attributes of a forest species, carbon footprints and green funding.
- **Carbon sequestration** – Purifies atmosphere through carbon sequestration.
- **Improves soil properties** – Through addition of organic matter, keeps the soil cool, enrich fertility, porosity and water intake capacity.

*The **Rubber Board** is a statutory body constituted by the Government of India, under the Rubber Act 1947, for the overall development of the rubber industry in the country.*

What are the impacts of the Project INROAD?

- **Development of Nurseries** – Over 3 crore trees have been planted so far under the project.
- The largest impact of INROAD project has been rejuvenation of nurseries in the region.
- **Grass-root Level engagement** - 2 lakh hectares will directly benefit nearly 2.5 lakh farmers.
- **1.4 Lakh beneficiaries** – So far, the project has benefitted nearly 1.4 Lakh beneficiaries across **94 districts** in North-eastern states.
- **Women Empowerment** – An indirect benefit of the project has been the motivation to women for a better life for them and their children.
- The commitment being exhibited by women working in the fields has been infectious.

- **Participating Member Companies (PMCs)** – Have been personally and actively engaged in supervising the project through a series of delegations.

Quick Facts

Rubber Board of India

- It is a statutory organization constituted under the *Rubber Act, 1947*.
- It functions under the administrative control of the *Ministry of Commerce and Industry*.
- **Headquarters** – Kottayam, Kerala.
- **Functions** – The Board is responsible for the development of the rubber industry in the country by assisting and encouraging research, development, extension and training activities related to rubber.
- It also maintains statistical data of rubber, takes steps to promote marketing of rubber and undertake labor welfare activities.
- It issues licenses to rubber producers, manufacturers, and exporters/traders.
- This license is known as the "Rubber Board license/registration," which is mandatory for anyone involved in rubber manufacturing and export.
- **Structure of Rubber Board** – The Board is headed by a chairman appointed by the Central Government.
- It has **28 members** representing various interests of the natural rubber industry.

Automotive Tyre Manufacturers' Association (ATMA)

- ATMA is amongst the most active and well-known national industry bodies in the country.
- It is *headquartered in New Delhi*.
- It is a representative body of 6 large tyre companies in India, accounting for over 90% of tyre production.
- ATMA has been accorded the coveted status of true voice of the Indian tyre industry.
- ATMA works towards promoting and safeguarding the interests of the tyre industry in India primarily by acting as conduit between the Government and the industry.

5.2 PM YASASVI Scheme

What PM YASASVI?

- **PM YASASVI - PM Young Achievers Scholarship Award Scheme for Vibrant India** is a flagship initiative by the Government of India, aimed at providing scholarships to students.
- **Nodal ministry** – Ministry of Social Justice and Empowerment.
- **Vision** – **Sabka Sath, Sabka Vikas** means *together with all, development for all*.
- **Beneficiaries:**
 - Other Backward Classes (OBC),
 - Economically Backward Classes (EBC) and
 - De-notified Tribes (DNT).
- **Eligibility** – Total annual family income of up to Rs 2.50 lakhs.
- **Selection Process** – YASASVI Entrance Test (YET) 2023 conducted by the National Testing Agency (NTA).
- **Streamlining schemes** – PMYASASVI has subsumed following five sub-schemes:
 - Pre-Matric Scholarship for OBC, EBC and DNT Students
 - Post-Matric Scholarship for OBC, EBC and DNT Students
 - Top Class School Education for OBC, EBC and DNT Students
 - Top Class College Education for OBC, EBC and DNT Students
 - Construction of Hostel for OBC Boys and Girls

What are the features the scheme?

- **Financial Scholarships** – To reduce the financial burden on families and encourage students to continue their education without interruptions.
 - Pre-Matric Scholarship from Class 9 to 10.
 - Post Matric Scholarship for their higher studies at post-matriculation or post-secondary stage.
- **Top-Class Education scholarships** – For students who excel in their studies will get scholarship to attend top-tier educational institutions.
 - Top Class School Education
 - Top Class College Education
- **Hostels for OBC boys and girls** – Scheme includes provisions for the construction and maintenance of hostels for students. By ensuring access to safe and supportive living spaces, it seeks to create an optimal environment for students' academic success.

What is the scope of the scheme?

- **Transformative initiative** – Towards realizing the vision of ***Viksit Bharat 2047*** to make India more knowledge-based economy.
- **Effective implementation** – By consolidating several pre-existing schemes into a single comprehensive program the financial aid reaches those in need efficiently and effectively.
- **Increase beneficiaries** – Targeting over 40 lakh students from OBC, EBC, and DNT communities across the country.
- **Reducing dropout** – By encouraging higher education at ***critical transition points***, in senior secondary school and post-secondary education.
- **Uniform implementation** – This scheme is implemented across India, ensuring that students from all states and union territories benefit from its provisions.

What are the impacts?

- **Reduce educational inequities** – By focusing on historically disadvantaged groups, the PM YASASVI Scheme aims ***to create a more inclusive education system***.
- **Ripple effect on economy** – This empowerment can lead to ***better employment opportunities*** and socio-economic mobility for both individuals and their families.
- **Strong foundation** – Supporting students at both school and college levels helps to nurture talent from an early age for personal and professional growth.
- **Access to higher education** – Empower marginalized students by removing financial barriers to education, thus increasing their and improving their long-term career prospects.
- **Just and equitable society** – Reducing the gap between students from different socioeconomic backgrounds to create equitable society.
- **Achieving SDG** – SDG 4 which ensures ***inclusive and equitable quality education*** and promote lifelong learning opportunities for all.
- **Hostel infrastructure** – By providing students with access to safe and supportive living conditions, the scheme enhances the overall learning environment.
 - Particularly for students who come from remote or underdeveloped regions and might otherwise struggle with access to schools and colleges.

What lies ahead?

- Effective implementation at the grassroots level is essential to reshape the educational landscape for millions of marginalized students in India.
- Proper monitoring and evaluation mechanisms to ensure that scholarships and infrastructure projects reach the intended beneficiaries.
- Raise awareness about the scheme, particularly in remote and rural areas to ensure that eligible students and their families are informed about the opportunities available to them.
- Focus on improving the quality of education in the schools and institutions.
- Capacity building initiatives such as teacher training, curriculum development and initiatives to enhance student engagement and retention.

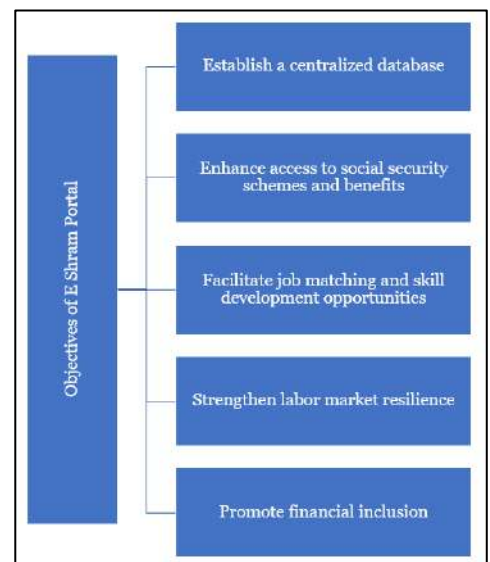
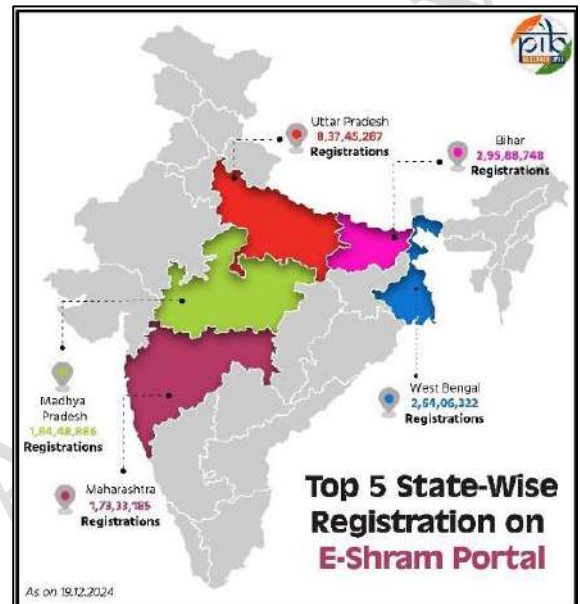
5.3 E Shram Portal

Why in News?

Recently, e-Shram portal has achieved a milestone of over 30 crore registered Unorganised Workers.

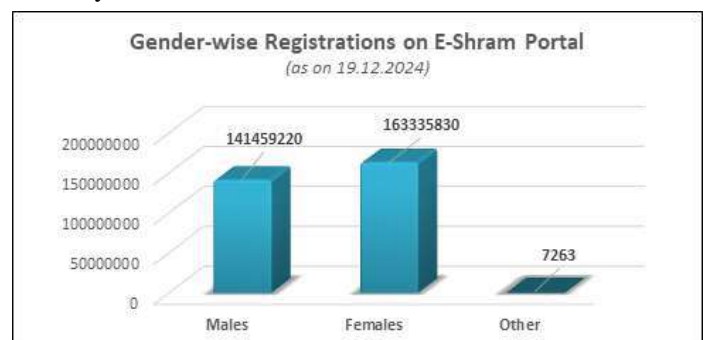
What is E Shram Portal?

- **E-Shram portal** – It is a flagship initiative by the Government of India that was launched in 2021 to support and empower the unorganized workforce.
- **Nodal ministry** – Ministry of Labour and Employment
- **Database** – It is designed to create a comprehensive National Database of Unorganised Workers (NDUW), world's largest database of unorganised workers.
- **Aadhaar link** – It is verified with Aadhaar, enabling the delivery of targeted welfare schemes and benefits.
- Registration on the E-Shram portal is free of cost.
- **Eligibility to register:**
 - Aged between 16 and 59 years.
 - Be employed in the unorganized sector, including self-employed individuals, daily wage labourers, and gig workers.
 - Possess an Aadhaar card, a valid mobile number linked to Aadhaar, and a bank account.
 - Not be a member of the Employees' Provident Fund Organization (EPFO) or Employees' State Insurance Corporation (ESIC).
- **Number of registrations** – **30,48,02,313** (As on December 19, 2024).
- **Top states with registrations:**
 - Uttar Pradesh (8,37,45,287)
 - Bihar (2,95,88,748)
 - West Bengal (2,64,06,322)
 - Madhya Pradesh (1,84,48,886)
 - Maharashtra (1,73,33,185)

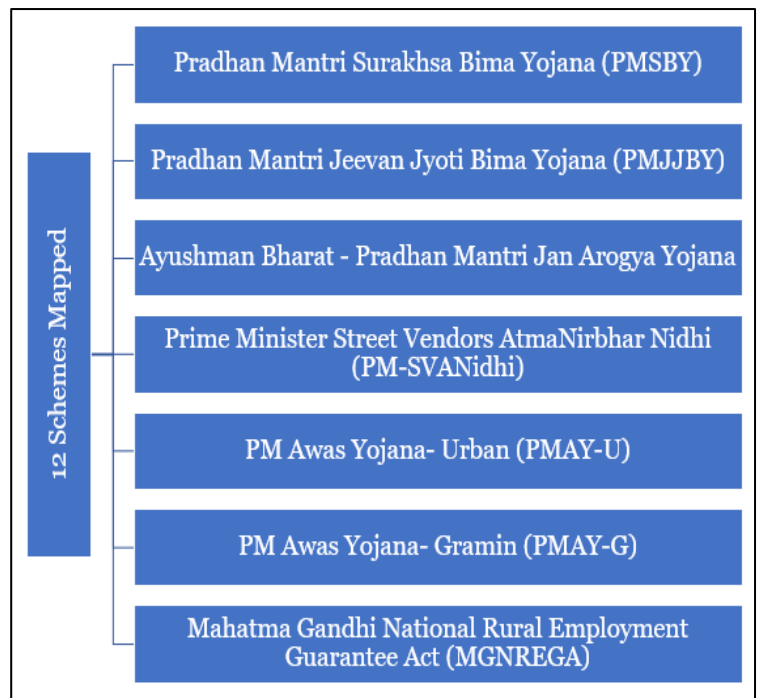
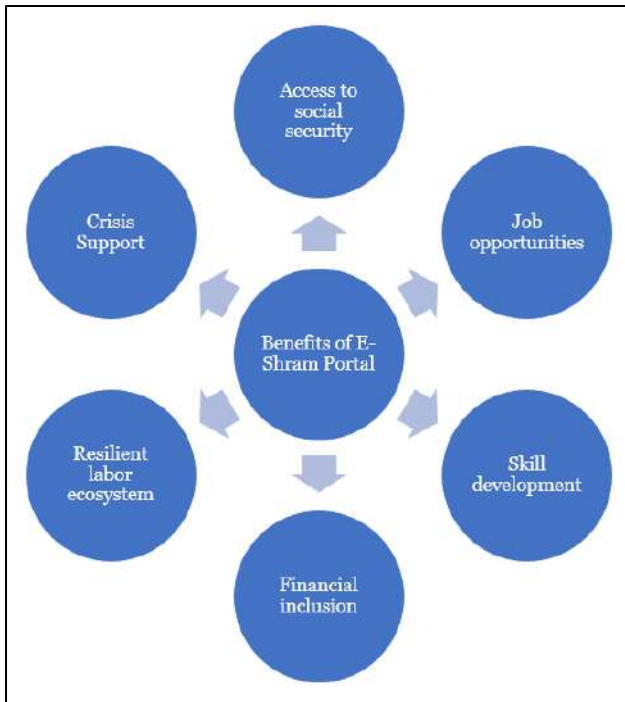


What are the key features of E-Shram portal?

- **Universal Account Number (UAN)** – Registered workers receive a UAN linked to their Aadhaar, enabling seamless access to benefits.
- **Single registration process** – The portal streamlines the registration process, requiring minimal documentation such as Aadhaar and bank account details.
- **Multilingual support** – Workers from diverse regions can access the portal in multiple Indian languages, ensuring inclusivity.
- **Grievance redressal mechanism** – A dedicated helpline and support system address workers' queries and grievances promptly.
- **Integration with employment and skill opportunities** – Registered workers can connect with employment opportunities, skilling, pension and state-specific schemes through the portal.
- **Family details for migrant workers** – It captures family details of migrant workers to aid child education and women-centric schemes for those who have migrated with their families.

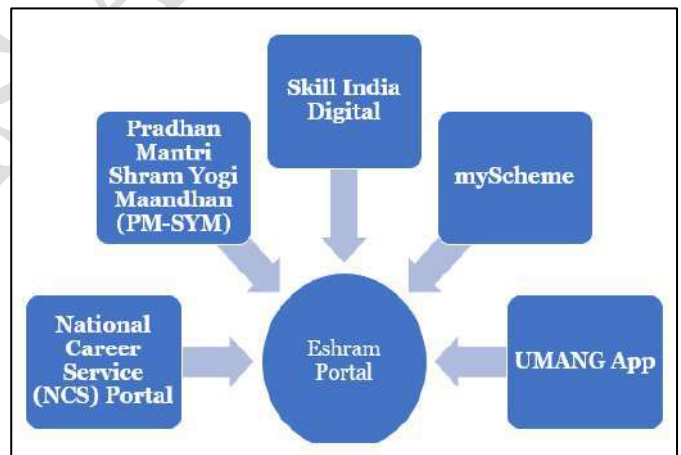


- **Data Sharing Portal (DSP)** – It allows the secure sharing of e-Shram beneficiary data with State and Union Territory governments and Building and Other Construction Workers’ (BOCW) Welfare Boards.



What are key developments with respect to the E-Shram Portal?

- **Integration with Gati Shakti** – To align infrastructure development with workforce planning.
- It enables workers registered on the E-Shram Portal to access job openings linked to Gati Shakti initiatives.
- **International accolades** – The e-Shram portal and its development were well appreciated at the 112th International Labour Conference (ILC).
- **Integration with central schemes** – 12 schemes of different Central Ministries / Departments have already been integrated/ mapped with the e-Shram.
- **Integration with other portals** – To provide one-stop labour services solution and to connect job-seekers with potential employers and skill providers.
- **E-Shram One-Stop-Solution** – It was *launched in 2024* integrate different social security/welfare schemes at e-Shram portal.
- By providing a unified platform for registration, benefits and job opportunities, the portal addresses long-standing gaps in the labor market.
- With over 30 crore workers already registered, the E-Shram Portal is well on its way to transforming the lives of millions and building a stronger, more resilient workforce for the future.



Building and Other Construction Workers’ (BOCW) Welfare Boards

- BOCW Welfare Boards are responsible for providing welfare measures for construction workers.
- These boards are established by state governments under the Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996.
- **The boards’ functions include:**
 - Providing immediate assistance to beneficiaries in the event of an accident
 - Paying pensions

- Sanctioning loans and advances for house construction
- Paying amounts for group insurance premiums
- Providing financial assistance for children's education
- Meeting medical expenses for major ailments
- To be eligible for registration as a beneficiary of the BOCW Welfare Fund, a building worker must meet the following criteria:
 - Should be between the ages of 18 and 60.
 - Have been employed in construction work for at least 90 days in the previous 12 months.

6. HEALTH

6.1 Non-Communicable Diseases

Why in news?

A recent study published stated that the prevalence and morbidity of NCD in India has been increasing in the past decade.

What is non-communicable disease (NCD)?

- Non-communicable disease (NCD) are chronic diseases that are not caused by infectious agents and *doesn't spread from person to person*.
- These diseases are long-lasting, progress slowly and often require prolonged treatment.
- **Global concern** – They are a major cause of death and disability worldwide, accounting for approximately **74% of all deaths globally**.
- It results in **86% premature deaths** (died before reaching 70 years of age) in low- and middle-income countries.
- **Low middle income countries contributes 77%** of all NCD cases.

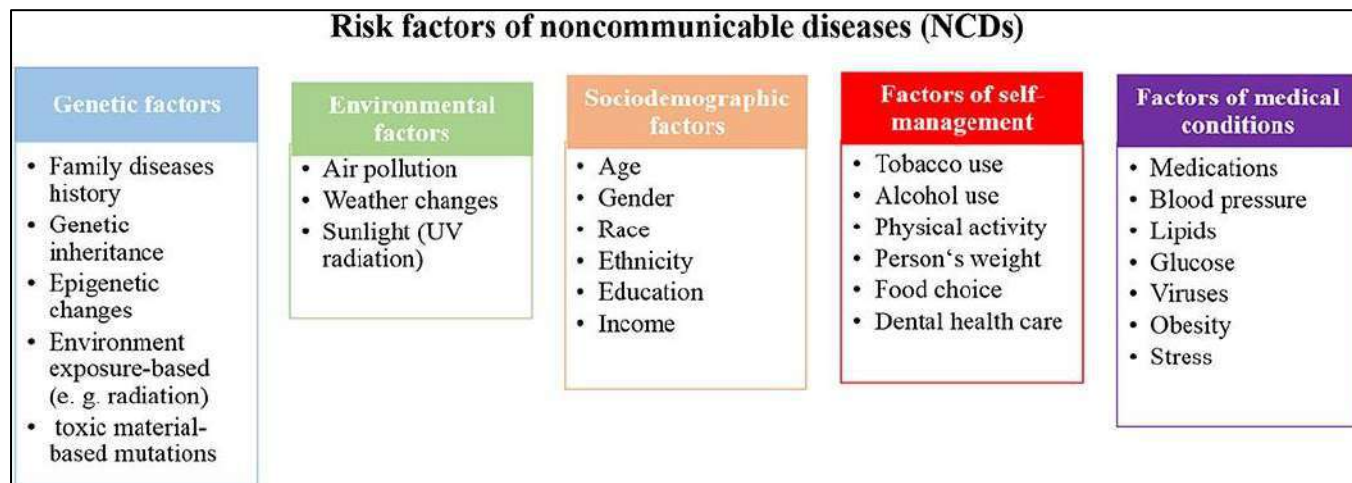
Status of NCDs in India

- NCD prevalence **has tripled since 1995**, with increasing burden in both urban and rural areas
- **Rising Burden** – NCDs account for **over 60%** of deaths in India.
- **Common NCDs** – Hypertension, diabetes and cancer are leading contributors.
- **Premature Deaths** – About 55% of NCD deaths occur **before the age of 70**, disproportionately affecting working-age populations.
- **Regional Disparities** – Higher prevalence in urban areas, but rural regions are increasingly affected.
- Kerala has reported the highest prevalence of non-communicable diseases of 177 per thousand individuals followed by Pondicherry, Andhra Pradesh, Goa, Tamil Nadu and Punjab.
- The north-eastern States have reported the lowest prevalence of non-communicable diseases.
- **According to WHO's report, deaths caused by NCDs in India are:**
 - Cardio vascular – 22.66 lakhs.
 - Chronic respiratory diseases – 11.46 lakhs.
 - Cancer – 9.20 lakhs.
 - Diabetes – 3.49 lakhs.

What are the Risk factors for NCDS?

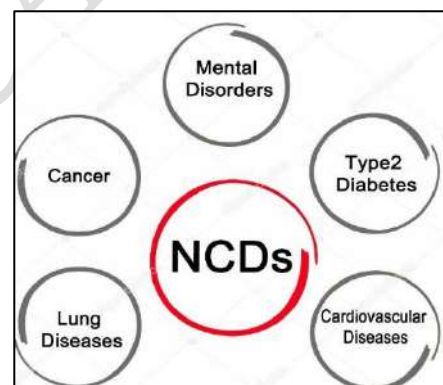
- A risk factor is a condition that increases the possibility of developing a non-communicable disease. The more risk factors one has, the greater the chance of getting a particular disease.
- **Lifestyle choices** – Poor diet, lack of physical activity and tobacco or alcohol use.
- The Lancet Global Health found that nearly 50% Indian adults insufficiently physically active.

- **Genetic factors** – Family history or genetic predisposition to certain diseases.
- **Environmental factors** – Exposure to pollution, unsafe drinking water and workplace hazards.
- **Ageing** – Increased risk due to natural wear and tear of body systems over time.
- **Environmental factors** – Air pollution is the major contributor to NCDs that accounts for 5.7 million deaths globally.



What are the types of non-communicable diseases?

- **Cardiovascular diseases (CVDs)** – Includes heart attacks, strokes and hypertension.
- **Cancer** – Is an uncontrolled cell growth in specific tissues or organs contributing 9.3 million cases annually.
- **Chronic respiratory diseases** – Examples include asthma and chronic obstructive pulmonary disease (COPD).
- **Diabetes (type-2)** – A metabolic disorder resulting in high blood sugar levels.
- **Mental health disorders** – Conditions such as depression and anxiety, increasingly recognized as NCDs.



What are the effects of NCDs?

- **Increased health burden** – Urban communities face a *triple health burden* during health crises due to hazardous work environments, limited healthcare access, and financial vulnerability.
- **Financial instability** – Catastrophic out-of-pocket on healthcare expenditures jeopardize family livelihoods and financial stability.
- Marginalized communities often lack health insurance, compounding financial stress.
- **Impact on Vulnerable Populations** – Informal workers, including sanitation workers, gig workers and migrants are disproportionately affected due to lack of hygiene, nutrition and contract protections.
- Social and economic marginalization of these vulnerable people exacerbates the impact on health outcomes.
- **Generational health impacts** – Limited access to preventive care contributes to worsening health conditions in marginalized families often persist across generations, creating a cycle of vulnerability.
- **Inaccessible health care** – Public health systems, designed to support the lowest 40% of the population, are often inaccessible to urban marginal.
- Growing NCD cases causes overburden on health systems that inturn fail to cater effectively.
- **Widening inequality** – Slum-dwelling populations and other marginalized groups face unequal access to health care highlights systemic issues in urban planning and governance.
- **Economic productivity loss** – Illnesses like diabetes and cardiovascular diseases *reduce workforce efficiency and productivity*.
- Untreated or poorly managed NCDs contribute to absenteeism and long-term incapacity among urban workers.

Government Measures in India

- **National Programme for Prevention and Control of NCDs (NP-NCD)** – Focuses on awareness, prevention, and affordable treatment.
- **Ayushman Bharat** – Provides financial support to following initiatives under the Pradhan Mantri Jan Arogya Yojana (PMJAY).
- Setting up of **State Cancer Institutes (SCI)** and **Tertiary Care Centers (TCCC)** in different parts of the country to strengthen cancer facilities scheme.
- **PM Swasthya Suraksha Yojana** – To setup oncology department in in news AIMS and upgrade the others.
- **Health and Wellness Centers (HWCs)** – To offer screening and management of common NCDs.
- **Tobacco control initiatives** – Campaigns like the National Tobacco Control Programme (NTCP) and increased taxes on tobacco products to curb tobacco product.
- **Fit India Movement** – Promotes physical activity and healthy lifestyles.
- **POSHAN Abhiyaan** – To combat malnutrition and promote healthy eating habits.
- **Integrated Disease Surveillance Programme** – Offers regular health check-ups & digital data collection.
- **Mobile Medical Units (MMUs) & Telemedicine** are implemented with National Health Mission support to improve healthcare access particularly in rural areas.

What are the measures to address NCD?

- **Strengthen primary health care** – Improve access to publicly run primary health care, especially for urban marginalized communities.
- **Leverage technology** – Implement real-time health monitoring using digital tools for conditions like hypertension and diabetes.
- Use screening for population-level evidence and individual awareness.
- **Promote community-based solutions** – Create health awareness and education among public to coordinate and work in communities with ASHA workers.
- Develop community-led NCD surveillance systems for marginalized urban settlements.
- **Engage all stake holders** – Engage employers, municipalities, traffic systems, schools and health systems in dialogue to address interconnected health determinants.
- Create solutions for healthy cities through collaboration with urban local bodies and experts.
- **Improve Primary Health Centers** – In rural areas by increased participation and enhanced accountability for provision of better facilities to the patients in the public health facilities.
- **Address Social Determinants of Health** – Tackle issues related to workplace safety, housing, family connections, and community health infrastructure.
- Recognize that health outcomes are deeply tied to social identities, employment and migration status.
- **Policy-level interventions** – Scale up state-level action plans for better access to primary health care.
- Emphasize preventive measures to avoid catastrophic out-of-pocket (OOP) healthcare expenses.

ASHAs are trained to work as an interface between the community and the public health system.

6.2 Universal Health Coverage for India

Why in News?

Recently Universal Health Coverage (UHC) Day is observed on December 12.

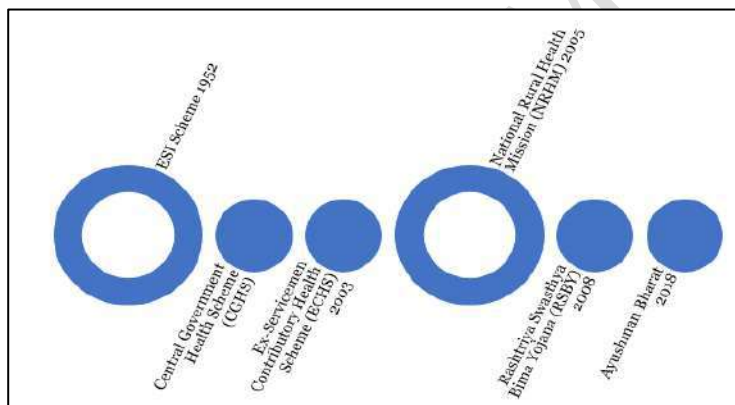
What is universal health coverage?

- **Universal health coverage** – All people have access to the full range of quality health services they need, when and where they need them, without financial hardship.
- **UHC Principle** - UHC is based on the core principles of quality and equality.
- UHC is central to achieving progress on the Sustainable Development Goal (SDG) 3.

- **Dimensions** – Quality, Access to needed health care and financial protection.
- **Quality** - The degree to which health services for individuals and populations increase the likelihood of desired health outcomes.
- **Origin of UHC in India** - William Beveridge presented a report on Social Insurance and Allied Services to the British government in 1942, which became the basis for its National Health Service (NHS) Act of 1946.
- **Chotta Beveridge** - In India, BP Adarkar, who Sardar Vallabhbhai Patel referred to as 'Chhota Beveridge', was appointed in 1943 to develop a plan for industrial workers.
- **ESI Social Security** - Adarkar presented an integrated plan of health, maternity and employment injuries insurance to the Indian government on August 15, 1944, which became the basis for the Employees' State Insurance (ESI) Act of 1948.
 - The ESI Scheme (ESIS) was inaugurated on February 24, 1952.

What is the current status of India in UHC?

- **Insurance coverage** - During 2019-21, only 41% Indian households had a usual member covered by a health insurance / financing scheme, ranging from 1.8% in Andaman & Nicobar Islands to 87.8% in Rajasthan (National Family Health Survey [NFHS] 2019-21).
- **Usage of public health facility** - Half of Indian households do not generally use a government health facility—48% of them due to poor quality of care.
 - It varies from 17% in Mizoram to 62% in Bihar (NFHS).



- **Accessibility issue** - 60% of Indian women had at least one problem in accessing health care when sick (NFHS).
- **Health worker visit** - 32% of Indian women (15-49 years) had contact with a government health worker over the past three months.
 - This figure ranged from 11% in Chandigarh to 54% in Karnataka (NFHS).
- **Health cost** - 49% of the households that sought OPD care and / or hospitalisation faced catastrophic health expenditure (HE) and 15% fell below the poverty line due to out-of-pocket HE.
- HE pushes 32-39 million Indians below the poverty line every year.

What is the need for state specific health coverage plan?

- **Multiple health systems** - Almost every health system type that is seen globally is present in different parts of India.
- **Difference in health expenditure** - Government expenditure (per capita) on healthcare varies significantly from State to State.
- **Difference in health status** – Dominant health issues and health parameters of different states are not same.
- Teenage pregnancy rates in low fertility states like West Bengal, Kerala and Himachal Pradesh, respectively 16% (high), 2.4% and 3.4% (National Family Health Survey-5, 2019-2021).
- **Different health expenditure growth** - West Bengal's government health expenditure has been growing at 11% per annum whereas it is 3% for Andhra Pradesh.
- **Varying trends in non-communicable diseases** - high blood sugar rates and low rates of hypertension is seen in West Bengal, Bihar and Gujarat, suggests high rates of genetically inherited insulin insufficiency.
- In Kerala, Tamil Nadu, and Telangana both conditions are prevalent.
- This necessitates tailored health system strategies and region-specific public health messaging to address the varying trends in non-communicable diseases across different areas.
- Hence, UHC plan for States must be developed considering these very different realities.

Himachal Pradesh, Kerala, and Tamil Nadu spend (per capita) Rs.3,829, Rs.2,590, and Rs.2,039, respectively, while Uttar Pradesh and Bihar spend only Rs.951 and Rs.701, respectively (National Health Accounts – Estimates for India 2019-20).

What are the challenges in universal health coverage?

- **Ineffectiveness of mere expenditure** - Increasing government health expenditure does not appear to be working to contain a key issue relating to the health burden on citizens.
- **High out of pocket expenditure** – It accounted for more than 50% of health spending not just in poor States such as Jharkhand, Bihar, and Uttar Pradesh, but also in comparatively prosperous States such as Kerala and Punjab.
- **Inadequate primary health centres** - The primary healthcare system in the State faces enormous challenges in meeting the healthcare needs of its population due to 58% shortfall.
- **Ineffectiveness of blanket solution** – Diverse health issues cannot be addressed by blanket solutions that are unmindful of the uniqueness of the local area health profile, and its deeper relations to history, culture, and ways of working.

Out-of-pocket health expenditure of India is 39.4% in 2021-22 as per the National Health Accounts Estimates for India 2020-21 and 2021-22.

What lies ahead?

- A holistic approach is essential, integrating public health initiatives, regional policy adaptations, and climate resilience, to build a robust and equitable healthcare system.
- Focus on the reduction of inequalities in our core health outcomes.
- If our economic aspiration is to be the world's third largest economy, our social aspiration should be to be the healthiest country.

6.3 Leprosy Eradication

Why in News?

Recently, Supreme Court has set aside an NGT verdict directing the removal of a centre for leprosy patients running since 1960 in Pune.

What is leprosy?

- **Leprosy** - It is a chronic infectious disease (Hansen's disease) caused by *Mycobacterium leprae*.
- **Infection** - The disease affects the skin, the peripheral nerves, mucosa of the upper respiratory tract, and eyes.
- **Transmission** - The bacteria are transmitted via droplets from the nose and mouth during close and frequent contact with untreated cases.
- **Treatment** - Leprosy is curable with multidrug therapy (MDT) by treating in early stage to prevent disability.
- **Spread** - Leprosy is a neglected tropical disease (NTD) which still occurs in more than 120 countries, with more than 200 000 new cases reported every year.
- The majority of annual new case detections are from South-East Asia.
- **Global elimination status** - Elimination of leprosy as a public health problem globally was achieved in 2000.
- **Status of leprosy in India** -Leprosy, although largely eradicated in many parts of the world, still remains a public health concern in India.
- **India caseload** - India accounts for 52% of the world's new leprosy patients despite being declared "Leprosy Eliminated" in 2005.

Elimination means prevalence of less than 1 per 10 000 population.

What are the challenges in eradicating leprosy?

- **Public perceptions** - The fear surrounding leprosy is compounded by its visible effects, making it harder to overcome.
- **Stigma** - Deep-rooted stigma associated with the disease discourages individuals from seeking treatment.
- **Social isolation** - Misunderstanding of disease leads to social isolation and the denial of basic human rights.
- **Discrimination** - In rural areas many individuals affected by leprosy hesitate to seek medical attention due to the fear of being isolated which contributes to a delay in treatment.
- **Marginalization** - Individuals suffering from leprosy are denied access to basic human rights including education, healthcare and employment.
- **Inadequate capacity** - Limited laboratory services and diagnostic tool.

In 2022-23, more than 1, 00,000 people were detected with leprosy in the country.

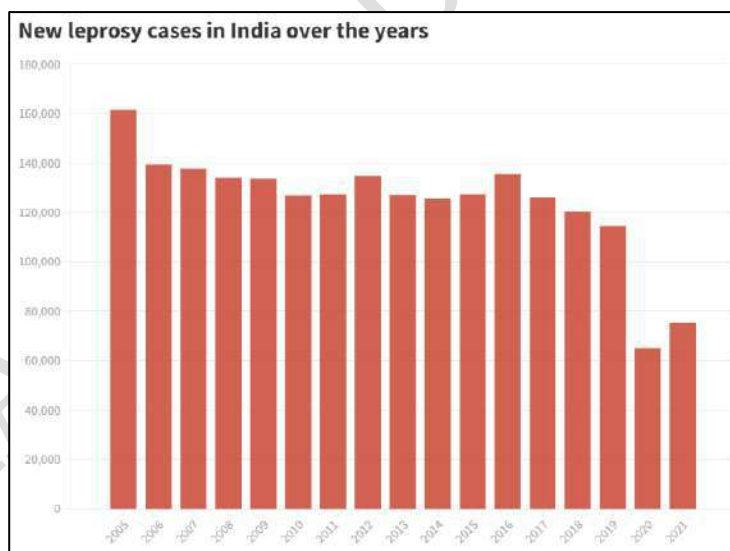
What are the roles of NGOs in combating leprosy?

- **Combating the disease** – Many NGOs like NLR-India provide medicines for free through donations
- **Supporting NLEP** - NGOs support India's National Leprosy Eradication Programme (NLEP) in its implementation.
- **Capacity building** - Training doctors and other healthcare workers for identification, diagnosis, treatment, management and prevention the disease effectively.
- **Offering rehabilitation services** – Programmes such as empowering the youth through vocational training, and healthcare camps.
- **Reintegration** - Ensuring that people affected by leprosy receive the help they need to reintegrate into the society
- **Raising awareness** - Educating the public, working on grassroot campaigns to raise awareness about the curable nature of the disease.
- **Fighting social stigma** – Educating the society about the disease to remove the prejudice about the disease and the patients.

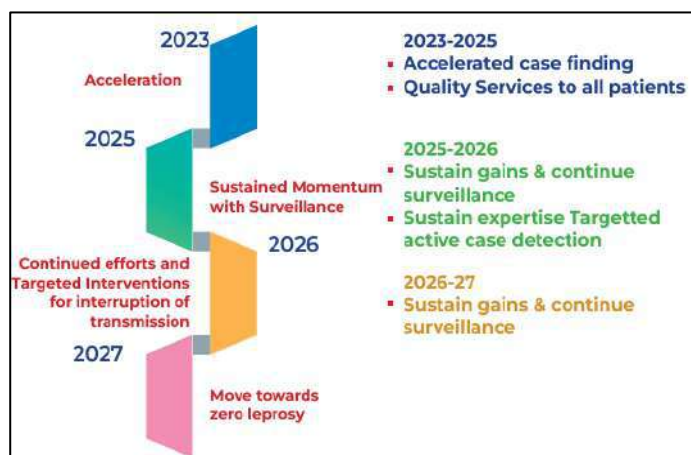
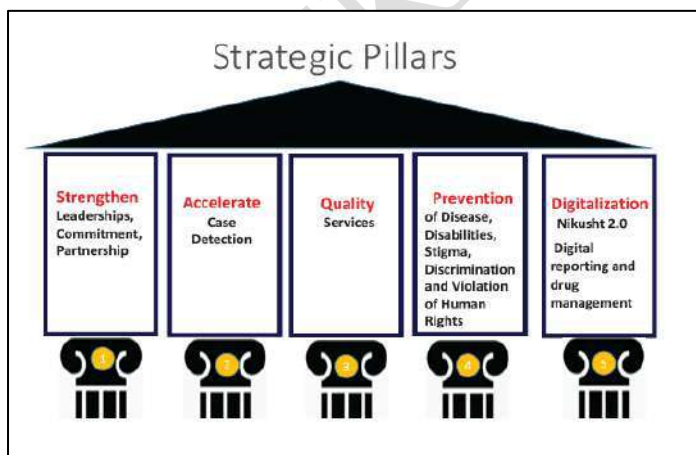
ASHAs play a vital role in identifying cases during home visits and referring them for diagnosis.

What is the progress of India in leprosy elimination?

- **NLEP** - National Leprosy Eradication Programme launched in 1983 to eradicate leprosy by early detection and treatment.
- **Public health concern elimination** - India achieved the milestone of elimination of leprosy as a public health problem at country level in 2005.
- The same is yet to be achieved in a number of states and districts.
- **Decrease in prevalence** - The prevalence rate of leprosy in India has decreased from 57.8 per 10,000 population in 1983 to 0.40 per 10,000 population in 2022.
- **Decrease in new cases** - The number of new leprosy cases detected was dropped from 1, 25,785 in 2014-15 to 75,394 in 2021-22.



- Alongside, the incidence of disabilities due to leprosy has also steadily decreased.
- **Target** - The government in 2023 set a goal to reduce the number of new cases of leprosy by 50% over five years.



- **New treatment regime** - The Central government has approved a [new treatment regimen for leprosy](#), aiming to stop its transmission at the sub-national level by 2027.
- **SPARSH Campaign** - Leprosy prevention awareness campaign is held from Jan 30 to Feb 13 while observing World Leprosy Day on January 30.

- **NSP 2023-27** - National Strategic Plan and Roadmap of Leprosy 2023-2027 (NSP), aims to achieve zero transmission of leprosy in India by 2027

What lies ahead?

- Involvement of the private sector in detecting and reporting cases is very important, as many cases come directly to the private practitioners.
- To interrupt the disease transmission, it is important to understand the disease dynamics, strengthen the host immune response of those who are proven to be more prone in contacting the disease.

7. GOVERNANCE

7.1 India's Policy Transformation in Corporate Governance

Why in News?

India's economic trajectory was defined by two key policy shifts: the planned development of 1951 and the liberalization of 1991, both catalyzing growth through distinct government roles.

What is corporate governance?

- **Corporate**- A business organisation having a separate legal entity, ie an identity distinct from its owners, is called a corporation or a company in India.
- **Section 2(11) of the Companies Act, 2013** defines "body corporate" or "corporation" to include
 - Private Companies
 - Public Companies
 - Personal companies
 - Small companies
 - Limited Liability Partnerships (LLPs)
 - Foreign companies
 - Companies incorporated outside India
- **Corporate governance** - It refers to the system of rules, practices, and processes by which a company is directed and controlled.
- It involves balancing the interests of a company's many stakeholders, such as shareholders, management, customers, suppliers, financiers, government, and the community.



How corporates are governed in India?

- **Legislations**
 - **Companies Act, 2013** - It is the primary legislation governing corporate governance in India.

- It includes provisions related to the composition & functions of the board, appointing auditor, disclosures, & shareholder rights.
- **Securities Contracts (Regulation) Act, 1956-** It governs the listing of securities and enforces regulations for stock exchanges and listed companies, contributing to corporate governance.
- **Regulations - SEBI (Listing Obligations and Disclosure Requirements) Regulations, 2015** apply to listed companies.
- It mandates specific corporate governance norms, including board composition, audit committees, and the role of independent directors.
- **Guidelines - National Guidelines on Responsible Business Conduct (NGRBC)** was issued by the Ministry of Corporate Affairs.
- It encourages businesses to adopt sustainable and ethical practices.



What are the major episodes of policy transformations in India?

1951-1965	• First major transformation
Mid-1960s to Late-1970s	• Low growth episode
Post-1980 & Liberalisation in 1991	• Second major transformation

- **First major transformation** - The launch of the First Five-Year Plan in 1951 marked the beginning of India's planned economic development.
- The emphasis on public-sector development, particularly in heavy industries, with significant private investment was also taking place.
- Despite modest growth, it marked a substantial shift from the pre-Independence annual growth rate of 0.5%, achieving a nine-fold increase.
- **Low growth episode**- It was marked by droughts, a new agricultural policy, and political instability, this period saw relatively low economic growth.
- **Second major transformation** - The 1980s saw the beginning of higher growth, but a significant policy shift from public to private sector investment occurred after the 1991 liberalisation.
- The most profound change post-1991 was the financial liberalisation, including opening banking and mutual funds to the private sector and reforming the share market.
- New capital issues by non-government public limited companies grew significantly, from Rs.600 crore in 1981-82 to Rs.1.5 trillion in 2021-22.
- **Evolution of India's trade patterns**- India's share in world merchandise exports declined from 1.9% in 1951 to 0.4% by 1980 but has since recovered to 1.8%.
- India's share in global trade in commercial services increased from 0.6% in 1990 to 4.3% in 2023.

What are the challenges associated with corporate governance?

- **Conflict of interest**- Directors and management may face conflicts between their personal interests and those of the company, leading to unethical decisions.
- **Lack of independence**- Independent directors may not be truly independent, compromising their ability to provide unbiased oversight.
- **Ineffective board functioning**- Boards may be dominated by a few individuals, reducing their effectiveness in oversight and decision-making.
- **Weak enforcement of regulations**- Although laws are in place, the enforcement of corporate governance regulations can be inconsistent, allowing malpractices to persist.
- **Transparency issues**- Companies may fail to provide adequate and accurate information to stakeholders, undermining trust and accountability.

- **Cultural and ethical deficiencies**- A lack of emphasis on ethical behavior and corporate responsibility can lead to governance failures.

What lies ahead?

- Shift to a neutral, market-friendly relationship to avoid cronyism and ensure fair competition.
- Reform PLI Scheme to foster a more dynamic corporate environment.
- Encourage the shift from family-managed to professionally managed enterprises through stronger competition.
- Raise the competence of the Competition Commission for enhancing private sector management dynamism.
- Regulate monopoly infrastructure to prevent private exploitation.
- Encourage companies to adopt and integrate ethical practices and corporate social responsibility into their business models.
- Utilize technology for better governance practices, such as digital voting platforms for shareholders and automated compliance monitoring systems.

***Political acceptability** comes more readily to a government visibly involved in supporting non-corporate private sector, reducing income inequalities and regional disparities, and addressing caste concerns.*

8. INTERNATIONAL RELATIONS

8.1 Switzerland suspends India's MFN

Why in news?

Recently, Switzerland has announced that it will suspend the most favoured nation (MFN) clause in its double taxation avoidance agreement (DTAA) with India, starting from January 1, 2025.

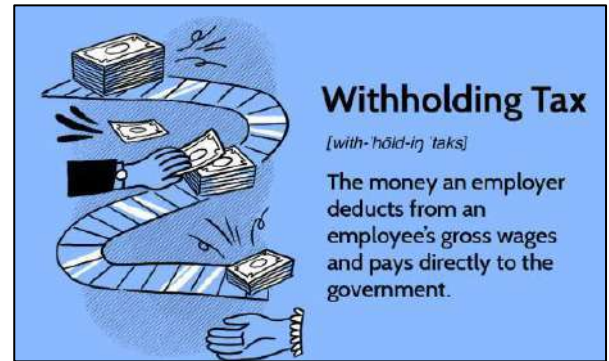
What is Most Favoured Nation (MFN) clause?

- **Most Favoured Nation (MFN)** - The MFN clause is a principle found in international treaties, including tax agreements that ensures equal treatment for all parties involved.
- **Equal treatment** - If one country offers favourable tax rates or conditions to another, it must extend those same benefits to all other countries covered by the treaty.
- **No favour** - This clause is designed to guarantee that no country is treated less favourably than any other in trade or taxation matters.
- **WTO MFN** – MFN is applicable to WTO General Agreement on Tariffs and Trade (GATT), General Agreement on Trade in Services (GATS) (Article 2) and the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS).
- **Exceptions** - Countries can set up a free trade agreement that applies only to goods traded within the group, discriminating against goods from outside.
 - They can give developing countries special access to their markets.
 - A country can raise barriers against products that are considered to be traded unfairly from specific countries.
 - In services, countries are allowed, in limited circumstances, to discriminate.
- But the agreements only permit these exceptions under strict conditions.
- **India Switzerland MFN** - Switzerland had recognized MFN status for India under its DTAA.
- **India Switzerland DTAA** – The Double Tax Avoidance Agreement, between India and Switzerland, was signed in 1995 and amended in December 2011.

What is withholding tax?

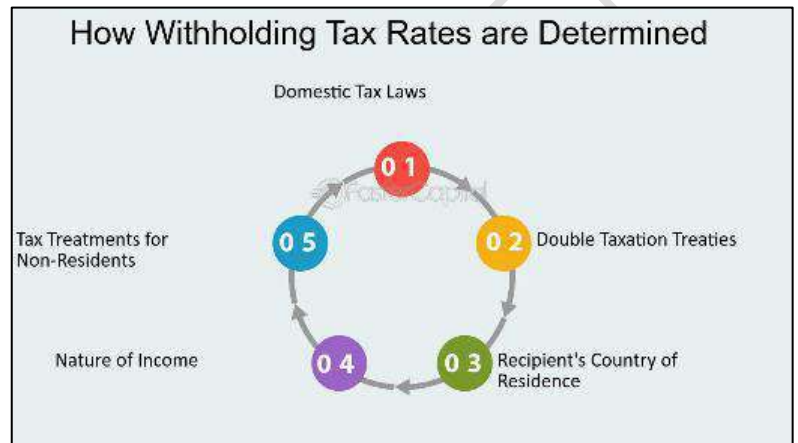
- **Withholding Tax (WHT) or Retention tax** – It is an obligation on the individual (either resident or non-resident) to withhold tax when making payments of a specified nature, such as rent, commission and salary.

- **IT act** - The applicable withholding tax rate is prescribed in the Income Tax Act, 1961 or relevant Double Taxation Avoidance Agreement (DTAA), whichever is lower.
- **Non-resident taxation** - Non-residents are liable to pay taxes in India on source income, including:
 - Interest, royalties, and fees for technical services paid by a resident
 - Salary paid for services rendered in India
 - Income arising from a business connection or property in India.
- **WHT Rate** - A person providing a benefit or a perquisite arising from a business or a profession can withhold tax at 10 % of the value of such benefit.



Why has Switzerland suspended the MFN clause?

- **2023 Nestle case** - Swiss company Nestle had sought a refund of withholding tax paid on dividends, claiming the benefit of the MFN clause under the India-Switzerland tax treaty.
- **OECD provision** - The case involved the application of lower tax rates on dividends from India to countries such as Colombia and Lithuania, which had negotiated new tax terms after joining the OECD.
- Switzerland initially believed that these lower rates should automatically apply to India as well, under the MFN principle.



- **Supreme Court Judgement** – Supreme Court ruled that such automatic adjustments require formal notification under Indian law, not just a blanket application.
- **Switz reaction** - As a result, Switzerland decided to suspend MFN clause under India-Switzerland tax treaty.

What are the impacts of MFN suspension?

- **Higher tax liabilities for Indian companies** - Indian companies receiving dividends from Switzerland will face an increased tax burden, as the withholding tax on those dividends will rise to 10 per cent from 5 per cent.
- **Effects on Swiss investments in India** - Swiss companies that receive dividends from Indian subsidiaries will continue to face a 10% withholding tax as it was always applied under the India-Switzerland DTAA.
- **EFTA investments unaffected** - It is unlikely to impact investments into India from the [European Free Trade Association \(EFTA\)](#), as these investments are already subject to the 10 % withholding tax rate.
- **No change for other DTAA benefits** - Indian companies operating in Switzerland will still be able to avail themselves of the other benefits provided under the India-Switzerland DTAA, such as tax relief on royalties and fees for technical services.
- **Re-evaluation of MFN clauses by other countries** – It could prompt other nations to reconsider how the MFN clause is applied in their own tax treaties with India, especially if similar legal rulings arise elsewhere.

What lies ahead?

- Aligning treaty partners on the interpretation and application of tax treaty clauses to ensure predictability, equity, and stability in international tax framework.
- Proactive negotiations to clarify and harmonise interpretations of treaty provisions are essential to safeguard Indian firms' interests abroad.

8.2 India Jamaica Bilateral Relations

Why in News?

Recently India dispatched 60 tonnes of emergency medical assistance to Jamaica.

What are the pillars of India -Jamaica relationship?

- **Jamaica** – It is one of the Caribbean Island nations in between north and South American continents.
- **India & Jamaica** - Ties are rooted in 4Cs of Culture, Cricket, Commonwealth, and CARICOM.
- **Historical connection** - Jamaica is one of the Girmitya countries where more than 36,000 Indians were brought in the 19th century.
- **Indian diaspora** - 70,000 strong Indian diaspora act as a living bridge between India and Jamaica.



- **Diplomatic relation** – It was established in 1962 and a resident Mission was established in Kingston in 1976.
- **Institutional Mechanisms** - The Foreign Office Consultation (FOC) serves as an important dialogue mechanism between India and Jamaica.

Girmitya are those Indians who went abroad as indentured labourers under an agreement.

- **Agreements/MoUs**
 - The Cultural Agreement, signed in 1996, laid the foundation for cultural exchange.
 - In 2010, MoU for cooperation in Food Research and Technology was signed between the Scientific Research Council of Jamaica and the Council of Scientific and Industrial Research (CSIR) of India.
 - Agreement for Cooperation in Civil Aviation was signed in 2016.
 - In 2021, High Commission of India, Kingston also signed an agreement with the Nature Preservation Foundation (NPF) for establishing an India-Jamaica Friendship Garden at the Hope Botanical Gardens.

Year	India's Exports (US\$ in millions)	India's Imports (US\$ in millions)	Total (US\$ in millions)
2020-21	64.06	2.23	66.29
2021-22	80.60	1.80	82.4
2022-23	87.75	4.99	92.74
2023-24	109.15	7.48	116.63
2024-25 (1 quarter)	20.40	2.80	23.2

From India to Jamaica	From Jamaica to India
Prime Minister Indira Gandhi (1975)	Prime Minister Mr. Edward Seaga (March 1983- to attend the 7th NAM Conference)
Prime Minister Shri Atal Bihari Vajpayee (February 1999-to attend the Ninth G-15 Summit in Montego Bay)	Minister of Foreign Trade Mr. Anthony Hylton (August 2001)
MOS for External Affairs Digvijay Singh (February 2003)	Minister of Industry, Commerce and Technology Dr. Phillip Paulwell (October 2001)
MOS for External Affairs Anand Sharma (February 2007)	Minister of State for Tourism and Culture Mr. Wykeham McNeille (January 2007- to attend the centenary celebrations of Satyagraha)
Minister for Overseas Indian Affairs Vayalar Ravi (June 2013- to participate in the 5th Biennial Diaspora held in Montego Bay, Jamaica)	Minister of Industry, Investment and Commerce Mr. Anthony Hylton (February 2014- to attend the NASSCOM India Leadership Forum)
Minister of State (MOS) for External Affairs General (Dr.) V. K. Singh (February 2015, April 2017)	Minister of Foreign Affairs and Foreign Trade Senator Kamina Johnson Smith (October 2017)
Hon'ble President of India Shri Ram Nath Kovind (15-18 May 2022)	

- **Trade and Investment** - Bilateral trade has experienced significant growth over the past decade, increasing from USD 28.28 million in 2011-12 to 116.73 million in 2023-24.
 - **Main items of exports from India** - Pharmaceutical products, Vehicles other than railway or tramway rolling stock and parts and accessories thereof and seafood.
 - **Main items of import from Jamaica** - Electrical machinery, pulp of wood or of other fibrous cellulosic material etc.

Development Partnership

- A *rural development project* in Kitson Town is being implemented through the FAO with the US\$ 1 million grant announced by PM Modi during the 1st India-CARICOM Summit in New York in 2019.
- In March 2021, a gift of 50,000 doses of 'Made in India' COVID-19 vaccine was made to Jamaica under the 'Vaccine Maitri' initiative of the Indian government.
- India extended a *Line of Credit (LOC)* in 2001 for import of water pumps from India.

Cooperation in Multilateral Organizations

- India and Jamaica cooperate in the multilateral fora with common views and positions on issues such as promoting South-South Cooperation.

Cultural Relations

- Jamaicans strongly relate their colourful festivities to the folkloric traditions and celebrations of India.
- Popular festivals like Holi, Diwali, Onam, Navratri and Garba, Durga puja are celebrated.
- A statue of Mahatma Gandhi depicting the famous "Dandi March" donated by ICCR was installed at the University of West Indies, Mona Campus, and Kingston in July 2012.
- International Yoga Day is celebrated annually in Kingston, Jamaica.
- In December 2021, six participants from Jamaica visited India under ICCR's Distinguished Visitor's Programme titled "Gen-Next Democracy Network" Programme.
- 10th May is celebrated as India Heritage Day in Jamaica.

- **Indian Diaspora** – It is home to approximately 70,000 Indian diaspora, whose ancestors arrived as indentured labourers primarily from Eastern Uttar Pradesh, Bihar, Basti, Deoria, and Gorakhpur between 1845 and 1917.
- **Indian Diaspora Conference** - It is a first of its kind, was organised on 26 March 2023. More than 400 Indian diaspora members participated in the Conference.

What are the recent developments?

- **IRIS participation** - In 2021, Jamaica Prime Minister participated in the launch of Infrastructure for Resilient Island States (IRIS) on the sidelines of COP26 in Glasgow.
- **ISA membership** - Jamaica has signed and ratified the International Solar Alliance (ISA) and is now a full-fledged member.
- **CDRI membership** - Jamaica has also joined the Coalition for Disaster Resilient Infrastructure (CDRI).
- **First Jamaican PM Visit** – Jamaican Prime Minister HE Dr. Andrew Holness visited India in October 2024.
- **Digital Public Infrastructure Cooperation** - Jamaica seeks to replicate India's achievements in using digital infrastructure, during COVID-19, to strengthen its own economy and improve access to services.
- **Digital Payments Partnership** - Egov Jamaica Limited signed an agreement with NPCI International Payments Limited (India) to adopt India's UPI (Unified Payments Interface) technology.
- **Cultural Exchange Programme** - A MoU on the Cultural Exchange Program was signed for the period 2024-2029 to promote cooperation between cultural institutions, strengthening bilateral relations through art, heritage, and education.
- **Sports Cooperation** - A MoU on cooperation in sports was signed to facilitate the exchange of knowledge and expertise in sports development and management.

8.3 China turns to Global South

Why in News?

Recently China's annual Central Economic Work Conference (CEWC) was held on December 11 and 12.

What are observations made by China's central economic work conference observed?

- **CWEC** – It is an annual meeting held in China which sets the national agenda for the economy of China and its financial and banking sectors.
- **Convenors** - It is convened jointly by the Central Committee of the Chinese Communist Party and the State Council of the People's Republic of China.
- **Attendees** - It is attended by all the members of Politburo, China's prime decision-making body headed by President Xi Jinping, ministers, provincial leaders and executives of state-owned financial and industrial giants.
- **Observations**
 - Recognised the seriousness of the persistent slowdown of the Chinese economy.
 - Noted the stagnant domestic demand and worsening external economic headwinds.
 - Reaffirmation of technology-driven "high-quality" growth model.
- **New directions**
 - A more expansive economic stimulus.
 - Changed to moderately loose monetary policy from prudent monetary policy
 - Reducing interest and mortgage rates
 - Lowering bank repo rates
 - Larger issue of long-term treasury bonds
 - Rise in fiscal deficit is being embraced
 - New type of industrialisation, focusing on the digital economy and artificial intelligence-led growth.
 - Ensure balance between the pace and quality of development.
 - Growth target of 5% and continue to contribute 30% of global GDP growth, as in the past several years.

*China has been **very conservative** in its **fiscal policy**, and has strictly followed an informal limit of 3% of gross domestic product (GDP) on fiscal deficits.*

What was China's aspiration towards Global South?

- **BRI** - Belt and Road Initiative BRI is a major contribution by China to the development of the Global South and sought the partnership of international economic organisations in taking it forward.
- **Preferred economic partner** - The Global South is coming into prominence as a preferred economic and commercial partner.
- **Trade and investment** - China is not only looking at the Global South as geopolitical ballast but also increasingly as a trade and investment partner.
- **Technology Transfer** - Open Science International Cooperation Initiative will promote technological advancements that benefit less developed nations.
- **Financial Assistance**: China committed to utilizing \$20 billion in development funds to support projects in developing countries, reinforcing its financial backing for economic growth.

How will it affect India's interest?

- **Increased Competition for Leadership** - China's initiatives to strengthen ties with the Global South present a direct challenge to India's ambitions in the region.
- **Economic Implications** - India's ability to compete economically is hampered by China's BRI.
- **Strategic threat** - China's growing presence in the region can be seen as a strategic threat, especially in areas like the Indian Ocean Region, where China's navy has been increasingly active.
- **Security interest** - China's presence in global south can potentially undermine India's influence and security interests in the region.
- **Resource Access** - China's investments in resource-rich countries in the Global South can limit India's access to essential resources such as minerals, energy, and agricultural products.

- **Regional instability** - China's involvement in regional conflicts and political dynamics in the Global South can affect regional stability.

What can India do?

- Strengthening India's own partnerships and leveraging its historical ties with these nations.
- Advocating for equitable representation in global governance and pushing for south-south cooperation at international forums like the G20.

8.4 India's foreign policy challenges

Why in News?

As the 2024 comes to an end, 2025 looks to be even more uncertain for India's foreign policy.

What were the developments in India's external relations in 2024?

- **Disengagement at LAC** - The most difficult negotiation completed this year was for disengagement at the Line of Actual Control with China.
- **India China Formal meet** - First formal Modi-Xi Jinping meeting in five years was held at Kazan, on the sidelines of the 2024 BRICS summit in Russia.
- **India and France** - French President Emmanuel Macron was the guest on Republic Day and bilateral ties on defence, energy and maritime cooperation were reaffirmed.
- **European FTA** - India-European Free Trade Association signed a Trade and Economic Partnership Agreement (TEPA) in 2024.
- **Pakistan relation**- External Affairs Minister made the first visit in nearly a decade to Islamabad for the SCO summit.
- **Australia** - India and Australia sealed an ambitious renewable energy partnership for cooperation in priority areas such as solar energy, green hydrogen, energy storage.

What are the foreign relation challenges India faced in 2024?

- **Bangladesh turmoil** – The ouster of Sheikh Hasina, former Prime Minister of Bangladesh, is a significant setback for India's security and regional policy.
- **Canada downturn** - Ties with Canada took a turn over the Nijjar killing case as Canadian authorities alleged the involvement of Indian officials in the case.
- **U.S. indictment** - Department of Justice of USA filed indictments against the Adani group and a new indictment against an Indian official for the alleged Pannun assassination plot.
- **Nepal & China** - Nepal has signed a framework agreement with China on the Belt and Road initiative, enhancing Chinese influence in South Asian region.
- **Israel Hamas war** – The escalation of Israel Hamas's conflict tested India's position in the Middle East.

What are the major foreign policy challenges for India in 2025?

- **Neighbourhood engagement** – India has to build relationship with the new governments in Bangladesh, Srilanka and Maldives.
- **China influence** – Increasing Chinese engagement with Bhutan, Nepal and Srilanka.
- **USA relation** – Discussion on Trade tariffs, market access in areas like "agricultural exports from United States to India and differences over Iran policy could also return with the new US government in 2025.
- **UK FTA** - Free Trade Agreement negotiations between India and United Kingdom will be relaunched in 2025.
- **Russia Ukraine Conflict** – Visit by President Vladimir Putin of Russia to India early in the new year will set the stage for a new phase of India's geopolitical balancing act.
- **CECA with Australia** – India and Australia will engage in negotiation on Comprehensive Economic Cooperation Agreement (CECA).
- **West Asian Initiatives** – India's engagement with West Asian countries for multilateral initiatives like IMEC (India-Middle East Europe-Economic Corridor) and I2U2 (India, Israel, UAE and U.S.) in trouble.

G.S PAPER III

9. ECONOMY

9.1 Role of Ethanol Blending in Energy Security and Rural Economy

Why in news?

The ethanol blending programme will revolutionize India's rural economy and strengthen energy security.

What is ethanol blending programme?

- **Ethanol blending programme (EBP)** – It is an initiative of Union Government that aims to increase the proportion of ethanol in petrol.
- The program promotes the blending of ethanol derived from sugarcane, maize and other agricultural feedstock with petrol.
- **Objective** – To reduce the reliance on fossil fuel imports and decrease greenhouse gas emissions.
- **Target** – To achieve 20% ethanol blending petrol by 2025-26.
- This target was previously set for 2030, but it is changed to 2025 in 2022.
- As of 2024, India achieved a 13.8% ethanol blend.
- **Framework for EBP – National Biofuel Policy, 2009** provides framework for implementation of EBP.
- **National Biofuel Policy** – It was *launched in 2009* and is part of India's effort to achieve carbon neutrality by 2070.
- It proposed a non-mandatory target of 20% blending of both biodiesel and bioethanol by 2017.
- The policy is revised in 2018 to achieve 20% bioethanol blending and 5% biodiesel blending by 2030.

About Ethanol

- Ethanol is a Colorless, combustible, and volatile liquid organic substance having the *chemical formula* C_2H_5OH .
- Ethanol is one of the primary biofuels, *naturally produced* through the fermentation of sugars by yeasts or through petrochemical processes like ethylene hydration.
- It is widely used not only as an alternative fuel source but also in various industries as a chemical solvent and in the synthesis of organic compounds.
- Ethanol also has *medical applications* as an antiseptic and disinfectant, adding to its versatile uses.
- Ethanol, as a domestically produced biofuel, more environmentally friendly, sustainable and contributing to a cleaner energy landscape.

To know more about ethanol blending click [here](#)

What is the role of ethanol blending in energy security?

- **Reduces crude oil import** – India is the world's second-largest importer of crude oil, and is highly dependent on foreign sources to meet its energy needs.
- This Programme address this issue by gradually substituting imported petrol with ethanol, a domestically produced biofuel.
- **Reduce in exchequer of Indian forex** – Through increased ethanol blending, India has reduced crude oil imports, saved foreign exchange, and promoted energy self-sufficiency.
- In last decade, through EBP India has saved 1.06 crore rupees in foreign exchange.
- **Reduces external vulnerability** – By achieving self-sustainability in energy needs India will have more stable economic environment and sustainable growth.
- Reduce dependency on global oil markets and shield India from **price volatility** in the global energy sector.
- **Addresses energy demand** – Ethanol full-fills the energy needs of India's growing energy demands, due to expanding population, increasing urbanization, and evolving lifestyles.
- **Sustainable energy** – Ethanol can reduce emissions by 88–108% compared to petrol.
- Around 98% of the fuel used in the road transportation sector comes from fossil fuels, while only 2% is met by biofuels like ethanol.

- India reduced CO₂ emissions by an estimated 544 lakh metric tons by ethanol blending to meet its climate goals.

How ethanol blending can boost the rural economy?

- **Rural industrialization** – The establishment of distilleries and processing plants can lead to **rural industrialization**.
- **Meet local energy needs** – This approach not only bolsters the economy but also enhances energy security by promoting local production of fuels.
- **Increase farmers income** – Government offers *incentives to ethanol producers* which contributes to the *doubling of farmer income* and insulating farmers from traditional market volatility.
- By creating a steady demand for sugarcane, maize, and other feedstock, the program provides farmers with a reliable income source.
- **Waste-to-wealth** – Production of ethanol using agricultural waste and unused resource to reduce environmental impact and promote circular economy.
 - For example, molasses from sugar production and bagasse (a fibrous residue of sugarcane) are used in ethanol and power generation.
- **GOBARdhan** – Encourages the use of bio-waste in energy production.
- GOBARdhan with EBP fuels ethanol blending by promoting other biofuels.
- **Employment creation** – Expansion of ethanol infrastructure has created employment opportunities in rural areas, from production facilities to transportation and distribution networks.
- **Improve rural livelihood** – These economic benefits further strengthen rural livelihoods and promotes sustainable economic development.

Sustainable Aviation Fuel (SATAT)
Promotes compressed biogas production as a cleaner fuel alternative in aviation sector.

What lies ahead?

- Support long-term biofuel growth by advancements in second-generation (2G) & third-generation (3G) biofuels.
- Use of non-food feedstocks like agricultural residues and algae, these technologies reduce competition between food and fuel.
- Address significant concern regarding the balance between food security and energy needs.
- Ensure that ethanol production continues sustainably, without compromising food supply.
- Aim for higher blending goals like E85 and E100, bringing economic prosperity, environmental benefits, and rural rejuvenation.

Quick facts

- **Flex-fuel vehicle (FFV) or E85** – FFV is a car with internal combustion engines that can run on gasoline or a blend of gasoline and ethanol.
- A blend of gasoline is usually has 85% ethanol and 15% gasoline and it can also run on unleaded gasoline.
- FFVs can store both fuels in the same tank.
- Sensors in the FFV system automatically adjust for the fuel composition.

9.2 Balancing Inflation Control and Economic Growth

Why in news?

Recently The Monetary Policy Committee (MPC) has maintained the status quo on the policy rates to stabilize headline inflation.

What is inflation and growth dynamics?

- **Moderate inflation and growth** – In the short term, moderate inflation is often considered a sign of a growing economy.
- In this scenario, inflation is a natural result of *expanding economic activity*, often paired with increased employment and investment.

- **High inflation and economic slowdown** – When inflation rises too high, it can hurt economic growth.
- High inflation erodes the purchasing power of consumers and it leads to low consumption, higher input costs that reduce investments and reduced demand for goods and services.
- **Hyperinflation and recession** – Rapidly rising prices can undermine confidence in the currency, discourage savings, and lead to capital flight, making it difficult for businesses to operate efficiently.
- This usually results in a severe economic contraction or recession.
- **Inflation and investment – High inflation can lead to higher interest rates**, as central banks raise rates to control inflation.
- These increases borrowing costs, which discourages business investment.
- As a result, gross capital formation may decline, further impacting growth.
- **Inflation targeting** – Central banks through inflation targeting aims to create a stable economic environment conducive to sustainable growth.
- However, this balancing act can be challenging, as attempts to curb inflation through tighter monetary policies can slow down economic growth
- **Current scenario** – In India, economic growth has slowed down significantly in the current fiscal year (2024-25), coupled with inflationary pressures.
- **GDP growth in Q2-FY25 dropped to 5.4%**, far below expectations, prompting the Reserve Bank of India (RBI) to lower its full-year growth projection from 7.2% to 6.6%.
- **Unchanged repo rate** – In response to the economic slowdown, the monetary policy committed has **maintained the repo rate at 6.5%** but has lowered the Cash Reserve Ratio (CRR) to inject liquidity into the banking system.

Gross Fixed Capital Formation refers to the growth in the size of fixed capital (investment in infrastructure, factories, machinery, equipment, etc.) in an economy.

To know more about RBI Monetary Policy, click [here](#)

Inflation is the sustained increase in the general price level of goods and services.

Why economic growth slowdowns despite higher inflation?

- **Low government spending** – Fiscal consolidation efforts have limited the government's ability to inject capital into the economy.
- Reduced public spending, especially in rural areas, has slowed infrastructure development and demand generation, which are essential for driving growth
- **Decline in private consumption** – Private consumption, a key driver of GDP, has weakened due to inflation eroding purchasing power.
- Higher prices of essentials like food and fuel have forced households to cut back on discretionary spending, impacting sectors such as retail, automobiles and consumer goods.
- **Elevated food and fuel prices** – The inflation remains elevated due to high food prices, particularly from the unseasonal rise in vegetable prices.
- **Lower agriculture production** – Growth at 3.5% remains inconsistent due to erratic rainfall affecting yields
- This has not only reduced disposable incomes but also limited the effectiveness of fiscal and monetary interventions.
- Rising food prices affecting core inflation.
- **Reducing gross capital formation** – The gross fixed capital formation registered a growth of just 1.3%, the lowest seen in several quarters and this was mainly due to the slowdown in public sector capital formation.
- It is due to cautious investor sentiment and high borrowing costs.
- **Low industrial outputs** – Slowdown in key sectors like manufacturing, mining, and construction reflected in reduced industrial growth output.
- **Global economic pressures** – Factors like elevated crude oil prices, geopolitical uncertainties and tightening financial conditions globally impact India's trade performance.

What are the measures to revive economic growth?

- **Increase in gross fixed capital formation** – Increase the investments in new projects and infrastructure

- **Supply-side interventions** – Addressing supply chain bottlenecks to reduce input costs.
- **Price liberalization** – Removing government price controls on goods and services to allow market forces to determine prices, which can help reduce supply bottlenecks and price distortions.
- **Increase capital expenditure** – Government needs to increase its capital expenditure infrastructure to boost economic activity in manufacturing and mining.
- Increasing the investment rate to 40% of GDP.
- Tax incentives for industries to reduce production costs.
- **Inflation control** – Stabilizing food prices by increasing agricultural production and better irrigation and storage facilities.
- **Structural reforms** – Promote market competition, improving regulatory frameworks, enhancing financial market stability, implementing tax structures that incentivize investment and improve public sector efficiency.
- **Labor market reforms** – Fostering labor-intensive manufacturing to generate employment by reducing rigidities in hiring and firing practices, allowing for better wage adjustments based on economic conditions.

What lies ahead?

- Inflation needs to be balanced with growth revival to bring economic stability & to become a Viksit Bharat.
- Invest in infrastructure, education, and technology to boost productivity and long-term growth.
- Coordinate economic policies with other countries to stabilize the global economy.

Quick facts

- **Monetary Policy Committee** – The Reserve Bank of India Act of 1934 (RBI Act) was replaced by the **Finance Act of 2016** to establish a formal framework for a Monetary Policy Committee (MPC).
- **Role** – The MPC is responsible for determining the key policy rate, known as the repo rate, to maintain inflation within the designated target range.
- The MPC replaced the former Technical Advisory Committee.
- **Structure** – The MPC consists of six members, that includes:
 - RBI Governor (who acts as Chairperson),
 - RBI Deputy Governor responsible for monetary policy,
 - One official appointed by the RBI Board and
 - Three additional members representing the Government of India.
- The external members serve a term of four years.
- A meeting requires a quorum of four members, including the Governor or, in their absence, the Deputy Governor who serves as a member of the MPC.
- Decisions are made based on a majority vote. In the event of a tie, the RBI Governor has the casting vote.
- The MPC's **decisions are binding on the RBI.**

9.3 Rupee Depreciation

Why in news?

The Indian rupee's exchange rate against the US dollar has breached the 85 mark.

What is exchange rate?

- **Exchange rate** - The value of currency relative to another currency and the number of units of one currency that exchanges for a unit of another.
- **Forex market** - A market in which different currencies are bought and sold as various countries have different monetary systems and require different currencies to buy goods, services and financial assets.
- In this market, each currency is treated like a commodity itself.
- **Not a physical place** - Forex market is an electronically linked network of big banks, dealers and foreign exchange brokers who are all the time bringing buyers and sellers together.

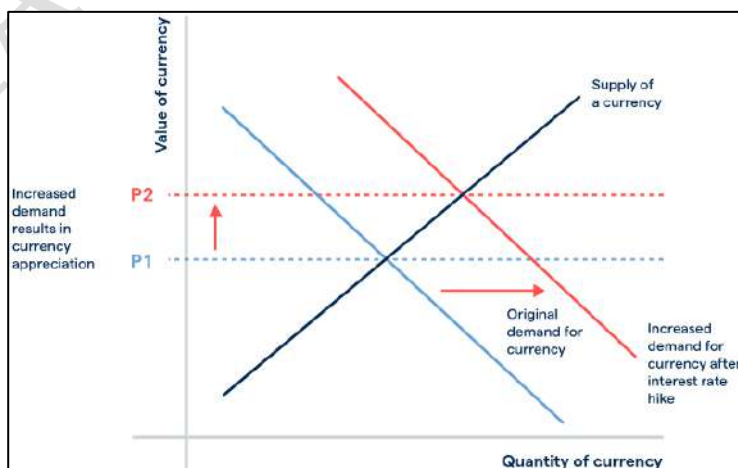
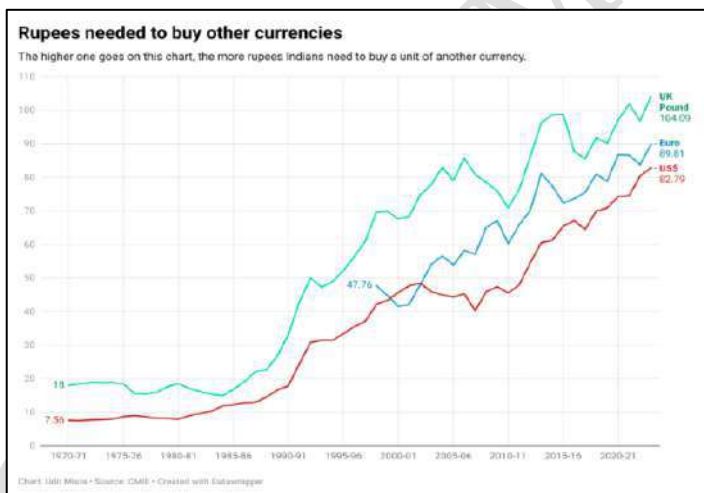
- The biggest FEM centre is London.
- **Appreciation** - A currency appreciates with respect to another when its value rises in terms of the other.
- **Depreciation** - A currency depreciates with respect to another when its value falls in terms of the other.
- **Exchange rate determinant** - The relative value of one currency against another depends on which is demanded more.
 - If Indians demand more US dollar than Americans demand the Indian rupee, the exchange rate will tilt in favour of the US dollar.

Society of Worldwide International Financial Telecommunications (SWIFT) is a satellite-based communications network to facilitate forex market messaging services.

Foreign Exchange Dealers Association of India (FEDAI) was set up in 1958 as an Association of banks dealing in foreign exchange in India (typically called Authorised Dealers - ADs) as a self-regulatory body.

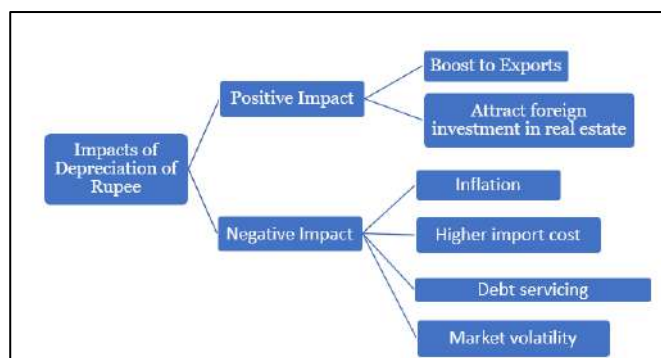
What factors determine the demand for rupee Vis dollar?

- **Trade of goods** - If India imports more goods from the US than what it exports to the US, then the demand for US dollar will outstrip the demand for Indian rupee.
- This, in turn, will make the US dollar gain strength against the rupee and its exchange rate versus the rupee will appreciate.
- **Trade in services** - If Indians buy more US services like tourism than Americans buy Indian services, then again, demand for dollar will outstrip the demand for rupee, and rupee will weaken.
- **Investments** - If Americans invest in India more than Indians invest in the US, then the demand for rupee will outstrip the dollar and rupee will appreciate against the dollar.
- **Global developments** – Conservative trade and protectionist measures of countries also affect trade and consequent currency demand.
- **Interest rate differences** - Higher interest rates tend to attract foreign investment, increasing the demand for and value of the home country's currency.
- **Inflation differences** – Higher inflation affects the real return value of investments made in domestic markets, thus discouraging investments.



What can be done to improve the Rupee value?

- Active intervention by RBI to curb the rupee's depreciation by selling dollars and conducting dollar/rupee swaps.
- Adjusting interest rates to control inflation and stabilize the currency.
- While the RBI's actions may provide short-term relief, it is vital that the government actively consider all measures, both fiscal and monetary, to bolster economic growth and stabilise the currency.
- Creating Policies to attract foreign direct investment (FDI) and portfolio investment.
- Long-term currency stability will depend on structural economic reforms and a return of favourable sentiment in the global markets.



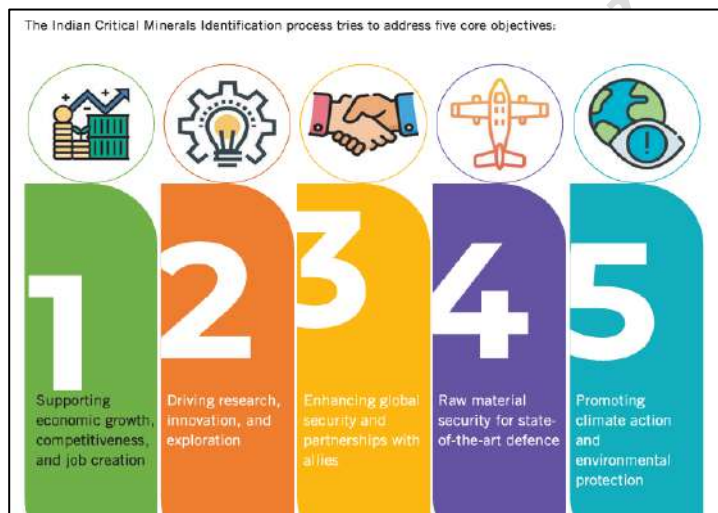
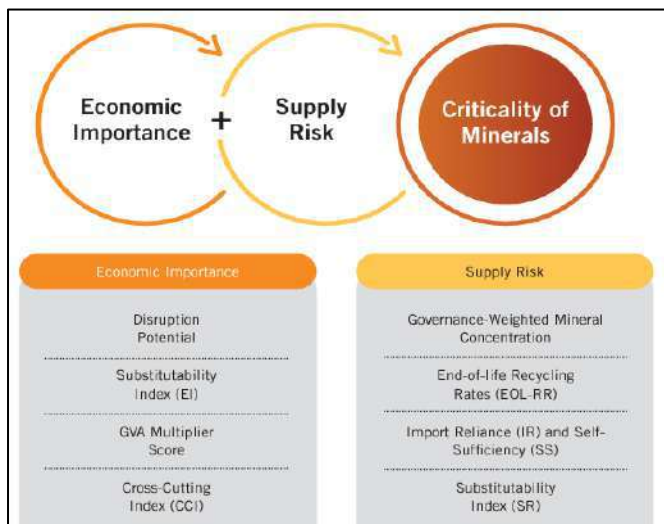
9.4 Critical Minerals Import Dependency of India

Why in News?

India to kick off critical minerals mission to bolster energy transition, EV manufacturing.

What are critical minerals?

- **Critical minerals** – These are both primary and processed minerals which are essential inputs in the production process of an economy, and whose supplies are likely to be disrupted due to the risks of non-availability or unaffordable price spikes.



- **30 Critical minerals** - The Ministry of Mines in 2023 identified 30 critical minerals deemed essential for the nation's economic development and national security.

What is the mineral dominance of China?

- **China's mineral wealth** - The world's largest mining nation, China has discovered 173 types of minerals, including 13 energy minerals, 59 metallic minerals, and 95 non-metallic minerals.
- **China's investment** - Supported by an exploration investment of \$19.4 billion, the reserves of nearly 40% of these minerals, have increased significantly last year.
- **China's mineral value chain** – It has invested strategically in mineral value chain production.
- China has dominance in processing and refining, with control over 87% of rare earth processing, 58% of lithium refining, & 68% of silicon processing.
- **Global investments** - China has strategically invested in overseas mining projects and built unparalleled midstream refining capabilities.
- **Weaponisation of critical mineral exports** - Beijing primarily targets minerals deemed critical by Western nations and their allies, especially those essential for semiconductors, batteries, and high-tech manufacturing.

Mineral	Usage	China's Dominance
Bismuth	Primarily used in pharmaceuticals & chemicals	80% of global refinery production
Lithium	Crucial for EV batteries and energy storage	58% of global refining
Tellurium	Important for solar power and thermoelectric devices	60% global production
graphite	Indispensable for EV batteries and steel production	Controls 67.2% of global output

Why does India rely on imports?

- **India's import dependence** – India is acutely vulnerable to Chinese supplies, particularly for six critical minerals where dependency exceeds 40 %.

Minerals	Bismuth	Lithium	Silicon	Titanium	Tellurium	Graphite
Import dependency on China	85.6%	82%	76%	50.6%	48.8%	42.4%

Sl. No.	Critical Mineral	Percentage (2020)	Major Import Sources (2020)
1.	Lithium	100%	Chile, Russia, China, Ireland, Belgium
2.	Cobalt	100%	China, Belgium, Netherlands, US, Japan
3.	Nickel	100%	Sweden, China, Indonesia, Japan, Philippines
4.	Vanadium	100%	Kuwait, Germany, South Africa, Brazil, Thailand
5.	Niobium	100%	Brazil, Australia, Canada, South Africa, Indonesia
6.	Germanium	100%	China, South Africa, Australia, France, US
7.	Rhenium	100%	Russia, UK, Netherlands, South Africa, China
8.	Beryllium	100%	Russia, UK, Netherlands, South Africa, China
9.	Tantalum	100%	Australia, Indonesia, South Africa, Malaysia, US
10.	Strontium	100%	China, US, Russia, Estonia, Slovenia
11.	Zirconium(zircon)	80%	Australia, Indonesia, South Africa, Malaysia, US
12.	Graphite(natural)	60%	China, Madagascar, Mozambique, Vietnam, Tanzania
13.	Manganese	50%	South Africa, Gabon, Australia, Brazil, China
14.	Chromium	2.5%	South Africa, Mozambique, Oman, Switzerland, Turkey
15.	Silicon	<1%	China, Malaysia, Norway, Bhutan, Netherlands

- **Inaccessible reserves** - Many critical minerals are deep-seated, requiring high-risk investments in exploration and mining technologies.
- **Structural challenges** – India lacks adequate institutional mechanisms and infrastructures capacity to extract critical minerals.
- **Lack of technological capacity** – Despite the presence of 5.9 million tonnes of lithium deposits in Jammu and Kashmir, India lacks the technological capability to extract lithium from such geological formations.
- **Lack of private sector participation** – High-risk investments in exploration, absence of adequate incentives and policy support has deterred private sector participation.

What measures has India taken to reduce the dependency?

- India has initiated a multi-pronged approach to reduce its dependency on China.
- **Establishment of KABIL** – It is a joint venture of three State-owned companies, to ensure supply side assurance of critical & strategic minerals and mineral security of the nation.
- **Strategic partnerships** - India has joined [Minerals Security Partnership](#) and the Critical Raw Materials Club to diversify its supply sources and strengthen partnerships.
- **National Critical Minerals Mission** – It was launched as part of Budget 2024-25, aimed at reinforcing India’s Critical Mineral value chain across all stages – from exploration and mining to processing, and recovery from end-of-life products.
- **Research investment** – India is investing in research through institutions like the Geological Survey of India and the Council for Scientific and Industrial Research.
- **Mineral recycling** - India has been promoting recycling and circular economy practices to reduce virgin mineral dependency.

Khanij Bidesh India Limited (KABIL), is a Joint Venture of National Aluminium Company Ltd. (NALCO), Hindustan Copper Limited (HCL) & Mineral Exploration & Consultancy Limited (MECL).

- **PLI Incentives** - Mines Ministry has proposed production linked incentive (PLI) scheme to encourage e-waste recycling, incentivize the production of recycled critical minerals and promote investments in advanced recycling technologies.

What India can do?

- Transitioning away from China will require sustained investment and long-term commitment.
- Financial and administrative support to accelerate the development of critical mineral mining, processing, manufacturing, and recycling may be provided by the Central Government.
- A national critical minerals strategy for India, underpinned by the minerals identified in this study, can help focus on priority concerns in supply risks, domestic policy regimes, and sustainability.
- There is a need for establishing a National Institute or Centre of Excellence on critical minerals.

9.5 Lighthouse Tourism

Why in News?

GOI is fostering lighthouse tourism as part of its Maritime India Vision (MIV) 2030 and Amrit Kaal vision 2047.

What is light house tourism?

- **Lighthouse tourism** – It involves transforming lighthouses and their surrounding areas into vibrant tourist attractions.
- **Light houses** - These structures, often located in scenic coastal or island settings, offer visitors a unique combination of natural beauty, maritime history, and recreational opportunities.
- Lighthouse tourism exemplifies the harmonious blend of heritage conservation and modern tourism development.
- **Aim** - To preserve the historical and architectural significance of lighthouses and unlock their potential for economic growth and community empowerment.
- **Benefit** - By developing these sites, the government seeks to enhance India's tourism offerings while creating employment opportunities and fostering local economic growth.
- **Lighthouse tourism potential of India:**
- **Over 9 lakh tourists visited lighthouses in the first half of the current fiscal.**
- **Geographical extension** - India has an extensive coastline of over 7,500 km and is home to 204 lighthouses that preserve its maritime legacy.
- **Cultural importance** - Some lighthouses date back centuries and are near UNESCO World Heritage Sites like Mahabalipuram in Tamil Nadu or other prominent cultural landmarks.
- **Adventure and leisure** - These sites can host activities such as trekking, boating, and water sports, appealing to adventure seekers.
- **Economic impact** - Developing lighthouse tourism can generate hospitality, transportation, and handicraft employment while boosting local economies.
- Recognising this potential, the government has identified lighthouse tourism as a priority area for development.

Lighthouse at Mahabalipuram was built around 640 CE by the Pallava king Mahendravarman I.

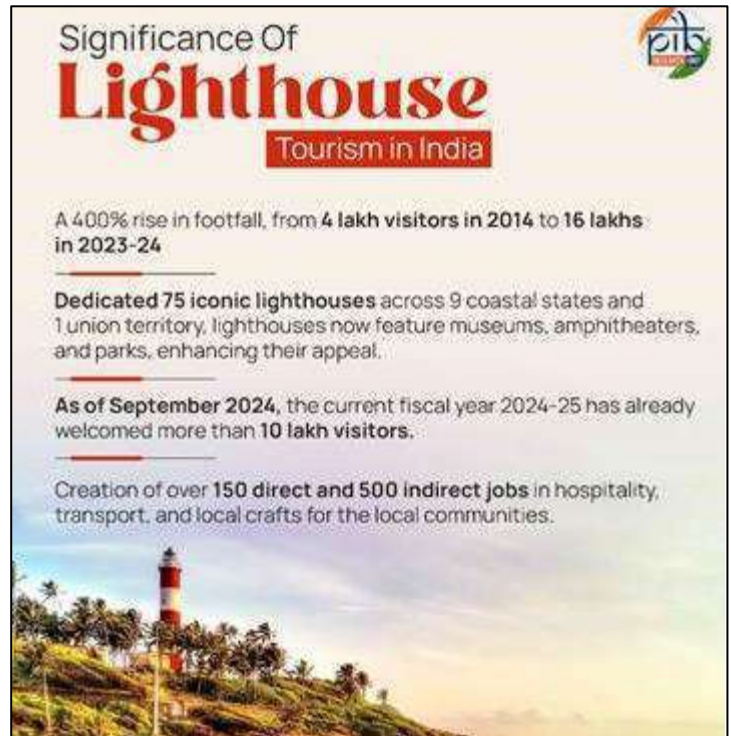
What are the steps taken to boost lighthouse tourism?

- **Present status** - In February 2024, PM dedicated 75 Lighthouses with tourist facilities in 10 states & UTs.
- **Promotion** - The Central Government is actively promoting lighthouse tourism as a part of its broader [Maritime India Vision](#) (MIV) 2030 and Amrit Kaal vision 2047.
- **Indian Lighthouse Festival Series** - It has been held annually since then, serving as a key platform to celebrate and promote lighthouse tourism.
- **Stakeholders Meet** - Union Minister of Ports, Shipping & Waterways chaired a Stakeholders Meeting to boost Lighthouse Tourism in Kerala in July 2024.

MIV 2030 aims to position India as a leader in the Global Maritime Sector and includes more than 150 initiatives within 10 themes to address national maritime goals.

The 2nd Indian Lighthouse Festival was held in Odisha in 2024.

- **Sagarmala programme** - It focuses on fostering partnerships with private stakeholders and integrated development to drive India's maritime and economic progress.
- **Standardization** - Directorate General of Lighthouses and Lightships (DGLL) actively collaborates with private players to ensure these projects meet international standards.
- **National framework** - The government plans to establish a national framework to empower the coastal communities and ensure sustainable development around lighthouses.
- **Integration with Coastal Circuits** - Lighthouses are incorporated into broader coastal tourism itineraries to enhance their appeal.
- **Awareness Campaigns** - Digital initiatives are being launched to showcase lighthouse destinations to domestic & international audiences.
- **Skill Development** - Training programs are being introduced to equip local communities with skills required for employment in hospitality and tourism-related sectors.



Significance Of Lighthouse Tourism in India

A 400% rise in footfall, from 4 lakh visitors in 2014 to 16 lakhs in 2023-24

Dedicated 75 iconic lighthouses across 9 coastal states and 1 union territory, lighthouses now feature museums, amphitheatres, and parks, enhancing their appeal.

As of September 2024, the current fiscal year 2024-25 has already welcomed more than 10 lakh visitors.

Creation of over 150 direct and 500 indirect jobs in hospitality, transport, and local crafts for the local communities.

What lies ahead?

- Emphasis on eco-friendly practices to protect fragile coastal ecosystems while promoting responsible tourism.
- Increase the accessibility to light houses through better transport connectivity.
- Increase the safety features in and around light houses to ensure safe light house tourism.

10. AGRICULTURE

10.1 Natural Farming Vs Organic Farming

Why in news?

National Mission on Natural Farming (NMNF) was launched recently with an outlay of Rs 2,481 crore by subsuming all previous schemes to promote natural farming.

What is National Mission on Natural Farming?

- **National Mission on Natural Farming (NMNF)** – The scheme aims to bring around one crore farmers under natural farming and is targeted to cover around 0.75 million hectares of land over the next few years.
- **Subsumed schemes are:**
 - Bhartiya Prakritik Krishi Paddhati - Bhartiya Prakritik Krishi Paddhati (BPKP) was launched in 2019-20 to promote natural farming.
 - Natural Farming Corridor - The Natural Farming Corridor is a program in India to promote natural farming practices along the Ganges River.
- **Natural farming** – It works on the broad principle that the soil itself contains all the nutrients essential for plant growth.
- **Zero budget** – It needs no external inputs; nutrient recycling and the entire process is treated as an *agroecology* based diversified farming system.
- Natural farming is a more *Indianised version of agriculture*, while organic is seen as a European concept.
- According to this technique, plants obtain *98-98.5% of nutrition from air, water, and sun, and the remaining 1.5% from the soil.*

- **Components of natural farming** – The components which create a suitable micro-climate for maximum beneficial microbial activity in soil are:
- **Beejamrutham** – Microbial coating of seeds using cow dung and urine-based formulations.
- **Jeevamrutham** – The application of a mixture made with cow dung, cow urine, jaggery, pulse flour, water and soil to multiply soil microbes.
- **Mulching** – For soil humus formation and to prevent water evaporation.
- **Waaphasa** – For soil aeration through a favorable microclimate
- **Insect and pest management** – Use of mixture made from cow dung, cow urine and green chilies called 'kashyams'.
- **Best practice in India** – Community Managed Natural Farming is a initiative by Andhra Pradesh government's has won the 2024 Gulbenkian Prize for Humanity, for contributing to global food security, climate resilience and ecosystem protection.
- Andhra Pradesh Community-managed natural farming started in 2016, to promote natural farming by local communities, notably by women's microcredit groups
- Supported by FAO and the French Agricultural Research Centre for International Development (CIRAD).

	Natural Farming	Organic Farming
Concept	Advocates minimal human intervention, relying on the concept of " <u>do-nothing farming</u> " by Masanobu Fukuoka.	Uses organic inputs like compost, manure and bio-fertilizers but still involves planned human intervention for pest control and soil management.
Use of Fertilizers	Uses only natural resources like Jeevamrutha (fermented microbial culture) and mulch to enhance soil fertility.	Permits the use of organic fertilizers such as vermicomposting and green manure, but disallows chemical fertilizers.
Pesticides	Focuses on creating an ecosystem where natural predators manage pests and may use simple natural mixtures like neem oil.	<u>Organic fields have higher levels of pests than conventional fields</u> which needs the use of organic pesticides and bio-pesticides for pest control.
Soil Health	Relies on soil microbes and organic matter to naturally replenish the soil without disturbing the soil structure.	Enriches the soil through organic amendments like compost, often requiring tillage.
Cost	Low-cost , as it avoids external inputs like compost and relies on farm-derived materials.	Relatively expensive due to the need for purchased organic inputs, machinery, maintenance and certification.
Crop Yield	Yields may be lower initially , but proponents argue they stabilize and sustainable over time.	Yields are generally better than natural farming but still lower than conventional farming.
Sustainability	Focused on preserving biodiversity and natural ecosystems for long-term benefits.	Sustainable, but may not fully eliminate environment impact <u>due to tillage & resource use</u> .
Water Usage	Promotes practices like mulching and cover cropping to retain soil moisture, reducing the need for irrigation.	May require more irrigation as organic fertilizers and tillage can increase water demand.
Biodiversity	Focuses on enhancing biodiversity by encouraging the <u>growth of multiple crops</u> , weeds, beneficial organisms in the same field.	Promotes biodiversity to limited extent as it involves <u>monocropping</u> with crop rotation.
Economic	Emphasizes self-reliance and reducing farmer dependency on markets and external agencies	Involves creating a premium market for organic produce, which can benefit farmers financially if properly marketed.

Why India is promoting natural farming over organic farming?

- **Lower input costs** – Natural farming eliminates the need to purchase organic fertilizers, pesticides or external inputs, significantly reducing farming expenses.
- **Improved soil health** – By avoiding tillage and external inputs, natural farming preserves soil structure and enhances microbial activity, leading to long-term soil fertility.
- **Water conservation** – Practices like mulching and using cover crops in natural farming help retain soil moisture, reducing water usage compared to organic farming.
- **Low energy consumption** – Without the need for compost preparation, machinery for tillage or certification processes, natural farming uses less energy.
- **Reduced market dependency** – Farmers practicing natural farming can produce all necessary inputs on-site, avoiding reliance on purchased organic products or fertilizers.
- **Climate resilience** – It is better equipped to withstand climate variability and extremes.
- **Accessibility for small farmers** – It is more affordable and feasible for small and marginal farmers who cannot afford the premium inputs required in organic farming.
- **Boost farmer incomes** – It has been found that it boosts incomes, from other forms of farming and allied activities such as beekeeping in the same field, multi-crop farming and so on.
- **Soil productivity** – It promotes soil health by reducing chemical applications and is better able to retain moisture and resist erosion, essential qualities in the context of climate adaptation.
- **Reduce agricultural carbon footprints** – By reducing greenhouse gas emissions, thus contributing to India's climate goals under the Paris Agreement.

*Sikkim is now the world's **first 100% organic state** and it won the prestigious Future Policy Gold Award from the UN Food and Agriculture (FAO), after beating 51 nominations from around the world.*

What lies ahead?

- Government needs to support farmers in transition period until the yield becomes equal to yield from chemical-based farming.
- Large-scale and long-term assessment of the natural farming method prior to recommending it for wider adoption.
- Promoting awareness among farmers to make more farmers adapt to natural farming.

11. ENVIRONMENT

11.1 Green Glass Ceiling

Why in news?

The recent analysis of IMF revealed that Women are being left out of jobs in sustainable sectors despite growing employment opportunities in these green sectors

What is green glass ceiling?

- **Green glass ceiling** – It is a hidden barrier where women are disproportionately left behind from green jobs in sectors like renewable energy and waste management, forcing them to remain in more polluting sectors.
- **Gender gap** – This results in gender disparity in green job as men dominate this sector, holding about 2/3rd of green jobs, while women occupy only 1/3rd.
- **Status of green jobs across world:**
 - **Advanced Economies (AE)** – In AEs, green jobs account for 20% of men's employment but only 6% of women's employment.
 - **Emerging Market and Developing Economies (EMDE)** – EMDEs, where 16% of men's jobs are green compared to just 4.6% for women.

***Green jobs** are the jobs that contribute to environmental preservation or restoration. It plays a vital role in reducing greenhouse gas emissions and improve environmental sustainability.*

- **Low-income countries (LIC)** – More evenly distributed between genders.
- **Reason for gender gap** - Lower number of women graduating in fields of science, technology, engineering and mathematics (STEM) as this stream are critical for accessing many green jobs.
 - In countries like Brazil, Colombia and South Africa, **the gender gap in STEM education and managerial positions** accounts for a large share of the **green employment gender gap**.

Polluting jobs

- Polluting job refers to the jobs in sectors such as **manufacturing, fossil fuel extraction and heavy industry**, which are major contributors to greenhouse gas emissions and they **remain concentrated in lower-skilled, middle-income segments**.
- More women are exposed to the environmental and health hazards associated in the polluting industries, particularly in LICs where **10.7% of women** are employed in these sectors compared to 8.6% of men.

What is the Role of Gender Equality in Sustainable Energy?

- **Reducing Gender gap** – As more gender-diverse workforce and leadership do better on risk management, innovation and problem-solving in combatting the climate crisis.
- **Faster transitions to greener economy** – By achieving gender equality and equal share of women in board membership were more likely to **reduce energy consumption, GHG emissions, and water use**.
 - CO₂ emissions can be reduced by 5% more than those with more men in management.
- **Harnessing green jobs** – As the demand for green talent is currently outstripping supply, with green job postings growing 8% per year since 2015, compared to just 6% growth in green talent.
 - Push towards green jobs may benefit the higher-earning segments of the workforce, middle- and lower-income workers many of whom are women remain trapped in traditional, polluting sectors.

What is green premium?

- **Green premium** – It refers to the **higher wages associated with green jobs**, which are roles that contribute to environmental sustainability, such as in renewable energy, conservation, and sustainable agriculture.
- **IMF analysis** – Shows that these **green jobs tend to pay more than traditional jobs**, reflecting a growing **demand for workers with specific skills** needed in the green economy.
 - The analysis highlights that both men and women benefit from this wage premium, but women enjoy a larger premium—12% compared to 7% for men.
- **Matching demand** – This could indicate that women may be entering sectors or roles within the green economy that are particularly high in demand or that their skills are especially valued in these contexts.
 - Overall, this trend underscores the potential for green jobs not only to contribute to environmental goals but also to promote wage equity among genders in the labor market.

SDG Goal 5 - Achieve gender equality and empower all women and girls.

What lies ahead?

- Standardizing the hiring processes to improve unconscious discrimination in recruitment.
- Enhancing STEM education for women.
- Upskilling and reskilling women can be a win-win solution.
- Investments in women's skills development and supporting their green employment will prove critical to empower women and to deliver just, ambitious, and low-carbon transitions.
- Better policy measure to reduce the gender gap in green jobs.

11.2 People in a Changing Climate

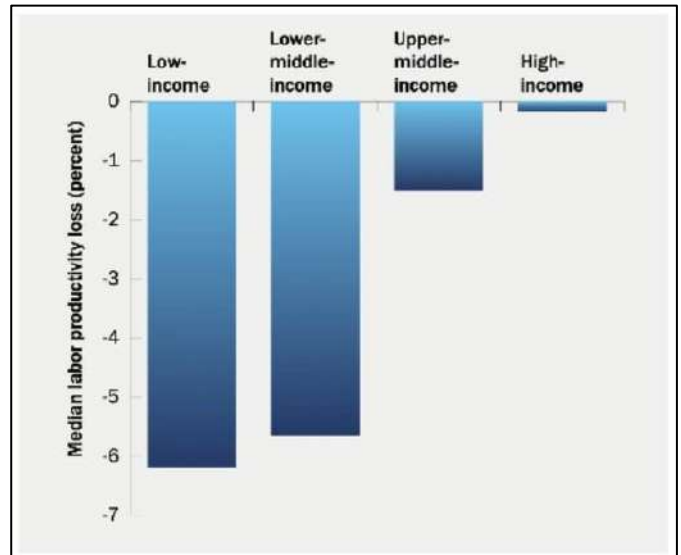
Why in News?

The World Bank Group's report "People in a Changing Climate" was launched at the COP29 in November 2024.

What is the Country Climate and Development Reports (CCDRs)?

- **CCDR** - Country Climate and Development Reports was launched in 2022 by World Bank.

- **Objective** - To guide countries in aligning developmental processes with climate action.
- They help countries prioritize the most impactful actions that can reduce greenhouse gas (GHG) emissions and boost adaptation and resilience, while delivering on broader development goals.
- **Coverage** - It covers 72 low-, middle- and high-income countries and economies.
- **Stakeholders** - CCDRs unite stakeholders, including governments, private sectors and citizens, to advance climate and development goals.
- **Final Report** - Based on the CCDRs of 72 countries, World Bank prepares a consolidated report.
 - The report for 2024 is **“People in a Changing Climate”**.



What are the observations of the report?

- **Resilience and adaptation** - Ending poverty on a livable planet requires all countries to enhance the resilience and adaptation of their people and economies to the impacts of climate change.
- **People centric** - People are at the center of climate change risks, but also at the core of adaptation and mitigation solutions.
- **Disproportionate impact** - Poorer countries are more vulnerable than richer ones, are exposed to different threats, and have lower adaptation potential.
- **Productivity loss** - Significant labour productivity losses happen due to rising temperatures.
- **Inadequate investment** - There is a high need for investment in the water sector, but current investments are much lower than what is required.
- **Effect of investment in water sector** - An investment of \$1.8 trillion in the water sector would result in estimated benefits worth \$7.1 trillion between 2020 and 2030.
- **PPP investment** - Bridging the \$960 billion annual investment gap requires public-private partnerships, especially in low-income nations.

Each additional \$1,000 in GDP per capita reduces expected **climate change-induced GDP losses** in 2050 by 0.5–0.7 % points.

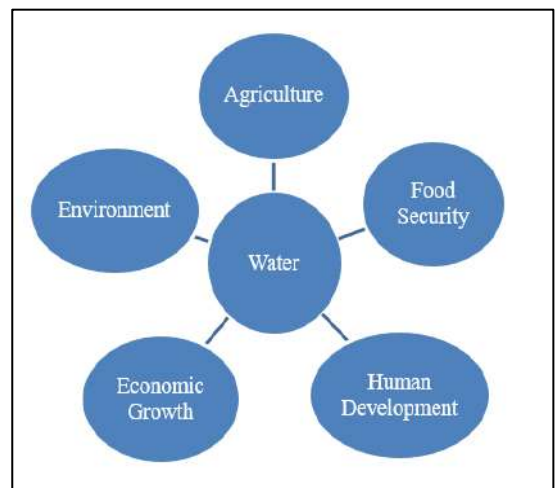
In most of the **CCDR** countries, the investment in water sector was found to be only **0.5 % of their GDPs**.

What are the significances of water in addressing climate change?

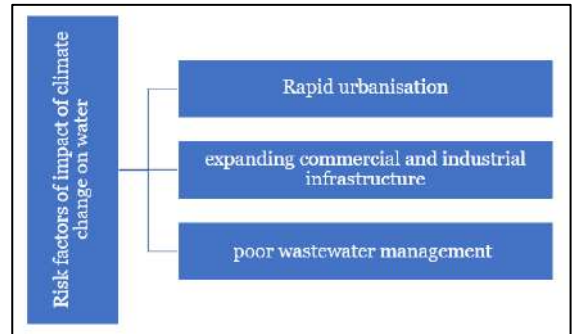
- **Climate change and water** - Climate change affects the availability of water and leads to extreme events such as droughts and floods.
- **Impact of drought** - During droughts, agriculture, energy production, food security is impacted.
 - These lead to migration and malnutrition, especially in low-income countries.
- **Impact of flood** - Flood situations lead to loss of lives, water-borne diseases, displacement of people and infrastructural damage.
- **Impact on economy** - Both of these situations deal a blow to the economy of affected countries, with a disproportionate impact on vulnerable groups.

What are the impacts across the globe?

- **Malawi** - Drought will lead the people to fall below poverty line by 14 %.
- **Ghana** - It would lose its hydropower generation capacity by 8-30 % by 2040.
- **Armenia** - It will face decline in rainfed crop yields by 2050.

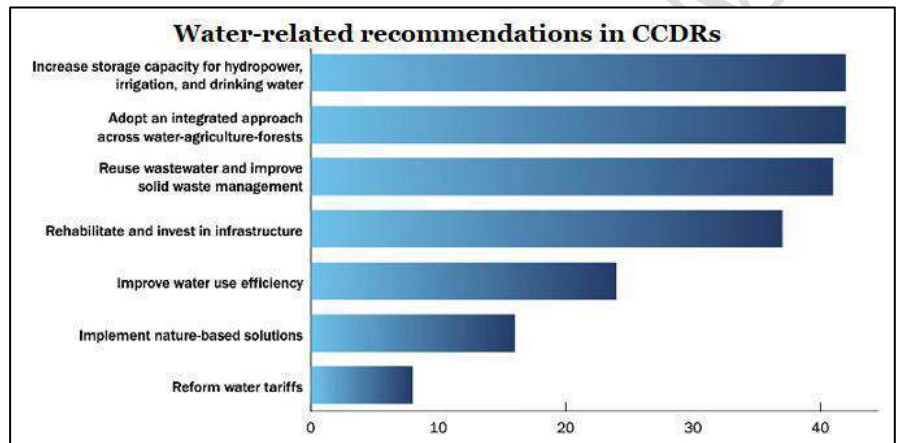


- **Argentina** – It would incur losses of \$2.1 billion (0.6 % of GDP) due to decline in agricultural production.
- **South Africa and Lebanon** – They would record a drop in agricultural production and farming jobs.
- **Uzbekistan and Zimbabwe** - Water borne diseases will become more common by 2040 and 2050 respectively.



What are the recommendations of the report?

- Enact policies focused on people, resilient infrastructure and macroeconomic strategies to reduce vulnerabilities.
- Foster green value chains, and support sustainable transitions with global collaboration.
- Create country-specific solutions for boosting water resources management and building climate resilience.
- Increase investment water resources management and bringing in reforms in institutional regulatory sectors.
- Invest in social intervention to protect the vulnerable.
- Demand-side management of water for sustainability and risk mitigation.
- Improve water security through wastewater management and promoting circularity
- Invest and focus on performance monitoring systems in wastewater treatment plants.



11.3 Animal welfare framework in India

Why in News?

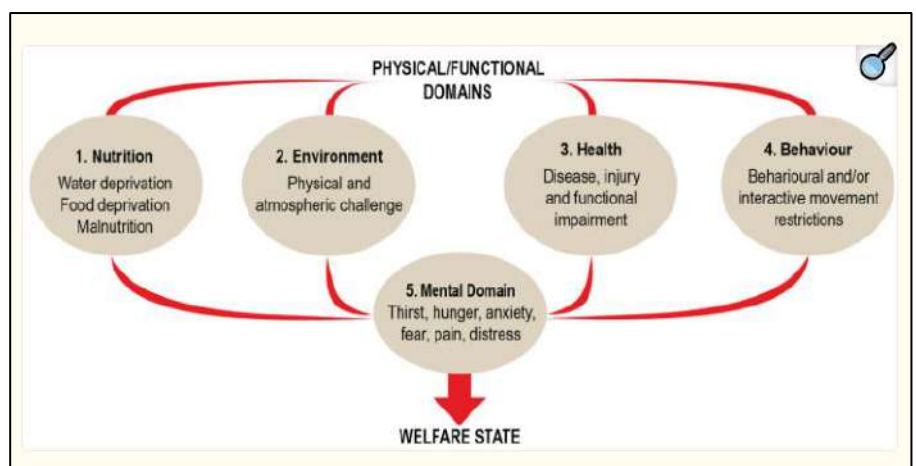
Recently, The World Association of Zoos and Aquariums (WAZA) has suspended the membership of Delhi Zoo for six months, citing concerns over the mistreatment of an African elephant at the facility.

What is WAZA's Animal Welfare Strategy?

- **WAZA** - The World Association of Zoos and Aquariums (WAZA) is the global alliance of regional associations, national federations, zoos and aquariums, dedicated to the care and conservation of animals and their habitats around the world.
- **Function** - Guiding zoos and aquariums across the world and ensuring animal welfare and conservation.
- Science-based knowledge in animal care and welfare, environmental education and global conservation

- **Five Domains Animal Welfare Model** – is a framework designed to assess and improve the welfare of animals.

- **Nutrition** - Ensuring animals have access to a balanced diet and clean water.
- **Environment** - Providing a suitable living environment that allows animals to express natural behaviors.
- **Health** - Preventing and treating diseases and injuries.



- **Behavior** - Allowing animals to engage in positive social interactions and express natural behaviours.
- **Mental State** - Considering the emotional experiences of animals, including positive experiences like anticipation and satisfaction.

What is the role of Central Zoo Authority (CZA)?

- **CZA** - Central Zoo Authority (CZA) is a statutory body constituted in 1992 under Wildlife (Protection) Act, 1972.
- **Objective** - To bring Indian zoos up to international standards.
- To complement the national effort in conservation of wild life as per National Zoo Policy, 1998.
- **Functions** - Enforce minimum standards and norms for upkeep and healthcare of animals in Indian zoos.
- Control mushrooming of unplanned and ill-conceived zoos.
- Specify the minimum standards, in line with global standards for housing, upkeep and the veterinary care of animals at Indian zoos.
- Cancel the recognition granted to a zoo if it is found to be failing to meet or maintain those standards.

What are the issues in zoo management in India?

- **Infrastructure deficiency** – Inadequate safety and recreational facilities for different types of animals with different requirements.
- **Poor living conditions** - Many zoo facilities suffer from neglect and poor maintenance, resulting in unsafe and unsanitary conditions for both animals and visitors.
- **Understaffing** - Many zoos in India has severe shortage of veterinarians, biologists, and educators.
- This makes it difficult to provide adequate care and maintain the health of the animal's suitable environment to keep these majestic animals.
- **Negligence of regulations** – The conservation provisions of Wild life protection act, 1972 has been neglected by zoos and CZA.
- **Complacency of CZA** - Shortcomings in framing and enforcement of up-to-date guidelines—in line with the global norms—regarding animal welfare applicable to zoos across India.
- **Lack of accountability** - The law does not prescribe any consequences for CZA in cases where the CZA wilfully neglects to discharge its statutory duties.

What are the issues with animal diplomacy?

- **Animal diplomacy** - It involves giving or lending animals as a sign of friendship or goodwill between countries.
- **Soft Power** – Animal diplomacy has long been encouraged as a tool for extending a country's soft power to other parts of the world.
- **Issues with animal diplomacy**
 - **Lack of concern for animal welfare** – Glorification of the practice without taking into consideration the welfare of the animals involved in these transactions.
 - **Change in habitat** - When a wild animal like an elephant is “gifted” to another country, it involves being forcefully separated from their herds, familiar habitats and native surroundings.
 - **Adaptation challenges** - Settling in requires them to get used to unfamiliar weather, captive conditions, and new caretakers in the receiving countries.
 - **Psychological challenges** - Immense physical and mental trauma to these animals, who often display aggressive behaviours, resulting in further mistreatment, cruelty, or neglect.
 - **Language barriers** - Often, the language that these animals are trained in is different from the language used by their handlers in the receiving country.

What is the animal welfare measures available in India?

- **Constitutional duty of animal protection** - Directive Principle of State Policy under Article 48A directs the state to protect and improve the environment and to safeguard the forests and wildlife of the country.
- **Prevention of Cruelty to Animals Act, 1960** - To prevent the infliction of unnecessary pain or suffering on animals.

- **Animal Welfare Board of India** – It is a statutory advisory body on for animal Welfare Laws established in 1962 under the Prevention of Cruelty to Animals Act, 1960.
- **Wild Life (Protection) Act, 1972** – To protect plants and animal species.
- **Indian Penal Code (IPC) 1860** - Section 428 and 429 of the IPC provides for punishment of all acts of cruelty such as killing, poisoning, maiming or rendering useless of animals.

What lies ahead?

- Ensure the compliance with all the conditions which have been set out by the World Association of Zoos and Aquariums.
- Maybe the CZA should look at and draw inspiration from the work of Indian rescue centres such as ‘Wildlife SOS’, which is dedicated to the care of abused, diseased, wounded and malnourished elephants.
- Introduces checks and balances in the law with respect to the CZA and even for errant zoos that do not follow prescribed standards of animal care.
- Enact an international convention to protect diplomatic animals that mandates a set of internationally accepted minimum conditions which must be fulfilled by both countries.

12. SCIENCE & TECHNOLOGY

12.1 The National Mission on Interdisciplinary Cyber-Physical Systems (NM-ICPS)

Why in news?

The innovation hubs established under NM-ICPS are expected to move towards self-funding through commercialization as part of their financial autonomy journey.

What are Cyber Physical Systems (CPS)?

- Cyber-Physical Systems (CPS) is merging of physical world with computational systems, primarily developed to monitor and control the physical devices in the systems.
- **Intelligent decision-making** – CPS enables immediate responses to changing physical conditions by real-time data from sensors.
- **Automation** – It makes the machines capable of making autonomous decisions, adapting to changing conditions, and optimize their performance.
- **Industry application** – This interaction between digital and physical component has application across various industries like manufacturing, healthcare, transportation and smart energy grid.

What is National Mission on Interdisciplinary Cyber-Physical Systems?

- **Aim** – To coordinate all stakeholders by establishing strong linkages between academia, industry, Government and International Organizations.
- **Launch** – In December 2018 with a budget outlay of 3,660 crore.
- **Technology Innovation Hubs (TIHS)** – This mission has setup 25 TIHS in reputed institutes across the country covering areas like AI, Machine Learning, Robotics, Cyber security, Data Science, Quantum Technologies and so on.
- **Ministry** – Department of Science & Technology (DST), Ministry of Science and Technology.
- **Mission objectives:**
 - It aims to establish India as a global leader in Cyber-Physical Systems (CPS).
 - To develop technologies, prototypes and demonstrate associated applications pertaining to national priorities.
 - To translate existing research into high technology readiness level (TRL), market-ready products.
 - Collaborating with the startup ecosystem, industrial sectors and governmental organizations to bring out technological solutions for people-centric problems.
 - To establish and strengthen the international collaboration.
 - Incentivize private participation to execution of pilot scale research projects.

Generative AI for Bharat (BharatGen)

- Generative AI for Bharat (BharatGen) is part of National Mission on Interdisciplinary Cyber-Physical Systems (NM-ICPS) and headed by IIT Bombay.
- **Aim** - To develop generative AI technology for 22 Indian languages to address India's socio-cultural and linguistic diversity.
- **Multimodal capabilities** – The models that can process and generate not only text but also speech and visual data, enhancing its application across various sectors.
- A key element of Bharat-Gen is its open-source foundational models, which will help **democratise AI across India**, he said.

What are the key achievements of this mission?

- **Innovation and startup incubation** – In just 6 years, over 1,500 new technologies and tech products from over 650 startups.
- **Employment generation** – The mission has provided over 16,000 jobs and over 1.5 lakhs people trained in entrepreneurship.
- **Plug and play testbeds** – Creation of testbeds in India for autonomous navigation and security operations of critical infrastructure.
- **Self-reliance** – In emerging technologies to develop and maintain one's own capabilities, technologies and expertise without relying on external assistance.
- **Digital Entomologist** – *AI-powered Livestock Management System* developed by Awadh IIT Ropar.
- **Nano bubble Technology for water treatment** – Nanobubbles are smaller than human hair and remain in the water for longer periods of time, providing direct oxygenation.
 - It can help treat water contaminants and disinfect waterways without chemicals.
- **First biodiversity index** – To describe the amount of species diversity in a given area and is estimated using solar-powered biodiversity sensors.
- **Drone-swarmling technology** – Is a combination of artificial intelligence (AI) and human intelligence that allows multiple drones to work together to complete tasks.
- **Secure IoT** – India's *first commercial chip designed* for IoT devices like smartwatches, connected meters, and EV battery management systems.
 - Built on the *Shakti Processor*, the chip offers a 30% cost reduction.
- **Ayusynk** – It enables recording and *real-time transmission of heart and lung sounds* that can be amplified and used in remote settings as well as for telemedicine applications.
 - It is developed by Ayu Device a startup under IIT Bombay is a digital stethoscope *offers a user-friendly, affordable diagnostic tool*.
- **IT-OT Security Operations** – It offers 24/7 cyber threat protection and is implemented at the National Highways Authority of India.

A test bed is a platform or facility for testing new technologies, scientific theories, or computing tools in a realistic environment.

What lies ahead?

- Make in India as a global leader in CPS technologies, to boost economic growth, self-reliance, and societal well-being.
- Commercialization of Technology Innovation Hubs to make them self-funding which enhances their financial autonomy.
- Incentivize Indian industry to fund and co-create their next innovations from these hubs.

12.2 Commercialization in India's Space Sector

Why in news?

In order to secure strategic autonomy in its access to outer space, it's high time for India to tap the potential of private players in space sector.

What is commercialization of space sector in India?

- Commercialization in India's space sector refers to the increasing involvement of private companies in space activities.
- It is enabled by policy changes that allow them to develop and launch satellites, provide space-based services, and compete in the global market.
- **Antrix Corporation Limited (ACL)** – It was established in 1992 is a wholly owned Government of India Company under the administrative control of the **Department of Space**.
- It is the Marketing arm of ISRO **for promotion and commercial exploitation of space products**, technical consultancy services and transfer of technologies developed by ISRO.
- **NewSpace India Limited (NSIL)** – It is **established in 2019** as a public sector undertaking of the Government of India.
- To spearhead **commercialization of space products including production of launch vehicles, transfer to technologies and marketing** of space products.
- **In-space** – It was **established in 2020** and functions as an **autonomous agency** in Department of Space (DOS).
- It acts as a **single window agency** for all space sector activities of private entities.
- **Emerging space startups** – Several private space companies have emerged in India, including Skyroot Aerospace, Agnikul Cosmos, Pixxel and Bellatrix Aerospace.

Evolution of the Indian Space Program

- The journey of India's space program began in the 1960s with the formation of the **Indian National Committee for Space Research (INCOSPAR)** under the guidance of Dr. Vikram Sarabhai.
- The launch of **Aryabhata in 1975** marked India's first satellite.
- **Development of launch vehicle (1980's)** – The SLV-3 successfully launched the **Rohini satellite**, making India a space-faring nation.
- **1990's** – Development of the PSLV (Polar Satellite Launch Vehicle) and GSLV (Geosynchronous Satellite Launch Vehicle) paved the way for reliable satellite launches.
- **Chandrayaan-1 (2008)** – India's **first lunar mission**, confirmed the presence of water molecules on the Moon.
- **Mangalyaan (2014)** – The Mars Orbiter Mission, made India the first country to reach Mars orbit on its maiden attempt.
- **Chandrayaan-3 (2023)** – **Successful soft landing** on the Moon's South Pole cemented India's status as a global space power.
- India is preparing for the Gaganyaan mission, first human spaceflight.
- Development of **reusable and heavy-lift rockets** like the Next Generation Launch Vehicle (NGLV).

What is the importance of commercialization of the space sector?

- **Developing reusable & heavy lift capability rockets** – As India is still depend on foreign nation in launching heavy satellites, there is a need for indigenous reusable and heavy lift capability rockets.
- For instance, GSAT-N2 is a communication satellite built by ISRO was launched on SpaceX's Falcon 9 rocket.
- **Economic growth** – India's space industry, valued at approximately **7 billion USD**, has the potential to grow exponentially through increased private sector participation.
- **Global competitiveness** – India's cost-effective launch capabilities, demonstrated by missions like Chandrayaan-3 and Mangalyaan, make it an **attractive destination for international satellite launches**.
- Expanding these services commercially **can enhance India's share in the 440 billion USD** in global space economy.
- **Job Creation and Skill Development** – The growth of private space firms will **create jobs** in aerospace engineering, satellite design, and data analytics.
- **Strategic independence** – Commercialization reduces reliance on foreign providers for satellite services and technologies, **strengthening India's autonomy in critical areas such as communication, navigation, and defense**.

- **Increased innovation** – Partnerships between ISRO and private firms can *expedite the development of advanced technologies* like reusable rockets and small satellite launchers.
- **Infrastructure development through PPP**– Commercialization encourages the development of state-of-the-art facilities, such as satellite assembly units and launch pads, through public-private partnerships (PPP).
- **Increased FDI inflows** – Commercialization will increase foreign direct investment (FDI) inflows in the space sector.
- India now permits **up to 100% FDI in space sectors** like satellite manufacturing and operation, satellite data products, and ground segment and user segment.

What are the measures needed?

- **Strengthen policy framework** – The government must implement further supportive policies to encourage private sector involvement.
- **Providing milestone-based funding mechanisms** – It can reduce risks on private players as funding will be provided only after they meet certain objectives at every stage.
- It will *ensure accountability and reduce cost overruns*.
- **Leveraging the private industrial base** – In parallel to developing the NGLV, the Department of Space can give out contracts for reusable, heavy-lift rockets to capable private players to foster competition and capacity-building.
- **Promote global collaboration** – Indian companies should be encouraged to explore partnerships with global firms for technology transfer and co-development of advanced systems.
- This can accelerate the development of indigenous capabilities.
- **Develop infrastructure** – Investment in testing facilities, launch pads, and research centers is crucial.
- Shared infrastructure can reduce entry barriers for startups and smaller firms.
- **Focus on education and training** – Building a skilled workforce is essential.
- Universities and research institutions must align their curricula with the needs of the space industry to ensure a steady pipeline of talent.
- **Public-private partnerships** – ISRO's expertise can complement the agility and innovation of private firms through well-structured collaborations.
- Joint ventures can address complex challenges and accelerate project timelines.

Quick facts

- **Next Generation Launch Vehicle (NGLV)** – It is designed to have a maximum payload capability of 30 tonnes to Low Earth Orbit.
- **Project duration** – It is targeted to complete the development phase in 8 years from 2024.
- **Significance** – NGLV will have 3 times the present payload capability compared to LVM3.
- It will also have reusability resulting in low-cost access to space and modular green propulsion systems.
- The development of NGLV will enable the launch of human spaceflight missions to Bharatiya Antariksh Station, Lunar/inter-planetary exploration missions and communication & earth observation satellite constellations to Low Earth Orbit.

12.3 Quantum Satellite

Why in News?

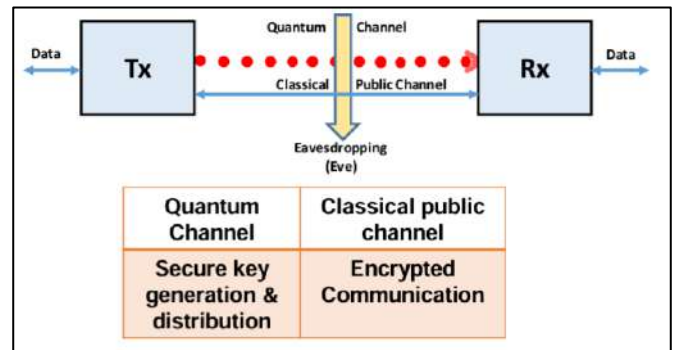
Recently, the chairperson of the National Quantum Computing Mission said India plans to launch a quantum satellite in “2-3 years for quantum communications”.

What is Quantum satellite?

To know about National Quantum Mission, click [here](#).

- **Quantum communication** – It relies on individual photons and quantum principles to carry quantum information.

- **Quantum satellite** - These are communication satellites that uses quantum physics to secure its signals.
- **Quantum cryptography** - It uses quantum key distribution (QKD) to secure messages.
- **Quantum Key Distribution (QKD)** – QKD involves sending encrypted data as classical bits over networks, while the keys to decrypt the information are encoded and transmitted in a quantum state using qubits.



- QKD enables two parties to produce a shared random secret key (encryption key) known only to them.
- **Quantum measurement** – it is the act of measuring the properties of a quantum system, like a photon (the subatomic particle of light).
- According to the rules of quantum physics, a quantum measurement changes the state of the system.
- **Methods of quantum encryption**
 - Encoding the key in a stream of photons (in two states, one representing 0 and the other 1) and any act of measuring those changes the state of the photons.
 - **Quantum entanglement** - when two photons are entangled, any change to one particle will instantaneously change the other.
- **Applications of quantum communication**
 - Satellite based Quantum Key Distribution (QKD) over larger distances
 - Protecting sensitive client information in Banking/ Finance Industry
 - Protecting customer credit card information
 - Government and defence industry
 - Protecting high value/sensitive data in remote data centres
 - NavIC based RS-Key distribution

What are worldwide developments related to quantum communication?

Worldwide Developments Related to Satellite based quantum communication (SBQC)

- ✓ Free space entangled photon distribution over 13km (China)
- ✓ Free space QKD over 144km using decoy state BB84 & E91 protocol (Spain)
- ✓ BB84 QKD achieved over 148.7 km of optical fiber
- ✓ Measuring polarization characteristics through LEO-to-ground atmospheric transmission paths (OICETS-Japan)

- ✓ Free space entangled photon distribution over 100km & Gnd-Sat QKD verification using hot air balloon (China)
- ✓ BB84 between moving airplane and GGS (DLR-Germany)
- ✓ LEO-Gnd polarization measurements (SOTA-Japan)
- ✓ Validating entangled photon source in space -1U Cubesat (SPEQS-1 - Singapore)
- ✓ GEO-Gnd CV-QKD experiment (AlphaSat XL - ESA)

- ✓ Decoy state BB84 QKD & Entangled photon distribution over 1200km using Micius satellite (QUESS-China)
- ✓ Sat-Gnd quantum-limited communication & polarization measurement using a 50-kg-class microsatellite (SOTA-Japan)
- ✓ Miniaturized polarization entangled photon pair source on board testing - 3U CubeSat (SpooQy-1-Singapore)

2005 - 2010

2011 - 2015

2016 - 2020

2021 - 2025

- Receiver onboard satellite to measure uplink quantum signals (QIESSAT-Canada)
- Long distance QKD using CubeSat uplink (NanoQIE-Canada)
- BB84 QKD and Sat-Gnd entangled photon distribution using 6U satellite (CQuCoM-UK, Austria, Singapore, Italy)

- Space-to-ground QKD experiment from the ISS (SpaceQUEST-ESA)
- Network of 6U CubeSats for communication with ground stations across UK (QUIARC-UK)
- WCP source downlink QKD and compact QRNG - 3U CubeSat (QUBE-Germany)
- Uplink polarisation based Quantum comm. on 12U & 3U CubeSat (NanoBob & Q3sat - Austria)

- Downlink QKD demonstration using 6U cubesat (ROKS - UK)
- Sending an integrated entangled photon source (810nm+1550nm) to ISS (SEAQUE - NASA)
- Deploy a satellite QKD test bed using 12U cubesat (SPEQTRE - Singapore)
- Spaceworthy entanglement and WCP source based QKD validation onboard (QuantESS and QuTDS - India)
- QQC payload development and establishment of satellite to ground Quantum comm. link (India)

Demonstrated milestones

Proposed missions

- China & Japan have successfully demonstrated Quantum Communication experiments from satellite to ground.

- **China** - It currently operates the world's largest QKD network with three quantum satellites and four ground stations.
- **Europe** - European Space Agency (ESA) is developing a technology demonstration satellite known as Eagle-1.
- **Germany** - Qube satellite was launched in August 2023 to test QKD capabilities.
- **India's progress:**
 - Single photon based inter-building free space quantum communication link was established over a distance of ~300m of atmospheric channel.
 - 2-way quantum secured client-to-client live video conferencing demonstration has been demonstrated.
 - NavIC enabled synchronization mechanism has been implemented.
 - BB84 protocol-based quantum key distribution (QKD) protocol was created.

What are the limitations of QKD?

- **Lack of source verification** - QKD does not provide a means to authenticate the QKD transmission source.
- **Upgradation difficulty** - Since QKD is hardware-based, QKD networks can't be upgraded or patched easily.
- **High cost** - QKD increases infrastructure costs that eliminate many use cases from consideration.
- **Limited security** - The actual security provided by a QKD system is not the theoretical unconditional security from the laws of physics but rather the more limited security that can be achieved by hardware and engineering designs.
- **Denial-of-service attack** - Since eavesdroppers can cause a transmission to stop, they can deny the use of a transmission by its intended users (a.k.a. a).
- **Restrictions on quantum physics** - non-quantum information can be amplified before being transmitted across large distances whereas the no-cloning theorem prohibits the amplification of quantum information.
- **Capacity limitation** - Even the best optical fibers/ terrestrial free space can carry these photons only up to few hundreds of kilometres before light absorption makes the process impossible.

Post-quantum cryptography refers to cryptographic techniques that resist attacks from both quantum and classical devices using more advanced classical encryption.

13. RENEWABLE ENERGY

13.1 Greenwashing Indian Railways

Why in News?

Recently Indian railways has exported unused diesel locomotives to African countries.

What is the status of Indian electrification?

- **First electric train** - After commencement of first Railway service between Mumbai & Thane in 1853, first electric train was run between Mumbai & Thane in year 1925.
- **Five-year plans** - First 5-year plan (1951-56) targeted electrification of 141 RKM of tracks and 12th five-year plan (2012-17) had a challenging target of electrification of 6500 RKM of tracks.
- **Mission 100% Railway electrification** - India has planned to electrify entire broad-gauge network routes of Indian Railways by March 2024.
- **Nodal Agency** - The Central Organization for Railway Electrification (CORE) along with other organizations.
- **Electrification Status** - Indian Railways had electrified 96.99% of the total broad-gauge network of Indian Railways (66,413 rkm, including Konkan Railway) as on 1 October 2024.
- The entire electrified mainline rail network in India uses 25 kV AC; DC is used only for metros and trams.
- **Objectives** - To provide environment friendly, green and clean mode of transport to the people.
- To use of renewable energy, especially solar, by making use of the huge land parcel available along the railway tracks.

What are the benefits of railway electrification?

- Electrification will provide energy efficient, eco-friendly mode of transport and also improve system throughput by modernization of the railway system.
- **Better railway efficiency** - Mission Electrification will result into seamless (end to end) train operation on electric traction.
- **Enhance connectivity** - Prioritizing electrification of high-density network (HDN), high utilized network (HUN) and last mile connectivity/port connectivity routes here started giving returns early.
- **Increased speed** - Electrification will help in increasing average speed of Freight Trains thereby help in achieving objective of "Mission Raftar".
- **Greater freight movement** – It enables haulage of heavier freight & longer passenger trains at higher speeds.
- **Financial savings** - Electrification plan will enable the state-owned railway to save an estimated Rs 264bn on its annual fuel bills.
- **Employment** - About 5.5 lakh man years will be generated during execution period of Mission electrification.
- **Reduced forex bill**- saving of foreign exchange by reducing the import of crude oil.
- **Reduced environmental pollution** – It reduces the emission of carbon pollution from diesel and switch over to renewable sources of energy such as solar and wind.

Mission Raftaar is a 'Mission' envisaged for speed enhancement and to achieve a target of doubling average speed of freight trains and increasing the average speed of Superfast /mail/Express trains by 25 kmph.

What are the issues with electrification of Indian Railway?

- **High Costs** - The electrification project is estimated to cost around Rs 1300bn.
- **Redundant Diesel Locomotives** -The plan will make about 4000 serviceable diesel locomotives redundant.
- As of now, there are about 760 diesel locomotives idling across the network, many of which have a residual life of over 15 years.
- **Economic Viability** - The average cost of transportation on many routes may increase due to electrification.
- **Technical Challenges** - The transition from diesel to electric traction requires significant infrastructure changes and upgrades.
- **Environmental Impact** -The process of manufacturing and installing new electric locomotives and infrastructure also has an environmental impact.
- **Insignificant pollution reduction** – Of the 70% of total diesel oil consumption in the country was by the transport sector, the Share of the Railways was just 3.24%.
- Trucks consume 28% and Agricultural sector 13.2%.
- **Untenable environmental benefits** - Electricity is a secondary source of energy which needs to be generated by expending a primary source of energy from fossil fuels such as coal, oil and natural gas.
- **Pollution shift** - Switchover to electric traction merely shifts the pollution caused by diesel locomotives to the source of power generation in a more concentrated form.

Nearly 50% of the electricity generated today in the country is through coal-fired thermal plants.

What lies ahead?

- Increase the share of renewable energy production for railway electrification.
- Transcend to high-speed magnetic levitation system and explore the possibility of Hyperloop.
