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News Analysis

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INDEX

SEPTEMBER 2024

1. IMPORTANT TOPICS OF THE MONTH

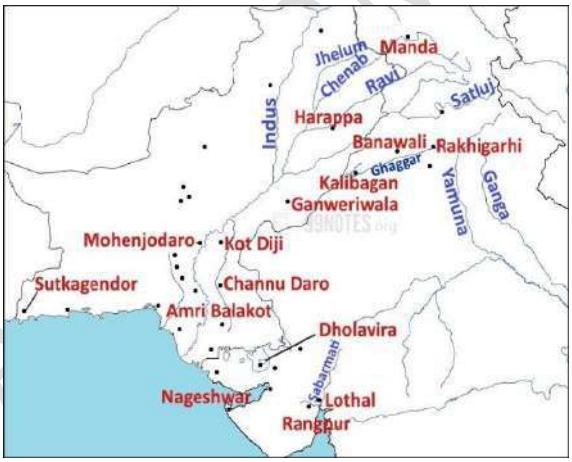
1.1 Rise and fall of cities in India

Why in News?

India has undergone five urbanisations evolving from the mercantile Harappan period to the post-independence industrial cities.

What was the first urbanization?

- **Indus Valley Urbanization** - First urbanisation was under the mercantile Harappans in the north-western part of India.
- **Period** – 2500 to 1900 BCE
- It was a vast civilisation, spread over a large geography, larger than any of its contemporaries like in Egypt, China, and Mesopotamia.
- **Indus Valley Civilization Cities**
    - Harappa and Mohenjo-Daro in present-day Pakistan.
    - Rakhigarhi in Haryana
    - Kalibangan in Rajasthan
    - Dholavira and Lothal in Gujarat.

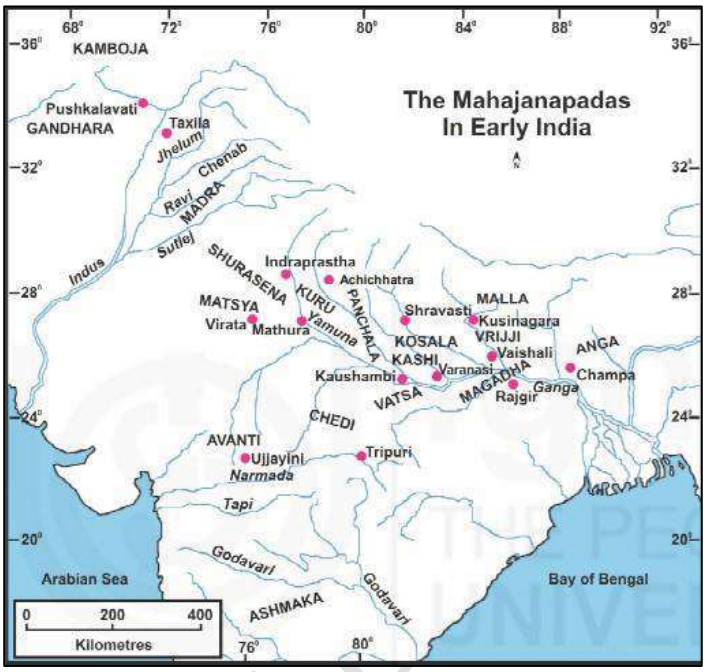


- **Characteristics of Harappan Cities**
- **Grid Layout** - The cities feature wide, intersecting streets with separate entry and exit to control movement.
- **Standardized Brick Construction** – They were in ***1:2:4 ratio,*** suggesting a centralized system of production and distribution.
- **Citadels** - Many cities had fortified citadels, likely used for defence or administrative purposes.
- **Drainage Systems** – It includes underground pipes and covered drains, to prevent flooding and maintain sanitation.
- **Water Supply Systems** - Wells and reservoirs were used to supply water to the city's inhabitants.
- **Granaries and Warehouses** – It indicates a well-organized system of food storage and distribution.
- **Great Bath** - Mohenjo-Daro featured a large, rectangular structure known as the Great Bath, possibly used for ritual cleansing or bathing.
- **Assembly Hall** - Harappa had a large, rectangular building that may have served as an assembly hall.
- **Trade and Commerce** – There are evidences of long-distance trade networks
    - *Dholavira and Lothal* were both significant centres of maritime trade.
- **Art and Crafts** – They were skilled artisans, producing a variety of artifacts like pottery, seals, and jewellery.

What was the second urbanization?

- **Mahajanpadas** - The second urbanisation *happened 1,500 years after Harappa*.
- **Period** - 500 BCE
- **Aryan Arrival** - Around 1500 BCE, the Aryan or Indo-European people came from Southern Russia, through the Oxus, bringing with them horses.
- These were mostly men, intermarrying with the local women, changing the makeup of the local DNA.
- Over time, they moved further east, into the Gangetic Plain.
- Ganga plains established trade relations with the Indus plains and beyond.

- **Cities** - Taxila, Pataliputra, Rajagriha, Shravasti, Kashi, Kaushambi and Ujjain
- **Fortified Cities -** Many cities were fortified with walls and gates to protect them from attacks.
- **Diverse Cultures –** It was due to their diverse geographical locations.
- **Centralized Administration –** They had a strong king and a well-organized bureaucracy.
- **Religious Centres -** Cities like Kashi attracted pilgrims and scholars from across the region.
- **Mercantile cities** - Merchant activity played a pivotal role in shaping the urban landscape due to expansion of trade networks.
- **Trade Route** - Cities located on major trade routes, such as Taxila, Pataliputra, and Ujjain, experienced rapid growth.
    - Toll taxes became important to protect the highways.



- **Emergence of New Philosophies** - The rise of Buddhism and Jainism was closely intertwined with the growth of trade and mercantile activity.
- Buddhist literatures provided information about the urbanization of this period.
- **First Coinage** - The first punch-marked coins in India were minted by them.
- **Fall of Trade** – Around the 5th Century CE, with the fall of Rome, an important trading partner, and the invasion of the Hunas, the merchants lost their importance and thus the Mahajanapadas began to disintegrate.

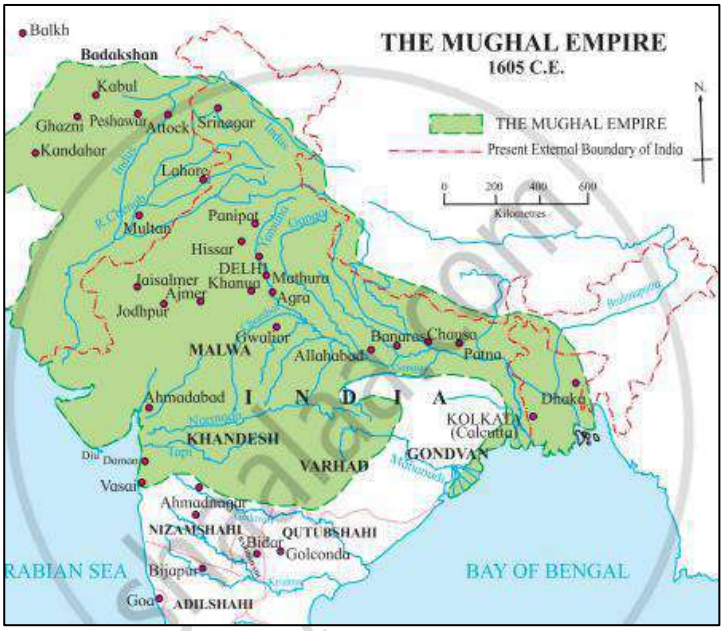
What was the third urbanization?

- **Temple urbanisation** – It took place as temple cities across South India and Southeast Asia.
- **Period** – ***7th to 12th Century***
- By the 10th Century Chola period, full-blown temple urbanisation emerged.
- **Cities** – Madurai, Kancheepuram, Thanjavur, Srirangam
- **Temple Centre** - Temple was the nerve centre of political and economic activity, surrounded by markets, courtiers, and courtesans.
- **Spiritual and Cultural Hubs -** Temples hosted religious ceremonies, festivals, and educational institutions.
- This attracted scholars, artists, and craftsmen, further contributing to the development of the city.
- **Pilgrimage Centres -** Temples often served as important pilgrimage site and attracted devotees.
- **Rise of Agriculture** - These Cities were more agricultural than mercantile.
- After the 4th-5th Century, when export-led mercantile trade fell, agriculture and Agri based activities started gaining prominent economic activity.
- **Devadana Lands -** Temples often received endowments of land and other resources, which generated income through agriculture, trade, and other economic activities.
- **Brahmadeya** - Around the time Buddhism was slowly declining and Brahmadeya or donations to Brahmins/temples started emerging.
- **Society** - These temples had Brahmin priests, Kshatriya patrons, Vaishya merchants, artists, etc.
- **Changes in Society** - Endogamy flourished and the caste system solidified.

What was the fourth urbanization?

- **Muslim Metropolis** – It was the Muslim Metropolis of Delhi sultanate and Mughal empire.
- **Period** - ***12th to 17th Century CE***.
- According to Abu-l Fazl, in 1594 there were 2837 towns of which 180 were named as larger cities.

- **Cities**
  - Delhi sultanate – Delhi, Hisar, Hansi, Sirsa, Meerut, and Aligarh.
  - Mughal Cities - Agra, Fatehpur Siki, Lahore, Sikandra, Shahjahanabad



- **Economy** - It was primarily agricultural.
- **Feudal System** - The courtiers were paid by giving them a share of the village wealth.
- **Religious Character** - Sufism, Dargahs (shrines), and Pirs became important.
- The Jama Masjid becomes a central site in these cities.
- **Cultural Centers** – Lahore, Agra were renowned cultural centre, known for its poetry, music, and arts.
- **Bazaars and Markets –** They catered to the needs of the population, offering a wide range of goods and services.
- **Fusion of Architectural Styles** - Mughal architecture often incorporated elements from Persian and Islamic styles, resulting in a unique and distinctive aesthetic.

What was the fifth Urbanization?

- **Postcolonial cities** – It is the colonial and post-colonial cities.
- Colonial administration had created a new urban, industrial and imperial landscape.
- **Period** – ***17th Century*** onwards.
- **New Factors** - Forces of international trade, mercantilism and capitalism.
- **Colonial Cities**
  - **British Colonial Cities** – Calcutta, Bombay, Madras, Shimla
  - **French Cities** – Pondicherry , Mahe
  - **Portuguese Cities** – Goa, Diu, Daman
  - **Dutch** – Masulipatinam
- Colonial cities reflected the mercantile culture of the European.
- **The big coastal cities** — Mumbai, Chennai, Calcutta, Kochi began as fortified settlements of the colonial powers, either the Portuguese or the Dutch or the French or the British.
- **European bases** - European commercial Companies had set up base in different places early during the Mughal era
  - Portuguese in Panaji in 1510
  - Dutch in Masulipatnam in 1605
  - British in Madras in 1639
  - French in Pondicherry in 1673.
- **Trading Centers** - With the expansion of commercial activity, towns grew around these trading centres.
- **Economic Capitals** - After the Battle of Plassey in 1757, expansion of trade made colonial port cities such as Madras, Calcutta and Bombay rapidly emerged as the new economic capitals.
- **Hill Stations** – Development of Shima, Ooty were a distinctive feature of colonial urban development.
- **Cultural Integration** - Building with Indian and European cultural mix Indo Saracenic style was created.
  - **Churches, cathedrals** – Bom Basilica in Goa, Santhome Church
  - **Administrative buildings** –Fort St. George, Fort St. William.

How the cities are developed post-independence?

- **Post Independence Cities** – Growth of planned cities due to industrialization and state reorganization.
- **Capital Cities** – New capital cities were constructed with the emergence of new States during state reorganization.
    - **Chandigarh** - Designed by Swiss-French architect Le Corbusier.
    - **Bhubaneswar** – It was selected to be the capital of Odisha in 1948 by integrating the temple town into its planning and the needs of modern administration.
    - **Gandhinagar** – It was formed in 1960 as capital of Gujarat.
- **Industrial Cities** - With heavy industrialisation, part of India's Five Year Plans, industrial cities like Bhilai, Jamshedpur, and Rourkela.

1.2 New Classical Languages

Why in news?

Recently, the Union Cabinet has approved to confer the status of Classical Language to five Indian languages.

What is a classical language?

- **Need for classical status** – To *recognize the historical significance* and role of the language as a guardian of Bharat's rich cultural and intellectual heritage.
- **Classical languages** – They are ancient languages with independent traditions and a rich literary history that continue to influence various literary styles and philosophical texts.
- **Introduction**– It was first introduced ***in 2004*** in India.
- **Responsible authority** – *Earlier, it was the Ministry of Home* Affairs but then the ***Ministry of Culture*** took over the responsibility since 2005 for further implementations and future recognitions.

> ***Tamil*** *was the first language to get the Classical language status in 2004.*

- **Linguistic Experts Committee (LEC)** – It is established by the Ministry of Culture to assess future proposals for the recognition of classical languages.
    - **Composition** - Representatives of the Union Ministries of Home, Culture and 4 to 5 linguistic experts.
    - **Chaired by** - The *president of the Sahitya Akademi*.
- It was ***established the in 2004 and in 2024***.
- **Importance** – By recognizing a language as classical, the government acknowledges their deep-rooted antiquity, vast literary traditions, and their invaluable contribution to the cultural fabric of the nation.

What are the criteria for declaring a language as classical?

- **Criteria in 2004 –** High antiquity of its early texts/ recorded history *over a thousand years.*
- A body of ancient literature/ texts, which is considered a valuable heritage by generation of speakers.
- The literary tradition must be original and not borrowed from another speech community.
- **Revision of criteria** – It was ***revised two times, in 2005 and 2024***, based on the recommendations of Linguistic Experts Committees (LEC).

2005 Criteria for Classical Language Status

- **Existing** – A body of ancient literature/texts, which is considered a valuable heritage by generations of speakers.
- The literary tradition must be original and not borrowed from another speech community.
- **Modified** – High antiquity of its early texts/recorded history over a *period of 1500-2000 years.*
- **Added** - The classical language and literature being *distinct from modern*, there may also *be a discontinuity* between the classical language and its later forms or its offshoots.

2024 Criteria for Classical Language Status

- **Existing** – High antiquity of its early texts/recorded history over a period of *1500- 2000 years*.
- A body of ancient literature/texts, which is considered a valuable heritage by generations of speakers.
- The Classical Languages and literature could be distinct from its current form or could be discontinuous with later forms of its offshoots.
- **Added** - *Knowledge texts*, especially prose texts in addition to poetry, epigraphical and inscriptional evidence.
- **Deleted** - The literary tradition must be original and not borrowed from another speech community.

How many languages have been declared so far?

- As of October 2024, there are ***totally 11*** classical language in India.
- 5 languages were added in 2024.

Language	Year of Notification	Notification by
Tamil	2004	**Ministry of Home Affairs**
Sanskrit	2005	
Kannada	2008	**Ministry of Culture**
Telugu	2008	
Malayalam	2013	
Odia	2014	
Marathi	2024	
Pali	2024	
Prakrit	2024	
Assamese	2024	
Bengali	2024	

What are the features of new classical languages?

- **Prakrit** - It was the vernacular of the common folk in ancient India, and the language of *heterodox religions like Buddhism and Jainism*.
- The term 'Prakrit' derived from Sanskrit word 'prakriti' meaning 'source' or 'origin'.
  - **Linguistic group** - Middle Indo-Aryan languages

Different dialects of Prakrit	
Magadhi	• It is the official language of the Mauryan court & in the Ashokan edicts. • It evolved into modern-day languages such as Bengali, Assamese, Odia, Bhojpuri, Magahi, and Maithili.
Ardhamagadhi	• Literally "half-Magadhi" which is prominently used by Jain scholars.
Shauraseni	• It was used by the women from lower class women and people in plays.

	• It later evolved into Hindustani, Punjabi, and other languages of the Hindi group.

- **Pali** – It is the *variant of Ardhamagadhi Prakrit*.
- It was the language of Theravada Buddhist canon.
    - **Linguistic group** - Middle Indo-Aryan languages
- After Theravada Buddhism declined in India, Pali survived as a *religious language in Sri Lanka, Myanmar, Thailand, Laos, and Cambodia*, where this Buddhist school continued to prosper.
- **Marathi** – It belongs to the *Indo-Aryan family* are *derived from early forms of Prakrit.*
    - **Official language**- In Maharashtra and UT of Dadra and Nagar Haveli and Daman and Diu.
- **Assamese** – It belongs to *Indo-Aryan family.*
    - **Official language -** Assam
- **Bengali** – It belongs to *India – European language family*
    - **Official language -** West Bengal, Tripura, Assam (Barak Valley), Jharkhand (additional official language) and Bangladesh.

*While **Konkani** is the official language of Goa, it allows Marathi to be used for official purpose sometimes.*

What steps have been taken to promote classical languages?

- *Ministry of Education* has taken various steps for advancing Classical Languages.
- **Establishing universities** – In 2020, *three Central Universities* were established through an Act of Parliament *to promote Sanskrit*.
- The *Central Institute of Classical Tamil* was created to facilitate translating ancient Tamil texts, promoting research, and offering courses for university students and language scholars.
- **Establishing Centres for Excellence** – It was established for studies in Classical *Kannada, Telugu, Malayalam, and Odia* under the auspices of the *Central Institute of Indian Languages in Mysuru*.
- It also takes steps in establishing Centres for promoting Classical Languages.
- **Recognition through awards** – Several *national and international* awards have been introduced to recognize and encourage achievements in the field of Classical Languages.
- **Chairs in Universities** - As UGC recommended, *professional chairs in central universities* were established.

What is the impact of classical language status?

- **Revives intellectual and cultural identity** - It encourage scholarly research, preservation, and the revitalization of ancient texts and knowledge systems.
- **Promotes national integration** - It instils a sense of pride and ownership among the speakers.
- **Self-reliance** – It aligns with the broader vision of a self-reliant and culturally rooted India.
- It will elevate their stature and will ensure their continued relevance in the modern world.
- **Employment generation** – It will create employment opportunities in academic and research fields.
- Additionally, the preservation, documentation, and *digitization of ancient texts of these languages* will generate jobs in archiving, translation, publishing, and digital media.

What lies ahead?

- Government shall continue providing technical & financial support for the development and preservation.
- Promote academic and cultural initiatives to increase public awareness and motivate more scholars to contribute language development.
- Research and document literary provision and transform to next generation.

1.3 India's Nobel Aspiration

Why in News?

It has been 94 years since an Indian won a Nobel Prize in the sciences while working in India.

How are Nobel prizes awarded?

- **Nomination** - Every year, a select group of hundreds to thousands of people like university professors, scientists, past Nobel laureates, and others, are invited to nominate potential candidates.
- Names of nominated candidates are not made public until at least 50 years later.
- **Dominance of Jews** - Of the 653 people who have won the Nobel Prize for Physics, Chemistry or Medicine, more than 150 belong to the Jewish community.
- But Israel, considered the Jewish homeland, has won only four Nobel Prizes in science, all for Chemistry.
- **Dominance of West** - The science Nobels have been overwhelmingly dominated by scientists from the United States and Europe.
- Many of them came from other countries in search of better scientific infrastructure and ecosystem.
- **Under Performance of South and East** - Only 13 of the 227 winners of Physics Prize, 15 of the 197 winners of Chemistry Prize, and 7 of the 229 winners of the Medicine Prize have come from Asia, Africa or South America.
- Outside of North America and Europe, there have been only nine countries whose researchers have won a Nobel Prize in sciences.
- **Excellence of Japan** - The largest number came from Japan, which has 21 of non-American European laureates.

The nominations for Physics and Chemistry Prizes are available till 1970 while those for Medicine have been revealed only till 1953.

India's Science Nobel Laureates

- **Sir. CV Raman** - Nobel Prize in Physics in 1930 for Raman Light scattering effect.
- **Indian-origin scientists**
  - Har Govind Khorana in Medicine in 1968
  - Subrahmanyan Chandrasekhar in Physics in 1983
  - Venkatraman Ramakrishnan in Chemistry 2009.

Nominated Nobel Laurate Scientists in the Past

- **Physics**- Meghnad Saha, Homi Bhabha and Satyendra Nath Bose.
- **Chemistry** - G N Ramachandran and T Seshadri.
- **Medicine or Physiology** - Upendranath Brahmachari.
- **ECG Sudarshan (Indian Origin)** – He made path-breaking discoveries in the field of quantum optics.

Other Famous Indian Scientists

- **Jagadish Chandra Bose** - First person to demonstrate wireless communication way back in 1895.
- **K S Krishnan** - A student and close collaborator of C V Raman in his laboratory, acknowledged as the co-discoverer of Raman scattering effect.
- **CNR Rao** – His work in solid state chemistry has long been considered worthy of a Nobel.

What are the challenges in India's science research ecosystem?

- **Inadequate Basic Research** - Few institutions are engaged in cutting edge research.
- **Short of Researchers** - The number of researchers as a proportion of population is 5 times lower than the global average.
- **Brain Drain** - In 2022, the number of Indian students leaving the country for higher education reached a six-year high of 770,000 and over 1.6 million people have relinquished Indian citizenship since 2011.
- **Low levels of public funding** - In 2020-21, gross expenditure on research and development ***(GERD) was about 0.7% of the GDP.***
  - India falls behind major developed and emerging economies such as China (2.4%), Germany (3.1%), South Korea (4.8%) and the United States (3.5%).

- **Under Performance of Private Sector** - Their contribution to India's GERD is still at the level of 36% whereas the remaining 64% is from public sources.
- **Low HEI Participation** – Higher Educational Institutions play a comparatively minor role in the overall R&D investment, contributing 8.8% ($1.5 billion).
- **Bureaucratic Hurdles** - The complex layers of administrative clearance, ranging from project proposals to budgetary allocations, contribute to delays and inefficiencies in the research ecosystem.
- **High Cost of Research** - Research activities require huge initial cost on human resources and infrastructural resources Opportunities for private research.
- **Lack of Incentives** - Limited availability of scholarships, research stipends, or financial aid for advanced research degrees can make such programmes economically burdensome for students.

Comparison of research productivity and innovation metrics in selected countries (2021-22)

Country	Researchers per million inhabitants (2021) (FTE)	PhDs produced annually (2021) (Rank)	Publication output (2022) (Rank)	Top 1% most cited articles (% share)	Patents granted (2022) (Rank)
India	262	40,813 (3)	3,06,800 (3)	0.7	30,490 (6)
The U.S.	4,452	69,525 (1)	15,06,000 (1)	1.88	3,23,410 (2)
The U.K.	4,491	27,366 (5)	2,87,200 (4)	2.35	10,578 (15)
China	1,687	53,778 (2)	9,78,100 (2)	1.12	7,98,347 (1)
S. Korea	9,082	13,882 (11)	1,09,200 (16)	1.02	1,35,180 (4)
Japan	5,638	15,804 (10)	1,71,000 (9)	0.88	2,01,420 (3)

Source: Publications data has been extracted from OpenAlex on February 7, 2024.

- **Deficiency in Collaboration** - Limited shared spaces and resources for interdisciplinary activities hinders collaboration and converge and exchange ideas for interdisciplinary research.

What are India's prospects in research activities?

- **Recognition** – The call of "Jai Jawan, Jai Kisan, Jai Vigyan, Jai Anusandhan" is intended to reinforce the foundation of research and innovation for development.
- **Increase in Fiscal Support** – In the interim Budget for 2024-25, a corpus of ₹1 lakh crore has been announced to bolster the research and innovation ecosystem.
- **Human Resource Potential** - Annually, India generates an impressive 40,813 PhDs and is in 3rd place after the United States and China.
- **High Research Output** - India's research output remains substantial, ranking 3rd globally, with over 3,00,000 publications in 2022.
- **Patent Improvement** - India also demonstrates commendable performance in patent grants, securing the sixth position globally with 30,490 patents granted in 2022.
- **Policy Boost** - Initiatives such as the National Deep Tech Startup Policy (NDTSP) signal a strong commitment to technological progress and innovation.
- **Bridging the Funding Gap** - Anusandhan National Research Foundation (ANRF) to fill R&D investment gap while nurturing a robust research culture within HEIs.

What lies ahead?

- Collaboration between the government, business enterprises and HEIs is essential to maximise the positive impact of science, technology, and innovation.
- Creating a conducive environment that emphasizes the benefits and opportunities associated with advanced research degrees is crucial for overcoming the enrolment challenge.
- Provide an efficient mechanisms that can facilitate swift approvals and clearances for research projects in specialized domains.

G.S PAPER I

2. GEOGRAPHY

2.1 Rapid Intensification of Cyclones

Why in News?

Recently Hurricane Milton rapidly intensified to Category 5 storm in less than a day on a path across the Gulf of Mexico toward Florida and became one of the strongest Atlantic storms.

How cyclones are categorised?

- **Tropical Cyclone** – It is a rotational low-pressure system in tropics when the central pressure falls by 5 to 6 hPa (hectopascals) from the surrounding and maximum sustained wind speed reaches 34 knots (about 62 kmph).
- **Cyclone Movement** - It is a vast violent whirl of 150 to 800 km, spiralling around a centre and progressing along the surface of the sea at a rate of 300 to 500 km a day.
- **Names** - Tropical cyclones are called "Hurricanes" over the Atlantic Ocean and "Typhoons" over the Pacific Ocean.
- **Sustained Wind Speed** - India Meteorological Department (IMD) uses a 3 minutes averaging for the sustained wind that is highest 3 minutes surface wind occurring within the circulation of the system.
- **Categorization of Cyclones** - The low-pressure systems over Indian region are classified into Low, Depression and Cyclone based on
    - Maximum sustained winds speed associated with the system
    - Pressure deficit/ number of closed isobars associated with the system.
- The pressure criteria are used when the system is over land and wind criteria is used when it is over the sea.
- **Pressure Criteria**
    - **Low** - If there is one closed isobar in the interval of 2 hPa.
    - **Depression** - If there are two closed isobars
    - **Deep depression** - If there are three closed isobars
    - **Cyclonic storm** - If there are four or more closed isobars.
- **Wind Criteria**

System	Pressure deficient hPa w.r.t T No.	Associated wind speed Knots (Kmph)
Low pressure area	1.0	<17(<31)
Depression	1.0- 3.0	17-27 (31-49)
Deep Depression (DD)	3.0 - 4.5	28-33 (50-61)
Cyclonic Storm (CS)	6.1-10.0	34-47 (62-88)
Severe Cyclonic Storm (SCS)	15.0	48-63 (89-117)
Very Severe Cyclonic Storm (VSCS)	20.9-29.4	64-89 (118-166)
Extremely Severe Cyclonic Storm (ESCS)	40.2-65.6	90-119 (167-221)
Super Cyclonic Storm	≥ 80.0	≥ 120 (≥ 222)

- **Intensity of Cyclone** - It is near-surface maximum wind speed around the circulation centre, or as the minimum surface pressure at the tropical cyclone pressure centre.

Cyclone Category	Wind Speed in Km/h	Damage Capacity
01	120-150	Minimal
02	150-180	Moderate
03	180-210	Extensive
04	210-250	Extreme
05	250 and above	Catastrophic

What is Saffir-Simpson Hurricane Wind Scale?

- **Saffir Simpson hurricane wind scale** – It is based on the highest wind speed averaged over a ***one-minute interval 10 m above*** the surface and is used in Atlantic and Pacific basins.
- **Rating** - It is a 1 to 5 rating based only on a hurricane's maximum sustained wind speed.

- **Damage Factor** - This scale does not take into account other potentially deadly hazards such as storm surge, rainfall flooding, and tornadoes but it estimates potential property damage.
- While all hurricanes produce life-threatening winds, hurricanes rated Category 3 and higher are known as major hurricanes.

Saffir-Simpson Hurricane Wind Scale		
Category	**knots**	**km/h**
5	≥ 137	≥ 252
4	113–136	209–251
3	96–112	178–208
2	83–95	154–177
1	64–82	119–153
TS	34–63	63–118
TD	≤ 33	≤ 62

- **Super-typhoon** – In the western North Pacific, the term super typhoon is used for tropical cyclones with sustained winds exceeding 150 mph.
- This is the equivalent of a strong Saffir-Simpson category 4 or category 5 hurricane in the Atlantic basin or a category 5 severe tropical cyclone in the Australian basin.

> ***Cyclone Milton's*** *wind speed went from 80 mph to 175 mph from 1 p.m. Sunday to 1 p.m. Monday, and its pressure dropped from 988 millibars*

What causes hurricanes to rapidly intensify?

- **Rapid intensification** – It is the increase in a tropical cyclone's maximum sustained wind speed of at least 30 knots – about 35 mph within a 24-hour period.
- Rapid intensification is difficult to forecast, but there are a few driving forces.
- **Ocean Heat**-Warm Sea surface temperatures provide the energy necessary for hurricanes to intensify and deeper the warm water, the more energy a storm can draw upon, enhancing its strength.
- **Low Wind Shear** - Strong vertical wind shear can disrupt a storm's organisation, while low wind shear allows hurricanes to grow more rapidly.
- **Moisture**-Higher Sea surface temperatures and lower salinity increase the amount of moisture available to storms.
- This allows more sustained heat and moisture to transfer to the storm, driving faster and stronger intensification.
- **Thunderstorm Activity** - Internal dynamics, such as bursts of intense thunderstorms within a cyclone's rotation, can reorganize a cyclone's circulation and lead to rapid increases in strength.

> ***Wind shear*** *is the change in wind speed or direction with height.*

> *Warmer waters provide the heat needed for moisture to evaporate, while lower salinity helps trap that heat near the surface.*

How does global warming influence hurricane strength?

- Global warming significantly influences hurricane strength through various interconnected mechanisms.
- The interplay between warmer oceans, increased atmospheric moisture, and rising sea levels due to global warming is making hurricanes stronger and more destructive.
- **Warmer Ocean Temperatures** - As global temperatures rise, sea surface temperatures also increase, providing more energy for storms.
- **Rapid Intensification** - Warmer waters also facilitate rapid intensification of hurricanes.
- **Increased Atmospheric Moisture** - A warmer atmosphere can hold more moisture, which leads to heavier rainfall during hurricanes.
    - Rainfall from tropical cyclones could increase by 11% by the end of this century if global warming is limited to 1.5°C.

- **Rising Sea Levels**-Higher Sea levels result from melting ice and thermal expansion of seawater due to warming and this sea level rise exacerbates the impact of storm surges during hurricanes.
- **Changes in Hurricane Behaviour** - Slower Movement of hurricanes lead to prolonged periods of heavy rainfall and wind in affected areas, increasing overall damage.

2.2 Antarctic Greening

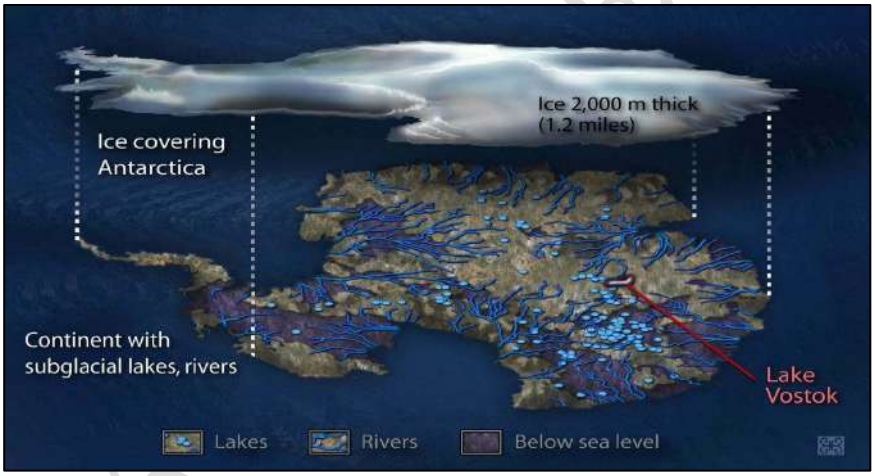
Why in News?

The extent of vegetation in the Antarctic Peninsula has increased 14 times in just 35 years.

What is the Antarctic Ecosystem?

One can suffer serious sunburn whilst there as the snow acts as a reflector which reflects nearly all the ultraviolet rays.

- **Antarctica** - It is the <u>*coldest, windiest, and driest*</u> of all the continents on Earth.
- **Antarctic Desert** - It is a desert with an average <u>*annual precipitation of just 166mm*</u> along the coastal regions, and even less in inland.
- **Average temperature**
  - **In the interior** - About -57°C, with the minimum temperature being -90°C during the winter season.
  - **Coastal Temperature** - Maximum of between -2°C and 8°C during the summer.



- **Ice Cap Climate** - With such cold conditions the snow hardly ever melts and mostly become compressed over time to form part of the ice sheet.
- **Antarctic Ice Sheet** - It is, on average, 1.6 km thick covering about 98% of the entire continent and this is nearly 90% of the entire world's ice.
- **Antarctic Fauna** - Antarctica is best known for its charismatic penguins, seals and whales.

Antarctic Fauna	
Whales	• Ten species of cetacean either live in or frequent the Southern Ocean including humpback and killer whales.
Seals	• Antarctica is home to six distinct species of seal, several of which are found nowhere else on earth.
Penguins	• There are eight species of penguin living in the subantarctic and Antarctica, including Adélie and emperor penguins.
Seabirds	• 100 million birds breed in Antarctica including the endemic snow petrel (Pagodroma nivea).
Krill	• Antarctic krill (Euphausia superba) is a small, crustacean and a keystone species in the Antarctic food web.

- **Antarctic Vegetation** - The majority of Antarctica's plant life is made up of hardy, primitive plants like mosses, liverworts and lichens.
- **Antarctic Plants** - While there are ***<u>no trees or shrubs</u>*** in Antarctica, there are two flowering plants Antarctic hair grass (*Deschampsia antarctica*) and Antarctic pearlwort (*Colobanthus quitensis*).
- **Microscopic insect** - Antarctic micro-forests offer shelter to over 60 species of microscopic insect-like creatures including springtails, rotifers, nematodes and tardigrades.

How quickly is Antarctica warming?

Intergovernmental Panel on Climate Change (IPCC) has estimated that the Earth as a whole is warming at the rate of 0.14-0.18 degrees Celsius per decade.

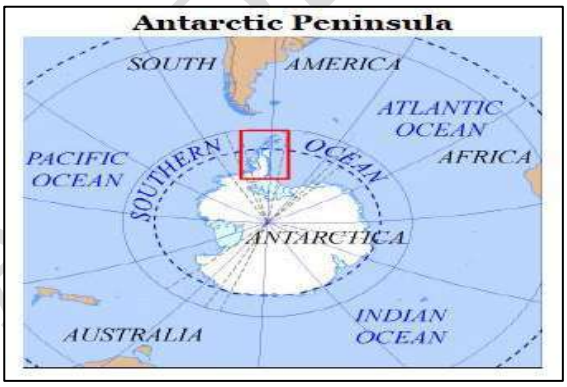
- **Antarctica Warming** - It is warming twice as fast as the global average, at a rate of between 0.22 degrees Celsius and 0.32 degrees Celsius per decade currently.
- **Antarctic Peninsula Warming** - It is warming five times faster than the global average and is now almost 3 degrees Celsius warmer on average than in 1950.

- **Antarctic Heatwaves** - Antarctica has also been experiencing record-breaking heatwaves, especially during the height of its winter season (which is summer in the northern hemisphere).
- **Recent Trend** - In July this year, ground temperatures in parts of the continent were around 10 degrees Celsius higher than normal, and up to 28 degrees higher on certain days.
- **Impact** - Rising temperatures in Antarctica have also resulted in a rapid decrease in the extent of sea ice, the 2024 extent was the second smallest of the satellite record.

*In March 2022, **Antarctica** experienced its most intense heatwave — temperatures in East Antarctica soared to 39 degrees Celsius above*

What is Antarctic Greening?

- Antarctic Peninsula is the long, mountainous extension of Antarctica that points north towards South America.
- **Antarctic Greening** - Plant cover across the Antarctic Peninsula has *increased more than 10 times* over the past few decades due to rising temperatures.
- The rate of greening has increased by more than 30% between 2016 and 2021.
- **Type of Greening** - *Vascular plants native to the area and the moss plants* in the peninsula are expanding.
- In the area surrounding Robert Island—recognised for its vegetation and significant greening trends—researchers observed an 18.7% increase in vegetated area between 2013 and 2016.
- **Causes of Antarctic Greening**
    - **Increasing Temperature** - Ground temperatures in the region have averaged 10 degrees Celsius higher than normal since mid-July this year, with some days reaching temperatures up to 28 degrees higher.
    - **Decrease in sea ice** - Melting ice and warmer temperatures due to global warming in Antarctica creates more favourable conditions for plant growth.
    - Acceleration in vegetation from 2016 to 2021 coincided with a marked decrease in sea ice extent during the same period.
    - **Climate Change** - Warmer open seas lead to wetter conditions that favour plant growth.



What are the impacts of increased vegetation in Antarctica?

***Antarctica** has already lost 280% more ice mass in the 2000s and 2010s than it lost in the 1980s and 1990s.*

- **Landscape Change** – Antarctic landscape remains largely composed of snow, ice, and rock and Soil in Antarctica is mostly poor or non-existent.
- The growth of moss plants in the peninsula is of high concern as mosses can colonise bare rock and add organic matter facilitate soil formation and change Antarctic's landscape.
- **Invasive Species** – Newly created soils could in milder conditions make the continent more favourable for the growth of other invasive species that could threaten native biodiversity and endemic species.
- **Reduce Albedo** - Increase in plant life could also reduce the Antarctic Peninsula's ability to reflect sunlight (solar energy) back to Space, as a darker surface absorbs more solar radiation.
- **Increased Ground Temperature** – Decreased albedo could further increase ground temperatures, with local and global repercussions.
- **Ice Loss** - Rising temperatures will exacerbate the loss of ice, and raise global sea levels.

3. SOCIAL ISSUES

3.1 Circular Migration

Why in News?

Recently India and Israel have signed a circular migration labour agreement.

What is Circular Migration?

- **Circular Migration** – It is a repetitive form of migration wherein people move to another place (the destination country) and back (country of origin) according to the availability of employment.
- It means that people move to different locations for a brief period of time when work is available.
- It is a phenomenon *mostly among low-income groups* who migrate to avail of seasonally available jobs in another country, city, place etc.
- **Circular Migrant** - As per the report on measuring circular migration by the United Nations Economic Commission for Europe Task Force, one is called a circular migrant if you have completed *at least 'two loops' between two countries*.
- Circular migration became quite popular in the 60s and 70s with the advent of globalisation and development.
- **Characteristics of Circular Migration**
    - Temporary residence in the destination location
    - Multiple entries into the destination country
    - Freedom of movement between the country of origin and the country of destination
    - Legal right to stay in the destination country
    - Protection of migrants' rights
- **Driving factors of Circular Migration**
    - Increased access to modern forms of transport and communication.
    - Social networks
    - Growth of multinational corporations
    - Ageing population in developed countries such as Western Europe and Japan.

What is Circular Migration within India?

- **Internal Migration** - In India, internal migration, which is migration within a particular country or State, has almost always been circular.
- **Rural to Urban** - With the advent of jobs in the manufacturing, construction and services sector, there has been a huge flow of migrants from rural areas to urban cities.
- Between 2004–2005 and 2011–2012, the *construction sector* witnessed one of the largest net increases in employment for all workers, specifically for rural males.
- **Rural Urban Collapse** – Due to this migration, rural populations and their economy dwindled and urban spaces witnessed infrastructural collapse as they are unable to properly house incoming populations.
- **Cause -** Uneven development post-liberalisation led to a lot of inter-State migration, with States like West Bengal, Odisha and Bihar having some of the highest rates of out-migration.
- **Pattern** - Initially, most of the migration was to Delhi, nowadays it has increased to southern States as well.
- Most of the rural migrants were occupied in agricultural jobs in their origin States and when they migrated a majority of them were engaged in low-skill jobs.
- **Positive Outcomes** - Higher paying jobs when compared to origin States, better household welfare due to remittances, ease of mobility etc.
- Women get more autonomy and decision-making power in the family due to the absence of men who migrate.
- **Issues** – As Language barrier is a big obstacle, migrants are often at the mercy of middlemen or brokers.
- They are made to work in unhygienic and unsafe conditions with little to no protective equipment.
- They are routinely exploited and suffer significant 'unfreedoms' in host States.
- Indigenous wage groups and unions resent these migrants as they are seen as taking away their jobs by agreeing to work for lower wages.
- **Bare Minimum** - The migrants are able to barely provide for themselves and their families, with no scope for further asset creation or savings.
- Uncertainty - There is also a certain precarity associated with these jobs as they are seasonal and often irregular.

What are the benefits of circular migration?

- **Balanced Migration** - It looks at migration not only from the point of view of the receiving country but also of the sending nation.
- **Human Capital Development** - Enhanced experience of working with sophisticated construction machinery and advanced management protocols
- **Prevent Brain Drain** – The negative effects of brain drain will reduce and a sort of brain circulation will be encouraged, wherein the migrants can use their talents in both countries and still contribute to remittances.
- **Improving Quality of Life** - The ageing demography of the developed world has created the greatest opportunity for India to enhance the quality of life of many Indians in a single generation.
- **Win Win solution** - Government-to-government agreements safeguard the wages and social security of migrant workers in destination countries and their guaranteed return.

> ***Brain drain*** *is the permanent out migration from home country to foreign country of highly-qualified human resources like doctors and engineers.*

What are the challenges?

- Even though India has the requisite numbers, fulfilling the global skills gap is not an easy proposition.
- **Language barriers** – Communication becomes challenging, since moving across different countries with short period stay doesn't let learning the language.
- **Legal compliance challenges** - G-to-G agreements for circular migration require exact skill-matching and many legal compliances.
- **Procedural challenges** - Acquiring a passport and the ability to demonstrate skills in a format required by the receiving country are challenges for rural people.
- Though Indian workers may have the requisite skills, they may not be able to demonstrate them in the pre-defined manner with the use of specific tools.
- **Identifying the resources** – It is a challenge to identify, at scale, youth with the exact required skills.

What are the government initiatives?

- **Demand Aggregation** - National Skill Development Corporation (NSDC) has aggregated the skill gap demand for many of India's partner countries.
- **State level SOPs** - Maharashtra Institution for Transformation (MITRA) worked closely with the NSDC to evolve SOPs and policy norms so that skilled youth could access higher wage markets.
- **Skill Development** - Launched in 2015, this mission aims to provide vocational training and skill development to Indian youth, making them more attractive to employers abroad.
- **Booster Training** - NSDC has developed a four-day course on Recognition of Prior Learning (RPL) to upgrade the existing skills.
- **International Cooperation Agreements** - India has signed bilateral and multilateral agreements with various countries to facilitate labor migration and protect the rights of Indian workers.
- **Overseas Employment Cell (OEC)** - The Ministry of Labor and Employment has established Overseas Employment Cells in various states to provide assistance to migrants and their families.

What lies ahead?

- Establish comprehensive bilateral agreements that outline the rights, responsibilities, and expectations of both migrants and host countries.
- Simplify visa processes, reduce costs, and increase the efficiency of obtaining work permits.
- Offer vocational training and skill development programs to migrants, equipping them with the necessary qualifications for specific job roles.
- Ensure secure and affordable remittance channels to encourage migrants to send money back to their home countries.
- Collaborate with employers in both countries to identify skill gaps and develop tailored training programs.

3.2 Alternative Universal Basic Income (UBI) Scheme

Why in News?

A recent report by the International Labour Organization talks about how jobs growth has been lagging globally due to automation and Artificial Intelligence, and problem of youth unemployment in India.

What are the differences between Cash Transfer Scheme and UBI?

- Both are safety net programmes aimed to address poverty and support their basic income.

Characteristics	Cash Transfer Scheme	Universal Basic Income
Definition	It is aimed at specific purpose for targeted groups.	It is intended to reach all with no conditions.
Coverage	Targeted to specific groups Women, Farmer, Youth, Children. • PM KISAN – Farmers • National Social Assistance Programme	Universal - All Citizens
Cash / Kind	It can be either • Cash as in PM KISAN Or • Kind as in Public Distribution System.	Only in Cash
Conditions	They can be conditional such as • To work as in Mahatma Gandhi National Rural Employment Guarantee Scheme Or • Sending children to school as in Mid-day meals.	No Condition
Individual / Group	It can be individual or family basis.	It is individual basis.
Purpose	They aim to directly address specific problems correspond to specific social objectives.	It addresses diverse problems aiming at holistic development.
Method of Transfer	• Direct transfer to Bank accounts. ○ Example: PM KISAN Or • Through an intermediary mechanism. ○ Example: Public Distribution System	Direct transfer to Bank accounts only.
Inclusion and Exclusion errors	They face inclusion and exclusion errors.	It addresses inclusion and exclusion errors by making everyone eligible.

What are the alternatives to Universal Basic Income?

- Financial feasibility is a big challenge to UBI scheme amounting to 3.5%-11% of GDP, which would either require cutting other anti-poverty programmes or drastically raising taxes.
- **Limited universal income transfer** – It is a modified UBI policy which can be implemented in combined with other transfer schemes instead of replacing them.
- **Negative Income Tax (NIT)** - This system provides payments to individuals whose income falls below a certain threshold, to supplement their income and ensure a minimum level of income for everyone.
- **Universal Basic Services (UBS)** - Instead of providing cash, this approach focuses on ensuring access to essential services like healthcare, education, housing, and transportation.
- **Universal Basic Food Scheme** - Pradhan Mantri Garib Kalyan Anna Yojana (PMGKAY) providing basic food security to almost two-thirds of its citizens.
- **Minimum Income Guarantee** - It targets specific groups such as the unemployed, disabled, or elderly, ensuring they receive a minimum level of income.

Quick Facts

State level Income Transfer Schemes

- **Rythu Bandhu Scheme (RBS)** - In 2018, Telangana launched it to give farmers unconditional payments of Rs.4,000 per acre.
- **KALIA** - Krushak Assistance for Livelihood and Income Augmentation programme launched by Odisha.
- **Rajiv Gandhi Kisan Nyay Yojana (RGKNY)** – Launched by Chhattisgarh to supplement the income of rice, maize, and sugarcane farmers through direct cash transfers.
- **Pudhumai Pen Thittam** – Launched by Tamil Nadu to provide financial assistance for higher education of government school girl students.
- **Mahalir Urimai Thogai** – Financial support to women head of the family.

3.3 Poverty, Prosperity and Planet Report 2024

Why in news?

World Bank has recently released the 'Poverty, Prosperity and Planet: Pathways out of the Polycrisis' report.

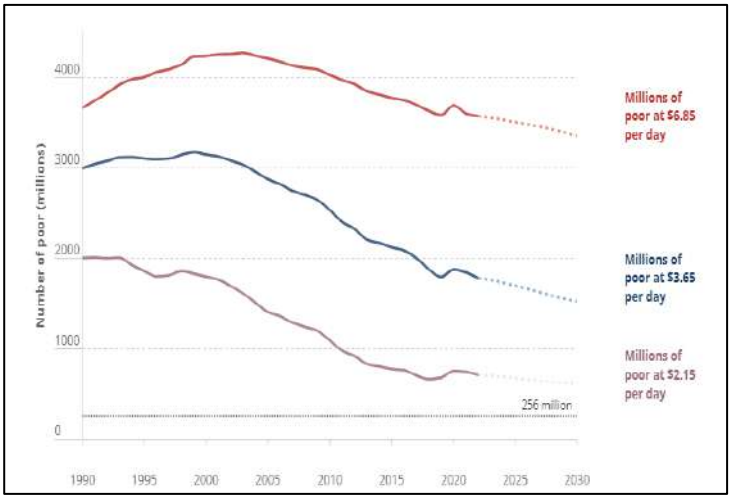
What are its key findings about poverty?

> ***Polycrisis*** *a complex situation where multiple, interconnected crises converge and amplify each other, resulting in a predicament which is difficult to manage or resolve.*

- **Pathways out of the Polycrisis** – It provides the first post-pandemic global assessment of poverty and shared prosperity.
- **Global Poverty Level** - Almost half the global population (44%), live today on less than $6.85 per day, the poverty line for upper-middle-income countries.
- **Global Extreme Poverty** - 8.5% of the global population (almost 700 million people) live today in extreme poverty, on less than $2.15 per day.
    - According to World Bank, the people in extreme poverty is who live on less than **$2.15 per day**.
- **Global Poverty Concentration** - Extreme poverty in Sub-Saharan Africa and fragile countries is increased.
- In 2024, Sub-Saharan Africa accounted for 16 % of the world's population, but 67 % (2/3rd) of the people living in extreme poverty.

> *Poverty threshold standard for middle-income countries is $**6.85 (about Rs 576) per day.***

- **Poverty Level in India** - More Indians are living below the poverty line in 2024 than in 1990, primarily driven by 'population growth'.
- **Extreme Poverty in India** - ***129 mn*** Indians living in extreme poverty in 2024 down from 431 million in 1990.
- **Cessation of Poverty Reduction** - Global poverty reduction *had slowed to a near standstill*, with 2020–2030 set to be a lost decade.
- **Poverty Forecast** - At the current pace of progress, it would take decades to eradicate extreme poverty and more than a century to lift people above $6.85 per day mark.
- Based on the current trajectory, 622 million people (7.3 % of the global population) are projected to live in extreme poverty in 2030.
    - Global poverty reduction target is 3 % by 2030.



- **Projection for India** - India's contribution to global extreme poverty was projected to decline significantly over the next decade.
- **Causes of Stagnant Poverty** - Interconnected crisis of slow economic growth, conflict and fragility, and climate-related shocks.
- **Recommendation** - It is critical to promote sustainable investments, mitigate climate risks, and create opportunities that foster inclusive growth.

What is Global Prosperity Gap?

- **Shared Prosperity** – It is a measure of the inclusiveness of growth.

- **Global Prosperity Gap** – It is a new indicator of shared prosperity used by the World Bank.
- It tracks how far the world is, on average, from a threshold of $25 per person per day with a specific emphasis on the incomes of the poorest.
- **Slowdown in Inclusive Growth** - Progress in reducing the Prosperity Gap stalled since the pandemic, highlighting a slowdown in inclusive income growth over this period.
- High inequality can reflect a lack of opportunities for socioeconomic mobility, which can further hinder prospects for inclusive growth and poverty reduction over time.
- **Level of Inequality** - Around one-fifth of the world's population lives in countries with high inequality.
- High levels of income or consumption inequality are concentrated among countries in Sub-Saharan Africa and in Latin America and the Caribbean.
- **Forecast** - At current growth rates, a typical upper-middle-income country will need 100 years to close the Prosperity Gap.

What are the climate change risks to poverty and inequality reduction?

- **Climate risk** - One in five people are at risk of an extreme weather event in their lifetime and faces severe setbacks in their livelihoods, significantly hindering poverty reduction efforts.
- **Increasing threat** - People's risks to climate hazards are expected to increase unless resilience is strengthened and greenhouse gas (GHG) emissions decline.
- Protecting people from extreme weather events requires acting on two fronts
    - Lowering vulnerability by enhancing risk management
    - Preventing the escalation of future climate hazards by accelerating transformations to reduce the emissions intensiveness of growth.
- **Trade-offs** - Eradicating poverty and boosting shared prosperity requires managing trade-offs between growing incomes and lowering GHG emissions.
- **Recommendations**
    - **Low-income Countries** - Prioritize poverty reduction by delivering economic growth and reduce multidimensional poverty.
    - **Middle-income countries** - Prioritize income growth that reduces vulnerability and synergies to reduce the carbon intensity of growth.
    - **Upper-middle- and high-income countries** - They account for four-fifths of global GHG emissions.
    - These countries need to act fast in transitioning to low-carbon intense economies while managing transition costs.

What lies ahead?

- Faster and more inclusive growth is needed to accelerate progress in achieving shared prosperity.
- Fostering international cooperation and closing financing gaps for sustainable development is critical to enable the transition toward more sustainable, low-carbon, and resilient economies.
- Achieving a world free of poverty on a liveable planet is possible but requires serious and immediate efforts.

3.4 Job Crisis Undermines State Legitimacy

Why in News?

Recently Universal Basic Income is being proposed as a measure to address job crisis.

What are the socio political aspect of employment?

- **Employment** – It provides dignity, adequate compensation, an opportunity for learning, and advancement for those who strive.
- **Relevance of Work** - Liberalism and capitalism have deprioritised traditional sources of community and increased the importance of work in conferring social standing and belonging.
- **Pathway to Social Life** - Work has become the dominant entry point into a broader sense of community and political engagement.

- **Unemployment** - Large sections of unemployed population feel they lack both dignity and financial security.
- Technological advancements and capital concentration potentially displaces large numbers of workers.
- **Disparity** - Concentration of purpose and financial gain among the elites can erode faith in the system and lead to political instability.
- **Political Challenge** - How we structure our society, what we value, and how we include everyone is fundamentally political.

What are the issues in job market?

- **Unemployment** - As per the Annual PLFS Reports, the estimated Unemployment Rate (UR) on usual status was 4.2%, 4.1% and 3.2% during 2020-21, 2021-22 and 2022-23, respectively.
- **Job Insecurity** - Many jobs are unpaid, informal, and does not provide for growth.
- **Defects in Unemployment Enumeration** - To count as employed, a person needs to have reported working for only one month in an entire year.
- **Inadequate Political Response** – Responses to job crisis is oscillating between deferring to market forces and resorting to short-term partisanship.
- **Market-oriented Approach** – It is the *'creative destruction*,' suggesting that old jobs and industries will be seamlessly replaced by new and better ones.

What are the impacts of job crisis?

- **Dissatisfied Youth** - Failure to create avenues for social and economic participation for young people will breed frustration.
- **Loss of Dignity** – The feeling of not contributing meaningfully to society, due to unemployment affects the dignity of a person.
- **State Instability** – It threatens not just economy, but the very legitimacy of the state.
- **Risk to Democracy** - Unemployment *affects trust in government* and satisfaction with democracy.
- **Radicalization** - Loss of faith in democratic institutions will make people seek alternatives, rendering political parties irrelevant, rise of populism, authoritarianism, and civic disengagement.

What are the issues of UBI in addressing unemployment?

- **Universal Basic Income** - It is a minimum "income" received by all citizens of a given population as financial transfers from the government without having to work.
- Making UBI as a solution to employment is associated with socio political problems.
- **Inequality** – UBI premises that technology and capital will create outsized winners while the majority will merely survive on their largesse.
- **Indignity** - UBI implies that a significant portion of the population is no longer needed in the economy, with a smaller subset "paying" for the rest.
- **Emotional Failure** – The UBI approach fails to address people's need to feel relevant and capable.
- **Encourage Populism** - UBI might encourage more anger and populism and provides for just surviving on the sidelines not for contribute and thrive.
- **Short Term Measure** - UBI would shift focus from structural reforms to mere economic transfers.
- **Disincentivize Evolution** – UBI entrench elite power by insulating them from pressures to address fundamental inequities in the economy and labour markets.
- **Erodes State's Role** - It risks recasting the state as a mere distributor of funds rather than the architect and arbitrator of societal processes required to create a just and participatory social and economic system

What lies ahead?

- Parties and institutions must find ways to address structural issues, including unemployment, inequality, and dignity.
- Restore a broader sense of public purpose and economic participation to the centre of our national dialogue to protect democracy and political institutions.

G. S. PAPER II

4. INDIAN POLITY

4.1 Under-representation of Women in Judiciary

Why in News?

The absence of women in the judicial system almost always revolves around entry-level measures that are aimed at ensuring that more women enter the profession as lawyers/ judges.

Data published by the Department of Legal Affairs in 2022 show that approximately 15.31% of all enrolled advocates are women.

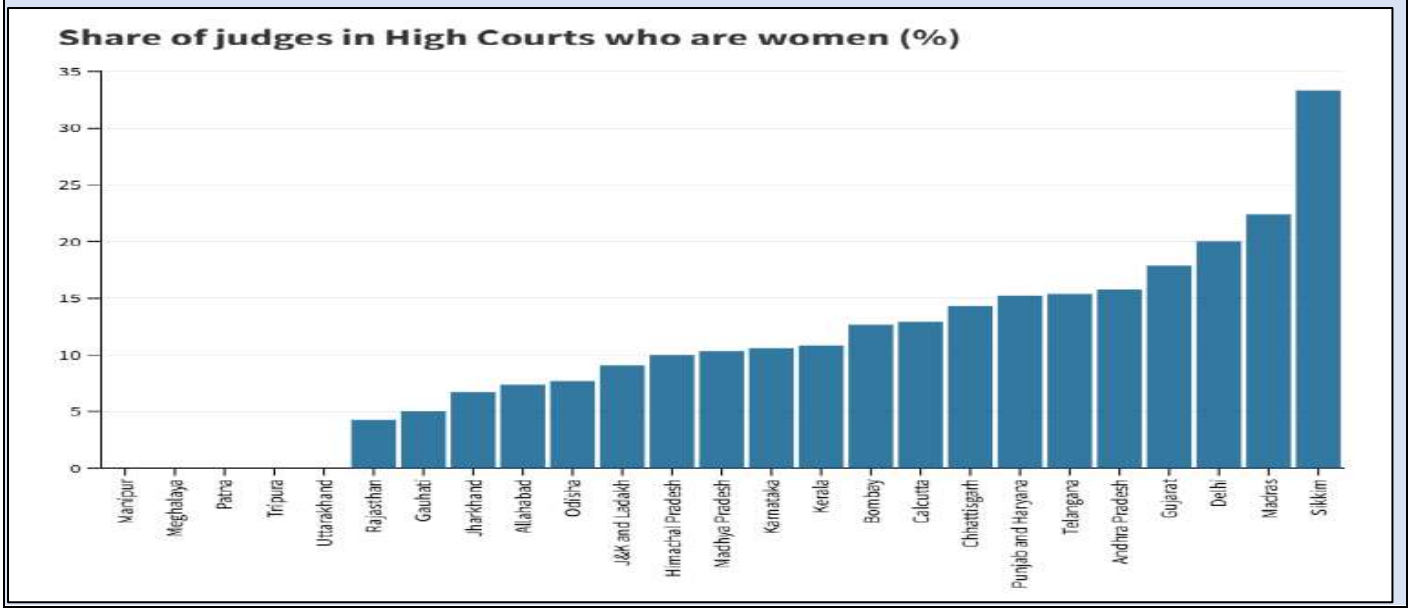
Why women are underrepresented in judiciary?

- **Entry barrier** - Direct recruitment continues to be a challenge for female aspirants due to the conditions like minimum period of 'continuous' practice for elevation to the Bench.
- **Under representation at entry** – It makes only smaller pool of candidates who may be able to establish themselves in the system and be considered for elevation.
- They are under-represented as senior advocates, advocates-on-record, and Bar Council representatives.
- **Retention barrier** - Even those women who have been included are unable to rise to positions of power.
- **Unsupportive environment** - Continued career growth becomes difficult in the face of a discouraging and unsupportive environment which fails to take into account their specific needs.
- **Gender bias** – It results in women judges being sidelined in administrative duties.
- **Transfer policies** – Insensitiveness of transfer polices to the women's role as primary care taker, makes it harder for them to continue in the realm.
- **Limited sanitary facilities**- Multiple courts, including prominent High Courts, lack adequate washrooms even for women judges, let alone for female staff, lawyers, or litigants.
    - A survey in 2019, by the Vidhi Centre for Legal Policy highlighted that nearly 100 district courts have no dedicated washrooms for women.
- **Family responsibilities** – Domestic duties of house management, children and elderly care makes it difficult for women to join after pregnancy.

None of the High Court Building Committees aside from Delhi, Allahabad and Himachal Pradesh currently has even a single woman judge as a member.

Status of women in Judicial System

- Supreme Court of India's "State of the Judiciary" report (2023) about women representation in the
    - District judiciary - 36.3%
    - High Court – 13.4%
    - Supreme Court – 9.3%



What are its impacts?

- **Bias in Court Decisions** - A lack of women judges can lead to biases in court decisions, particularly in cases involving gender-based issues.
- **Deficiencies in Legal Reasoning -** A lack of diversity among judges can result in a narrow understanding of social issues.
- **Illegitimacy of the Judiciary** - When the judiciary does not reflect the gender composition of society, it can raise questions about its legitimacy and fairness.
- **Impact on Future Generations -** The lack of female role models in the judiciary can negatively affect young women's aspirations and self-perception.
- **Reinforcement of Stereotypes -** The absence of women in judicial roles can reinforce societal stereotypes about women's capabilities and roles in leadership positions.

What lies ahead?

- Make the provision to ensure representation in higher judiciary be mentioned in Memoranda of Procedure.
- Implement inclusive policies to enable their entry and retention.
- Ensure the continued support and encouragement and retention of women in the judiciary.
- Provision of family-friendly amenities including feeding rooms and crèches.
- Employment of a feminist lens to recognise the differential needs of women and diminish the impacts discriminatory policies.
- Infrastructural amenities, gender-sensitive recruitment and transfer policies, and adequate training and support are crucial to ensure that the judiciary lives up to its promise of empowering women.

4.2 Internal Democracy of Political Parties

Why in News?

Many national and regional political parties in India are struggling to maintain democratic structures.

What is the internal democracy of political parties?

- **Internal democracy** – The processes and mechanisms by which party members participate in decision-making and leadership selection.
- It's a crucial aspect of a healthy democratic system, ensuring that the party represents the interests of its members and is accountable to them.
- **Open Membership** - Parties should have open membership policies, allowing anyone who meets the criteria (e.g., age, citizenship) to join.
- **Regular Elections** - Regular elections for party leadership positions, such as party president or leader, ensure that members have a say in who represents them.
- **Internal Party Elections** - Members should have the right to participate in internal party elections for various positions, from local to national levels.
- **Party Conventions** - Party conventions provide a platform for members to discuss party policies, elect leaders, and ratify decisions.
- **Free Expression** - Members should have the right to freely express their opinions and dissent within the party, without fear of reprisal.
- **Fair Competition** - Internal party elections should be fair and transparent, with equal opportunities for all candidates.
- **Accountability** - Party leaders should be accountable to the party membership and subject to internal disciplinary procedures if they violate party rules or principles.
- **Transparency** - Party decision-making processes should be transparent, with information about party activities and finances made publicly available.

What are the challenges to internal democracy of political parties?

- Concentration of Power - The tendency in political parties towards the concentration of power in one or few leaders at the top.

- **Heroism** - India's multi-party democracy thrives on diversity but often sees political parties driven by individual charisma rather than internal democracy.
- **Dominance of Elites** - In some cases, a small group of elites may dominate a party, limiting the influence of ordinary members.
- **Factionalism** - The formation of factions within parties can undermine internal democracy by creating divisions and hindering consensus-building.
- **Corruption** - Corruption within parties can erode public trust and undermine democratic principles.
- **Lack of Participation** - Low levels of member participation in party activities can weaken internal democracy and lead to a disconnect between party leadership and the membership.
- **Violation of Party Constitution** - Not keeping membership registers, not holding organisational meetings, and not conducting internal elections regularly.
- **Lack of Transparency** - Ordinary members of the party do not get sufficient information on what happens inside the party.

What is the role of EC in maintaining internal democracy of political parties?

- **Registering Authority** - The EC is the registering authority for all the political parties in our country and thus gives the parties a legal recognition as an entity.
- **Functional Monitoring** - EC monitors whether the political parties are functioning according to their Constitution, by-laws, etc through periodical review of compliance.
- **Oversee Party Election** - Elections monitors whether the elections to their office bearers are taking place regularly.

*The **Election Commission of India** is an autonomous constitutional authority constituted under Article 324 for administering Union and State election processes in India.*

- **Recognising Party Split** – Whenever there is a split in an election party, EC recognizes a group based on 4 tests political party's symbols order, 1968.
    - Following the party Constitution
    - Majority of the party
    - Majority of the legislature
    - Proceeding according to the by-laws.
- All these four tests are applied every time starting from Sadiq Ali case.

What are the challenges to EC?

- **Limited Jurisdiction -** ECs typically have jurisdiction over elections for public offices, but their authority over internal party matters is often limited.
- **Judicial Ruling** - 2002 ruling of the Supreme Court restricted the EC from going into the political process and anything which is part of the political process per se of political parties.
- **No Deregistration Power** - EC has no power to de-register a political party based on any violation of party's constitutional and not conducting periodic elections.
- **Impact of Independence** – When EC becomes political, it becomes susceptible to various political pressures from which it should maintain its distance.
- **Party Autonomy** - Parties often assert their autonomy and resist external interference, even when their internal processes may be undemocratic.
- **Limited Resources -** ECs may have limited resources and personnel to investigate and address complaints of undemocratic practices within parties.

***ECI can de-register** if registration has been obtained on the basis of fraud or other things.*

What lies ahead?

- Consider the wholistic approach of delivering elections on the stipulated time and in a free fair manner.
- Educate the electorate to consider the internal democracy of political parties an important parament while voting for a party.
- Develop clear and specific laws and regulations governing inner-party democracy.

5. GOVERNMENT POLICIES AND INTERVENTIONS

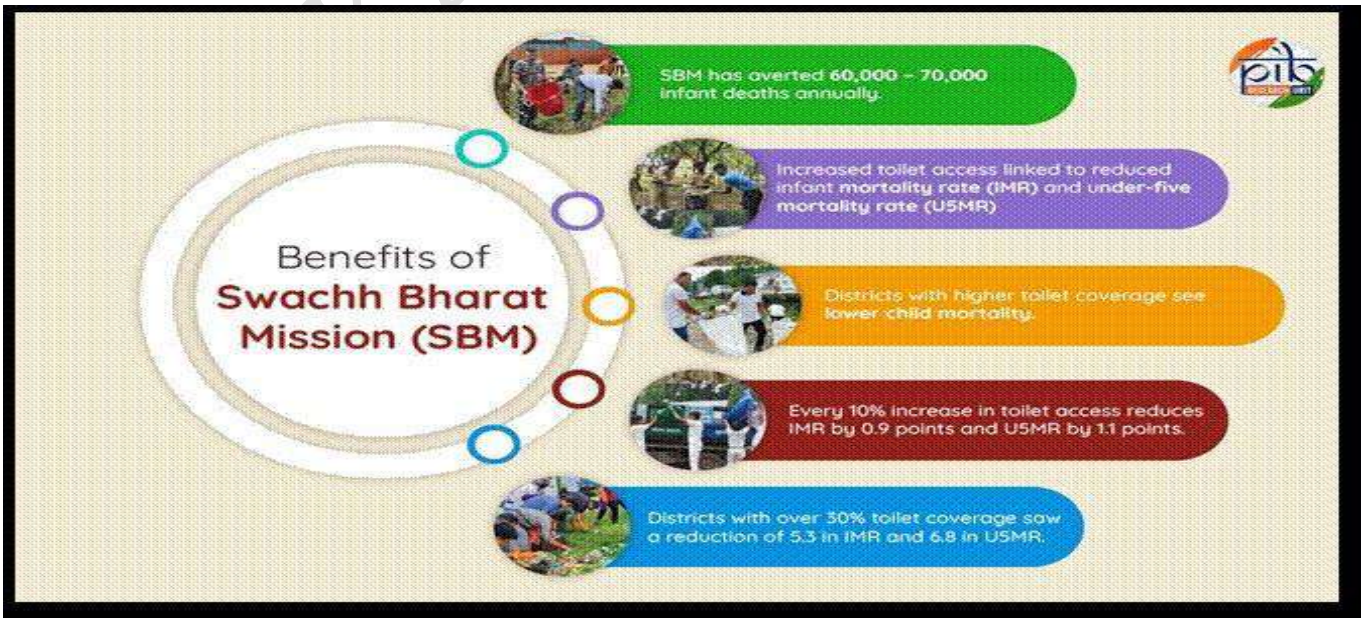
5.1 Decade of Swachh Bharat Mission

Why in News?

Oct 2, 2024 marks the 10th year anniversary of the launch of Swachh Bharat Mission.

What is Swachh Bharat Mission (SBM)?

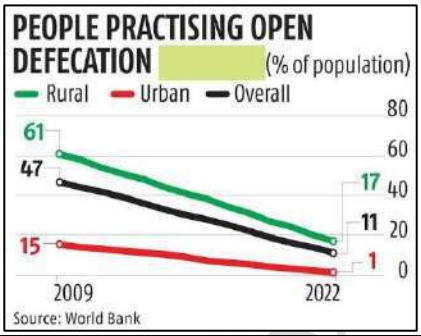
- **SBM** – It is largest behavioural change movement in the world, aiming to end open defecation through awareness campaigns, education, and infrastructure development.
- **Launched in** – October 2, 2014.
- **SBM Phase I Period** – 2014 to 2019.
- **Aim** - To create a Clean India by 2019.
    - Address the issue of WASH (Water, Sanitation, and Health)
    - Eliminating open defecation
    - Improving unsanitary toilets
    - Eradicating manual scavenging
    - Enhancing solid waste management
    - Promoting behavioural change regarding sanitation
- **Components** - The mission will cover all rural and urban areas.
    - **SBM Gramin (SBM G)** - Implemented by Ministry of Drinking Water and Sanitation.
    - **SBM Urban (SBM U)** - Implemented by Ministry of Housing and Urban Affairs
- **Implementation Responsibility** - Entire project is governed and monitored by state agencies.
- **Unique Approach** – SBM combines toilet construction with substantial investments in IEC (Information, Education, and Communication) and community engagement.
- **Individual Household Latrine (IHHL) Scheme**- It provides financial assistance to eligible households to build toilets.
- **Community-Led Total Sanitation (CLTS)**- It emphasizing community participation and behavioural change by mobilizing communities to collectively take action to end open defecation.
- **IEC Campaign** - The mission places a strong emphasis on IEC activities to create awareness about the importance of sanitation, hygiene practices, and the usage of toilets.



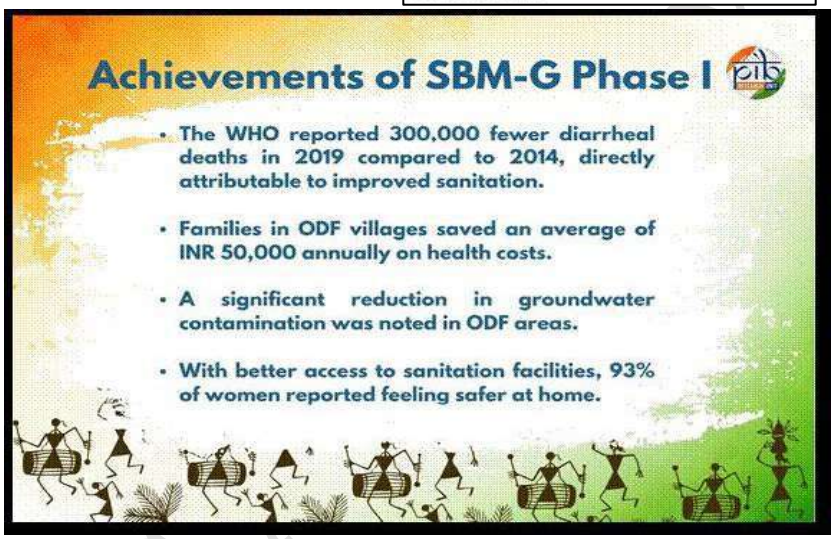
- **Swachh Bharat Mission Phase II (2019-2025)**
    - SBM Urban 2.0 launched on October 1, 2021 to achieve Garbage Free Status for all cities.

- SBM Gramin 2.0 was launched to transform all the villages from ODF to ODF Plus Model.

What are the achievements of SBM?



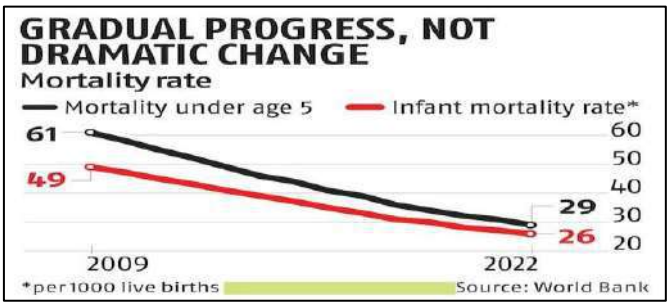
- **ODF Free** - Government declared India "Open Defecation Free" in 2019.
- **Increased Toilet Construction** - More than 12 crore toilets have been built since the launch of the Swachh Bharat Mission (SBM) 10 years ago.
- **Increased Toilet Access** - Over 82% households had toilet access in 2019-21 up from 45 % in 2004-05.
- **ODF Plus Villages** - Currently, 93 % of villages have achieved the ODF Plus status.
- **Waste Management** - 78 % of the waste have been processed.
- **Reduced Mortality** - Improvements in sanitation facilities have led significant reductions in infant and child mortality rates.
- Districts with over 30 % toilet coverage under SBM experienced reductions of 5.3 in the Infant Mortality Rate (IMR) and 6.8 in the Under-5 Mortality Rate (U5MR) per thousand live births.
- **Public Movement** – The efforts of Sanitation workers, religious leaders, athletes, celebrities, and Non-Governmental Organisations and the general public have transformed the SBM into a huge public movement.



- **Environmental Improvement** – Significant reduction in ground water contamination and improvement in landscape are observed in open defecation areas.
- **Women Safety** - With better access to sanitation facilities, 93% of women reported feeling safer at home.

What are the issues?

- **Continuing Open Defecation** - Although there has been a decrease in open defecation, 11 % of the population still practised it in 2022, mostly in rural areas.
- **Rural Urban Divide** - Urban centres have 95.6 % access to toilets compared to 76 % in rural India.
- **Caste in Waste Management** - Sanitation and waste management in India are associated with the wide prevalence of caste and the same old caste practices is still prevailing despite the efforts.
- **Manual Scavenging** - Only 66% districts in country free of manual scavenging.
- **Poor Quality and Maintenance** – The quality of toilets and lack of adequate water infrastructure discourage the continued used of the facilities.
- **Inequality** – The reach of SBM facilities in communities in slums and other marginalized is far less than developed areas of the cities.
- **Waste Handling** - In rural India, toilet construction has not been linked to waste treatment and in peri-urban areas, the faecal sludge generated is discharged into the environment without treatment.
- **Insufficient Funds** – Village panchayats do not have enough financial resources to get road sweeping machines, more vehicles to transport the waste.
- **Decline in Budget Allocation** - SBM urban had a massive downward revision in Revised Estimates of 2023-24 from the Budget Estimates by around 49 %.



What lies ahead?

- Implement cleanliness initiatives at the district, block, village, and local levels.

- Promote bio toilets to address manual scavenging and increase fund allocation for their rehabilitation.
- Improve the administrative and technical capacity of local governments for the effective implementation of diverse objectives of the mission.
- Increase the technological solutions in handling the solid waste from generation to disposal.
- Encourage the use of waste-to-energy plants and biological methanation at the local and regional level.

Rationalising PDS and NFSA

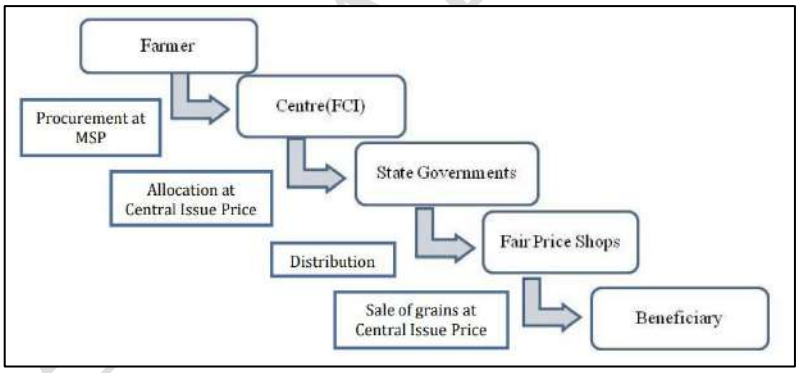
Why in News?

October 16 is observed as World Food Day every year by the United Nations Food and Agriculture Organisation (FAO).

How has the Public Distribution System evolved?

> ***The public distribution*** *of essential commodities was in existence in the country during the inter-war period and its focus on distribution of food grains in urban scarcity areas, had emanated from the critical food shortages of 1960s.*

- **Public Distribution System (PDS)** – It evolved as a system of management of scarcity through distribution of food grains at affordable prices.
- PDS is operated under the joint responsibility of the Central and the State/UT Governments.
- **Role of Central Government** - Procurement, storage, transportation and bulk allocation of food grains to the State Governments through Food Corporation of India (FCI)
- **Role of State Government** - Allocation within State, identification of eligible families, issue of Ration Cards and supervision of the functioning of Fair Price Shops (FPSs)
- **Commodities under PDS** - Wheat, rice, sugar and kerosene are being allocated to the States/UTs for distribution.



- Some States/UTs also distribute additional items of mass consumption through the PDS outlets such as pulses, edible oils, iodized salt, spices, etc
- **Benefit of PDS** - PDS had substantially contributed to the containment of rise in food grains prices and ensured access of food to urban consumers.
- As the national agricultural production had grown in the aftermath of Green Revolution, the outreach of PDS was extended to tribal blocks and areas of high incidence of poverty in the 1970s and 1980s.
- **Revamped Public Distribution System (RPDS)** – It was launched in June, 1992 to strengthen and streamline the PDS by adopting area approach for ensuring effective reach of the PDS commodities.
- **RPDS Distribution** - Food grains for distribution in RPDS areas were issued to the States at 50 paise below the Central Issue Price and the scale of issue was up to 20 kg per card.
- **Targeted Public Distribution System (TPDS)** - In June, 1997, the Government of India launched the TPDS with focus on the poor.
- **BPL Families** – They were identified by the States as per State-wise poverty estimates of the Planning Commission for 1993-94 based on the methodology Lakdawala committee methodology.
- **Benefits** – For BPL Families, 20 kg of food grains per family per month at 50% of the economic cost and for APL families at economic cost.
- **Antyodaya Anna Yojana (AAY)** - It was launched in December, 2000 for one crore poorest of the poor families.
- **AAY Benefits** - Rs.2/- per kg. for wheat and Rs.3/- per kg for rice and 35 kg per family per month.
- **Expansion of AAY** - AAY Scheme has since expanded to cover 2.50 crore poorest of the poor households.
- **National Food Security Act** - The 2013 Act aimed at reducing exclusion errors legally entitles up to 75% of the rural population and 50% of the urban population to receive subsidized foodgrains under TPDS.

- **Expanded Coverage** - About two thirds of the population of maximum coverage of 81.34 crore persons, is covered under the Act.
- **Pradhan Mantri Garib Kalyan Anna Yojana (PMGKAY)** - It has been extended for a period of next five years with effect from 1st January, 2024.

What is the need for rationalizing PDS and NFSA?

- **High Cost of Food Subsidy** – The annual food subsidy for distribution of food grains to AAY households and PHH beneficiaries, Other Welfare Schemes and Tide Over is to the tune of Rs. 2.13 lakh crore.
- **Reduced Poverty** – As per NITI Aayog's Multi-dimensional Poverty Index, poverty ratio has declined from 29.13 % in 2013-14 to 11.28 % in 2022-23.
- The coverage of 66% target under NFSA can be reduced accordingly.
- **Price Revision** – Subsidized food prices have not been revised since inception of the act.
- **PDS leakages** - A substantial part of almost 25 to 30 % of food and fertilisers subsidies, , never reaches the intended beneficiaries.
- **Fund Diversion** - Along with fertiliser subsidy, it cuts down much more rational and productive investments in agri-food space, such as in Agri-R&D, precision agriculture, micro-nutrients, women's education and sanitation.
- **Corruption** - when Subsidies are abundant and almost open-ended, become an instrument of corruption.

> ***PDS "leakages"*** *refer to the proportion of PDS rice and wheat released by the Food Corporation of India (FCI) that fails to reach consumers and it is estimated by matching NSS data on household PDS purchases with "offtake" data of the Food Ministry.*

- **Ineffectiveness** - Targeting errors such as Many individuals who are not poor possess Below Poverty Line (BPL) ration cards, while some eligible poor households lack these cards.
- This misallocation undermines the effectiveness of food distribution.
- **Adaptation to Changing Conditions** - As climate change impacts agricultural productivity, rationalizing policies can facilitate the adoption of climate-resilient crop varieties and efficient irrigation systems.

What lies ahead?

- Ensure enough lead time to prepare for proper implementation and transformation.
- Digitisation of the agri-food system could help in rationalizing the food subsidy system.
- Revise the subsidized food prices in alignment with the inflation figures.
- Encourage states to implement SMART PDS system to improve its effectiveness and efficiency.

5.2 Gram Panchayat-Level Weather Forecasting

Why in News?

Recently, Indian Government has launched the System of Weather Forecast at Gram Panchayat Level.

What is Gram Panchayat level weather forecasting?

- It is part of the Government's *100 Days Agenda* and reflects a *Whole of Government approach*.
- **Launch** – It was launched ***in 2024,*** a joint programme of
  - Panchayat Raj Ministry
  - India Meteorological Department (IMD)
  - Ministry of Earth Sciences
- **Aim** – It is aimed at *empowering rural communities* and enhancing *disaster preparedness* at the grassroots, and will benefit farmers and villagers across the country.
- **Localised forecasting** – It is based on gram panchayat boundaries data provided by the Panchayati Raj Ministry.
- **Target** – It will be available for *nearly all 2.6 lakh panchayats* across India
- **Dissemination of information** – It will be made through Panchayat Raj Ministry's digital platforms like
  - ***Mausamgram*** of IMD
  - ***e-GramSwaraj*** of Ministry of Panchayati Raj

- ***Meri Panchayat app*** of Ministry of Panchayati Raj

What are the features of localised weather forecasting?

- **SMS alerts on weather warning** – It will also be sent to Panchayat representatives regarding extreme weather events like cyclones and heavy rainfall, ensuring immediate action to protect lives, crops, and property.
- **Hourly forecasts** – It can see data on the current temperature, wind speed, cloud cover (in percentage), rainfall, and relative humidity at the level of gram panchayats.
- **Five-day forecasts** – It will be of minimum and maximum temperatures, rainfall, cloud cover, wind direction, and wind speed, and an overall weather forecast.
- **Coverage** – It is available at the district and block levels.
- **Accuracy** – It currently has the ability to forecast weather events over a *12 km x 12 km area*
  - **Experimental forecasts** – For 3 km x 3 km grids
  - **Future objective** – To make hyper-local forecasts for 1 km x 1 km areas.

Mausamgram

- It is a noble initiative aiming at "HAR HAR MAUSAM HAR GHAR
- MAUSAM" (weather information at each house hold at any time).
- **Developed by** – Indian Meteorological Department (IMD)
- **Aim** – To provide location specific forecast at Gram Panchayat level.
- **Weather forecasts**
  - hourly up to 36 hours
  - 3-hourly from 36 hrs to next five days
  - Every 6-hourly from next 5 days to 10 days.
- It will be further augmented with the implementation of Mission Mausam.

e-GramSwaraj

- **Launched by** – Ministry of Panchayat Raj
- **Objectives** - It helps to prepare and execute Gram Panchayat Development Plan (GPDP).
- It will ensure real time monitoring and accountability.

Meri Panchayat app

- **Launched by** – Ministry of Panchayat Raj
- **Objectives** – It aims to create a unified mobile governance platform for rural areas, including residents, functionaries, and Panchayati Raj Institution System stakeholders.
- It seeks to streamline and consolidate various functions and information scattered across different portals into one cohesive mobile platform, thus serving the varied needs of Gram Panchayats.

How does it help the public?

- **Efficient disaster management** – It will also reduce the loss of life and property from the meteorological disasters.
- **Promote sustainable agriculture** – It empowers the cultivators to make critical decisions in agriculture, such as planning sowing, irrigation, and harvesting activities
- **Enhance farmer's livelihood** – It can ensure better returns and increase their profits.
- **Strengthen grassroots governance** – It improves administration and ensures tailor made approaches in information dissemination.

Mission Mausam is a two-year initiative by the Indian government to improve India's weather forecasting and climate resilience.

There are 2.55 lakh village panchayats across the country, with resident populations of a few thousands on average.

- **Enable climate-resilient rural population** – It enable rural communities to better plan agricultural activities and prepare for weather-related risks.

5.3 Global Hunger Index 2024 (GHI)

Why in News?

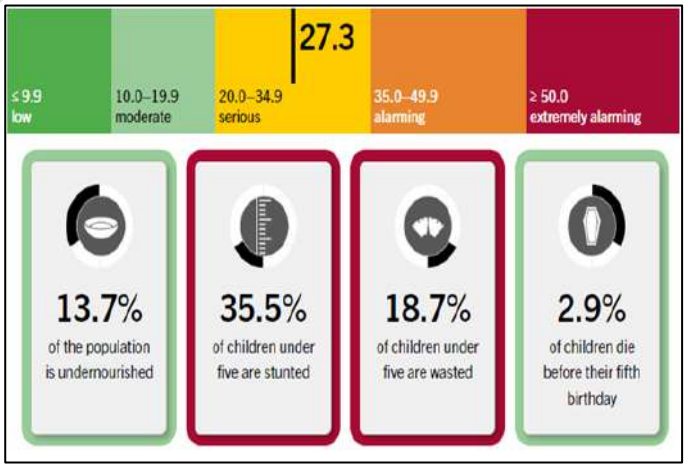
Recently, Global Hunger Index (GHI) 2024 has been published.

What are the components of Global Hunger Index?

- **GHI** - It is a tool for comprehensively measuring and tracking hunger at global, regional, and national levels.
- **Released by** - Concern Worldwide, an Irish humanitarian organisation, and Welthungerhilfe, a German aid agency.
- GHI scores are based on the values of four component indicators.
- **Undernourishment** -The share of the population with insufficient caloric intake.
- **Child Stunting** - The share of children under age five who have low height for their age, reflecting chronic undernutrition.
- **Child Wasting** - The share of children under age five who have low weight for their height, reflecting acute undernutrition.
- **Child Mortality** - The share of children who die before their fifth birthday, partly reflecting the fatal mix of inadequate nutrition and unhealthy environments.

What is the hunger level of India?

- **India's GHI 2024 Rank** - India ranks 105th out of the 127 countries with a score of **27.3**.
- **Hunger Status** - Severe
- As per the report, about 200 million people i.e. 14% of India's existing population is undernourished.
- **Data Used** - It considers the Sample Registration System statistical reports released by Ministry of Statistics and Programme Implementation publishes annually.
- **India's Undernutrition (As per the report)**
  - **Infant mortality Rate** - It was 26 per 1,000 live births in 2022, while the global average was 28.
  - **Undernourishment** - 13.7% of the population
  - **Child Stunting** - 35.5% of children
  - **Child Wasting** - 18.7% of children
  - **Child Mortality** - 2.9% of children dying before their fifth birthday.



- **Contention by India** - Ministry of Women and Child Development had expressed concerns about the data not being accessed from their ICT application 'Poshan Tracker'.
- **Difference in Data** – Government data on child wasting was 7.2% while the report states 18.7%.

What are the reasons?

- **Systemic Failure** - GDP growth alone does not result in improved food and nutritional security for the entire populace.
- **Low Per Capita Income** – India's per capita income, of $2,485 in FY24, was less than a fourth of the global average of $13,920 in FY22.

India was the world's fastest growing economy, at 6.8% in FY24, with an estimated GDP of almost $4 trillion, ranking fifth globally.

- **Food Inflation** – It had more than doubled between FY22 and FY24, from 3.8% to 7.5%, affecting the poor.
- **Impact on Farm Output** - Extreme weather events, low reservoir levels and damaged crops, affected farm output.

- **Failure of Safety Net Systems** – Inadequate coverage of social security programs.
- **Climate Change** - It has already begun to cast a long shadow on India's food security affecting its productivity.
- **Intergenerational Undernutrition** - Poor nutritional status of mothers being transferred onto their children.
- India's high child wasting rate entail mothers inflicted with insufficient weight gain during pregnancy and low birth weight among infants.

What needs to be done?

- **Inclusive Development** – Enact policies to emphasise pro-poor development alongside addressing social/economic inequalities.
- **Improve access to safety nets** - Improve access to programs such as the Public Distribution Scheme (PDS), PMGKAY and Integrated Child Development Services (ICDS).
- **Agri Transformation** - Invest in agriculture and a holistic food systems approach to promote diversified, nutritious and ecological food production including nutri-cereals such as millets.
- **Health Improvement** - Make effective investments in mother and child health and improve water, sanitation and hygiene.
- **Multifaceted Approach** – Engage interventions to consider links between food and nutrition, gender and climate change.
- **Strengthen Existing System** – Diversify the food given under ICDS and index the allocation with inflation.

5.4 Pradhan Mantri Bhartiya Janaushadhi Pariyojana (PMBJP)

Why in News?

Recently, Pradhan Mantri Bhartiya Janaushadhi Pariyojana (PMBJP) reached a significant milestone, with Janaushadhi medicines worth Rs. 1,000 crore sold in the year 2024-25 till October 2024.

What is Janaushadhi Pariyojana?

- It is a campaign ***launched in 2016***, to provide quality medicines at affordable prices to the masses making essential healthcare accessible to all citizens.
- **Launched by** – *Department of Pharmaceuticals* under Ministry of Chemicals and fertilisers in association with Central Pharma Undertakings.
- **Objectives** – Ensuring *access to quality medicines* for all sections of the population especially the poor and the deprived ones.
- Creating *awareness about generic medicines* through education and publicity to counter the perception that quality is synonymous with high price only.
- Encouraging health care professional particularly in those government hospitals, to *prescribe generic alternatives*, thereby promoting cost-effective treatment options.
- Generate *employment* by engaging individual entrepreneurs in opening PMBJP Kendra
- **Implementation** – It is implemented by ***Pharma & Medical Bureau of India (PMBI)***, a society registered under the Societies Registration Act.
    - Pharma & Medical Bureau of India (PMBI) was earlier called as Bureau of Pharma PSUs of India (BPPI).
- **Operation** – It is operated by government agencies as well as by private entrepreneurs.

> ***Generic drugs*** *are marketed under a non-proprietary or approved name rather than a proprietary or brand name. They are equally effective and inexpensive compared to their branded counterparts.*

What are its salient features?

- **Incentives to the Kendra owners** – Rs. 5.00 lakh to be given @ 15% of monthly purchases made, subject to a ceiling of Rs. 15,000/- per month.
- **One-time incentive** – Rs. 2.00 lakh is to be provided for furniture & fixtures and computer & printers to the PMBJP Kendras opened in *North-Eastern States, Himalayan areas, Island territories* and backward areas mentioned as aspirational district by NITI Aayog.

> ***Janaushadhi Kendras*** *(JAKs) are accessible points for quality healthcare, providing a friendly environment where individuals can find the medications theu need.*

- It is also provided if it is opened by *women entrepreneur, Divyang, SCs & STs and Ex-servicemen*.
- **Prices of the medicines** – They are ***50%-90% less*** than that of branded medicines prices in the open market.
- **Quality procurement** – They are procured only from World Health Organization – *Good Manufacturing Practices (WHO-GMP*) certified suppliers for ensuring the quality of the products.
- **Quality assurances** – Each batch of drug is tested at laboratories accredited *by 'National Accreditation Board for Testing and Calibration Laboratories (NABL)'* for ensuring best quality.
- **Access to sanitary napkins** - Jan Aushadhi Suvidha ***Oxo-biodegradable Sanitary Napkins*** were launched in 2019.
- They are made available at *Rs.1/ per pad only* in more than 12600 PMBJP Kendras across the country.
- **Jan Aushadhi Sugam** – It is a *mobile application* launched in 2019 for various purposes like
    - To locate nearby Jan Aushadhi Kendra through Google map
    - To search Jan Aushadhi generic medicines
    - To compare prices of Generic v/s Branded medicines in terms of MRP, overall savings, etc.

What are its impacts?

- **Promotes health equity** – It ensures essential healthcare products are available, accessible and affordable to everyone, especially the marginalized.
- **Savings to the citizens** - It is estimated to have saved *approximately of Rs. 30,000 crores* of citizens in the past 10 years.
- It has saved about Rs. 5000 crore in the current year (FY 2024-25)
- **Greater coverage** - The number of kendras has grown to more than 14,000 and all districts have been covered.
- **Extensive product basket** – It includes *2047 medicines and 300 surgical devices*, catering to various therapeutic groups.
- **Nutrition security** - *Nutraceuticals products* like protein powder, malt-based food supplements and glucometer, etc. have been launched.
- **Generates employment** – It is also providing a good source of *self-employment* with sustainable and regular earnings.
- The scheme is truly doing justice to its tagline "Jan Aushadhi - Seva bhi, Rozgar bhi".

What are its significant milestones?

- **Growth in number of JAKs** – Kendras increased from just 80 in 2014 to *more than 14,000 today*, an astonishing increase of over 170 times in a decade.
- **Growth in sales** – Medicines worth Rs. 1,000 crore sold by October 2024, two months earlier than in the previous year.
- It also achieved a noteworthy sales figure of Rs. 200 Crores in September 2024 alone
- **Increased demand** – *Nearly 1 million people* visiting these user-friendly Kendras daily.
- **Future prospects** – It *plans to establish 25,000* Jan Aushadhi Kendras throughout India in the next two years.

What lies ahead?

- Organise workshops across India with Kendra owners, doctors and various important dignitaries.
- Embrace the integrated approach for spreading awareness about PMBJP with State Governments.

5.5 Dietary Diversity for Children

Why in News?

A recent study finds that, India's central region showing the highest prevalence of minimum dietary failure.

What is diet diversity?

- **Diversity in diets** – It is associated with consuming diverse food groups that provide enough nutrients through a healthy diet.
- It includes adequate quantities of carbohydrates, proteins, vitamins, and minerals through diverse diets.

- It includes cereals, mainly pulses, nuts, oil, meat, fish, eggs, fruits, and vegetables.
- **Dependent factors** – Diet diversity was found to be dependent upon four major factors
    - Availability
    - Affordability
    - Awareness
    - Utilisation
- **Benefits** – Food group diversity is associated with improved linear growth in young children.
- **Lack of diet diversity** – It can increase the risk of micronutrient deficiencies, which can harm children's physical and cognitive development.

Impact factors of Malnutrition

- Poverty
- Food insecurity
- Inadequate access to health care
- Lack of education
- Lack of access to safe water and sanitation

What is minimum dietary diversity for children?

- **Minimum dietary diversity (MDD) score** – It is a population-level indicator to *assess diet diversity* as part of infant and young child feeding (IYCF) practices.
- It is calculated for *children of 6-23 months old*.
- **Development** – It is ***developed by WHO and UNICEF*** to provide simple, valid, and reliable metrics for assessing IYCF practices at the population level (WHO/UNICEF, 2021).
- **Umbrella program** – It is a component of the Minimum Acceptable Diet (MAD) indicator, which is a composite indicator described in the same 2021 guidelines.

Minimum Acceptable diet (MAD) among children aged 6–23 months

MAD for currently breastfeeding children		MAD for not currently breastfeeding children		
MDD	**MMF**	**MDD**	**MMF**	**MMFF**
Consumed foods and beverages from at least five out of eight defined food groups* during the previous day	Consumed solid, semi-solid or soft foods at least the minimum number of times~ during the previous day	Consumed foods and beverages from at least five out of eight defined food groups* during the previous day	Consumed solid, semi-solid or soft foods at least the minimum number of times~~ during the previous day	Consumed at least two milk feeds~ during the previous day

- **Data collection** - Data are gathered from a questionnaire administered to the child's caregiver.
- Respondents are asked to indicate whether or not their child consumed any food over the ***previous 24 hours from each of the eight food groups.***
- **Calculation**

$$\frac{\text{Number of children 6 – 23 months of age who received foods from 5 or more food groups yesterday during the day or night}}{\text{Children 6 – 23 months of age for whom data on breastfeeding and diet were collected}} \times 100$$

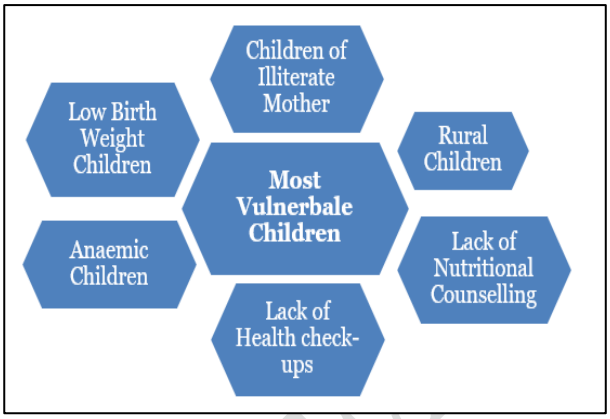
- **Significance** – It can be used to monitor and assess the dietary quality of infants and young children and the appropriateness of complementary feeding practices at the population level.

MDD-IYCF Food Groups	
1	Breast milk
2	Grains, white/pale starchy roots, tubers and plantains
3	Beans, peas, lentils, nuts and seeds
4	Dairy products (milk, infant formula, yogurt, cheese)
5	Flesh foods ((meat, fish, poultry, organ meats)
6	Eggs
7	Vitamin-A rich fruits and vegetables
8	Other fruits and vegetables

What are key findings of study?

- **Regional disparities** – There is huge variations across different states and rural-urban areas.
- **Impact on children** – About 77% of children in India aged 6-23 months lack diversity in diet as suggested by the WHO.
- **Poor performers** – Uttar Pradesh, Rajasthan, Gujarat, Maharashtra and Madhya Pradesh reported the highest levels of inadequate diversity in children's diets, all above 80%.
- **Better performers** – Sikkim and Meghalaya were the only two to report an under-50% prevalence.

- States such as Kerala, Tamil Nadu, Himachal Pradesh, Jammu and Kashmir and Odisha have provided adequate diets for non-breastfed children compared to other states / UTs.
- **Improved food groups** - *Egg consumption raised* from around 5% in NFHS-3 to over 17% in NFHS-5.
- *Legumes and nuts consumption increased* from nearly 14% during 2005-06 to over 17% during 2019-21.
- The consumption of *vitamin A-rich fruits and vegetables increased* by 7.3%, whereas the consumption of fruits and vegetables increased by 13% over the same time.
- For *flesh foods*, the consumption increased by 4%.
- **Insufficient diets** - The *consumption of breastmilk dropped* from 87% in NFHS-3 to 85% in NFHS-5.
- *Dairy products consumption decreased* from 54% in NFHS-3 to 52% in NFHS-5.



What lies ahead?

- Promote dietary diversity through the consumption of a variety of foods from different food groups.
- Implement a food-based minimum dietary diversification approach.
- Call for improvements in public distribution systems.
- Intensify programmes like ICDS.
- Enhance more nutrition counselling efforts.
- Increase awareness and knowledge about the importance of MDD.

*The **POSHAN Maah** thematic celebration on **POSHAN Vatikas** captures the importance of diversity in diets. Promoting MDD helps in preventing malnutrition and improving the health and development of children.*

6. GOVERNANCE

6.1 Empowering local bodies for effective urban governance

Why in News?

Recently heavy rains severely affected cities across Gujarat, and responses of local bodies have been commented.

What are Urban Local Bodies?

- **Urban local bodies (ULBs)** – These are the fundamental grass root democratic unit of urban governance in our cities.
- **Types** - Municipal Corporations, Municipalities, Nagar Panchayats.
- They are the first point of contact for citizens and are responsible for providing essential services such as waste management, sanitation, and urban planning.
- **Pre-colonial Governance** - Indian cities had informal governance structures that varied based on the city's primary activities, whether as trading hubs or religious (temple) towns.
- **Colonial Governance** - British established city level institutions such as improvement trusts to deal with the city's sanitation problems.
- The improvement trusts were tasked with the responsibility of cleaning up the city and ensuring that epidemics were prevented.
- These trusts in Bombay or Calcutta were tasked to handle diseases like the plague by planning for wider streets, improving drainage systems and decongesting overcrowded housing.
- **Post Independence** – 74th Constitutional Amendment Act in 1992 accorded constitutional recognition to ULBs as the third tier of governance, alongside the central and state governments.

The first municipal body was established in Madras in 1687, followed by Bombay and Calcutta.

*In 1882, **Lord Ripon**, father of local self-government in India, introduced the resolution for local-self-governments, thereby laying the foundations of a democratically elected municipal government to manage cities.*

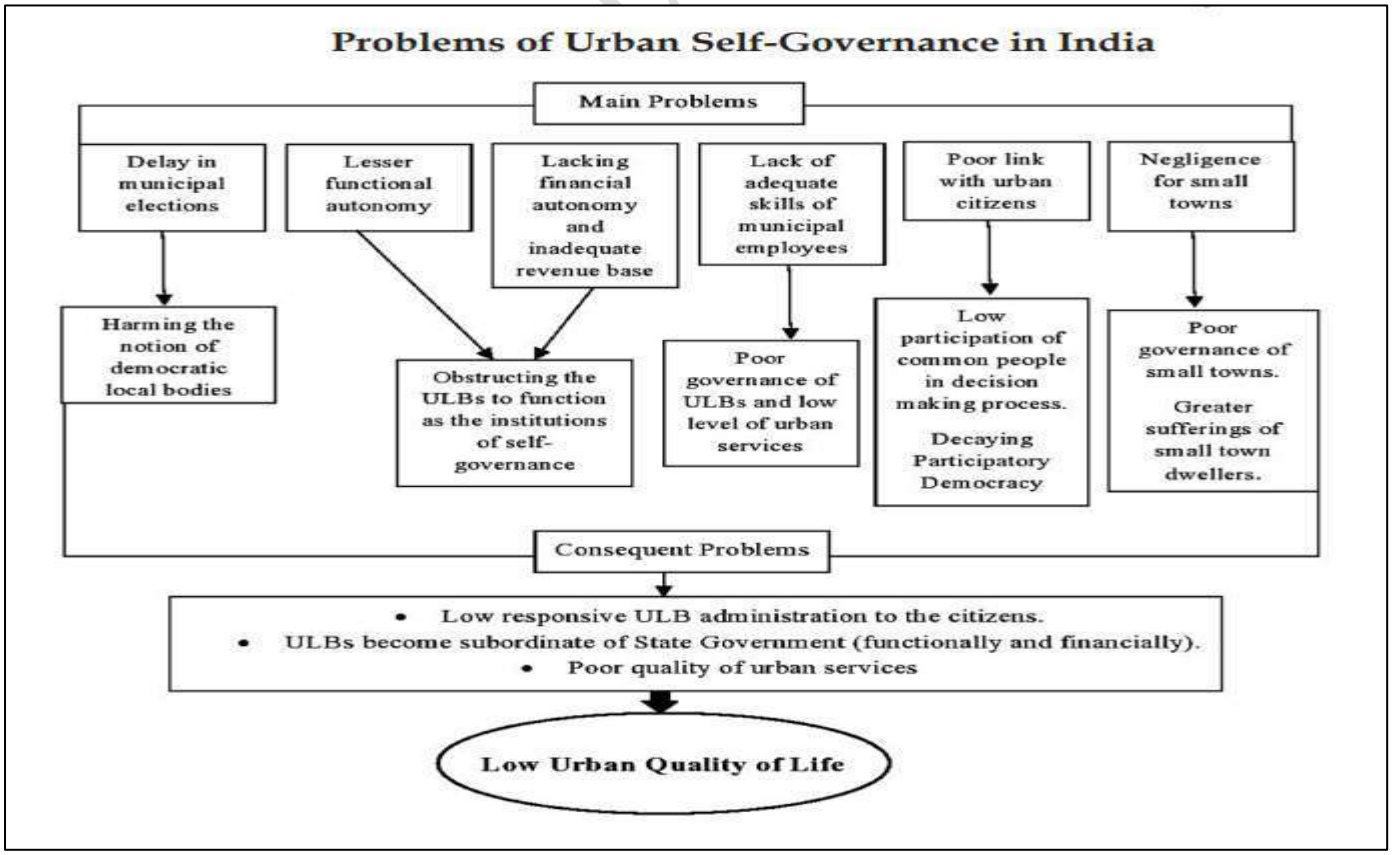
***Government of India Acts 1935** recognised the importance of local self-governments and they were treated under provincial or state subjects.*

- **Constitutional Provision** - The Part IX-A, Article 243P – 243ZG, provides for the compositions, roles and responsibilities of these ULBs.
- **Functional Devolution** - The 12th Schedule of the constitution specifies 18 functions of ULBs ranging from urban planning, land use to public health and waste management.
- **Election** - Mandatory elections for every 5 years, with municipal councillors elected from local constituencies (wards).
- **Municipal Corporation Administration** - The elected (directly or indirectly) mayor serves as the ceremonial head, real executive power rests with the municipal commissioner, a state-appointed bureaucrat.

What are the significances of local bodies?

- Urban local bodies (ULBs) play a crucial role in the development and management of urban areas.
- **Deliver Essential Services** - They are responsible for providing water supply, sanitation, drainage systems and waste management.
- **Protecting Public Health** - They ensure public health by managing waste collection and disposal, maintaining cleanliness, and providing urban primary healthcare facilities.
- **Providing Education -** They often oversee the establishment and management of schools and educational institutions.
- **Social Welfare -** They implement social welfare programs to address the needs of vulnerable populations.
- **Urban Planning -** They create and implement urban plans to guide development & ensure sustainable growth.
- **Land Use Regulation** - They regulate land use to prevent haphazard development and preserve green spaces.
- **Attracting Investment** – They can create a conducive environment for businesses and attract investments by providing necessary infrastructure and services.
- **Managing Urbanization -** They play a vital role in managing the challenges associated with rapid urbanization, such as housing shortages, traffic congestion, and pollution.
- **Climate Change -** They can implement measures to mitigate the impacts of climate change, such as promoting sustainable practices and improving disaster preparedness.

What are the issues in ULB governance?



- **Constrained Political Autonomy** - More executive powers are entrusted to municipal commissioners than mayor leading to administrative overlaps, delayed decision-making.

- **Operational Dependency** – Inadequate devolution of functions to local bodies makes them depended on State governments devolves functions
- **State Interference** - State governments exert significant influence over city affairs and influence day-to-day functioning of ULBs, further diminishing the autonomy of local governance.
- This often leads to administrative overlaps, which reportedly delay decision-making, especially at a time of crisis.
- **Corruption -** It can undermine the effectiveness of ULBs, diverting resources and hindering development.
- **Delay in Municipal Elections** - Despite the constitutional requisite to conduct elections every five years, in most of the states the local body elections are not conducted properly.
- **Inadequate Funding –** They often suffer from insufficient funding, limiting their ability to provide essential services and infrastructure.
- A major source of municipal revenue is property taxes, with remaining funds coming from the state government.
- **Limited personnel -** They often lack qualified personnel with the necessary skills and expertise to manage complex urban issues.
- There is one planner for 75,000 urban populations, a low figure compared to other local governments globally.
- There are only 5,000 qualified town planners, and cities would require at least 3 lakh town planners by 2031.

What steps can be taken to empower ULBs?

- Municipal governance reforms are needed for Indian cities to respond effectively to urban problems.
- Greater financial autonomy could enable them to generate revenue & reduce dependence on government funding.
- Enable ULBs to raise funds through pro-market measures such as bonds and securities or by levying user charges such as congestion charges, parking fees, etc.
- Innovative financial plans with diverse sources of income allow ULBs to be more flexible and creative to address their problems.
- Participatory budgets empower city residents to participate in deciding how their taxes can be effectively utilised.
- Upgrade technical expertise and state capacity by bringing in experts and personnel for improved service delivery.

7. INTERNATIONAL RELATIONS

7.1 B20 Summit

Why in News?

B20 Summit Brazil 2024 will be held during October 24 -25 in 2024.

What is B20 Summit?

- **B20** - Business 20 (B20) is the official G20 dialogue forum with the global business community, connecting the business community with G20 governments.
- The group includes around 900 business representatives and proposes to the G20 policy recommendations prepared by task forces meeting virtually over the presidential term.
- **G20 2024 Presidency** – Brazil

> *The **B20** officially met for the first time at the Toronto summit in 2010, in an effort to deal with the effects of the 2008 economic crisis.*

- **Business Potential** - Businesses of the world have the potential to leverage new opportunities for growth and benefit from wider dispersal of developmental gains.
- **Policy Priorities** - Businesses of both advanced and emerging economies have come together and identified key priorities and policy actions that will facilitate inclusive growth and development.
- **Businesses and Global Growth** - As lead players in the growth endeavour, businesses also must prioritise certain actions to align with emerging challenges faced by the world.

What can the businesses do for inclusive development?

- Equitable growth remains a top imperative as the world seeks to promote inclusive development.
- **Skill development** - Empowering workers and building their capacity to adapt to changing industrial scenarios.
    - Tailored programmes for skilling and upskilling workers, particularly women.
    - On-the-job training
    - Working with academic institutions and developing curricula suited to evolving industry needs.
- **Financial Access** - Tailored credit solutions along with diversity and inclusion policies.
    - In India, the convergence of Unified Payments Interface and digital access has transformed financial transactions, with over 530 million accounts opened under the landmark Jan Dhan Yojana.
- **African Inclusion** - Expand business footprint in Africa to not only leverage its rapid growth and young demographics but also to support the continent's inclusion in global value chains.
    - Africa was admitted to G-20 in 2023 during the presidency of India.

What can the businesses do for better food security?

- Sustainable food systems and boosting food and nutrition security are another critical pillar of focus for encouraging sustainability efforts.
- **Challenges in Food Security**
    - **Climate Change**- Myriad factors including the impact of extreme weather events have exacerbated the global food crisis.
    - **Trade Issues** - National security concerns and unfair trade practices are leading to rising tariffs and other hurdles that constrain the efficacy of trade.
- **Role of Businesses in Addressing Food Security**
    - **Sustainable Agri Practices** -Investing in infrastructure and Agricultural technologies such as precision farming, digital tools.
    - **Resilient Global Trade** - Organisations such as the World Trade Organization should be strengthened to identify and counter unfair trade practices.
    - **Collaboration** - Fostering collaborations with governments and international organisations for amplifying efforts on food security.

What is the role of business in ensuring common global aspirations?

- **Digital transformation and innovation** - It must harness AI for responsible use in health care, climate change and resource management.
- **Youth Inclusion** - It can engage youth in developing innovative solutions to pressing contemporary issues and drive positive societal impact.
- **Investments** – It can invest in social tech startups, digital platforms for research and development collaborations.
- **STEM** – Corporates should develop science, technology, engineering and mathematics (STEM) talent in mission mode.
- **Sustainability** - Fair and just climate policies can enable businesses to work towards carbon mitigation.
- **Energy Transition** - Building renewable energy capacity and greater use of biofuels and green hydrogen can be promoted by businesses.
- **Circular Economy** - Industry should promote circular economy options and strive to inculcate sustainable business practices in their usual operations across the board.
- **Corporate Governance Standards-** Businesses should go beyond established best practices in compliances and regulatory systems to continually drive ethical operations.

G.S PAPER III

8. ECONOMY

8.1 Indian Labour Market

Why in News?

Recently 7th Periodic Labour Force Survey (PLFS) has been released for the period of July 2023 to June 2024.

What are the issues with the Labour Market of India?

- Indian labour market has a complex interplay of rural and urban trends, gender disparities, and the persistent struggle of India's youth to secure stable employment.
- **Worker population ratio** – WPR for individuals aged 15 and above saw a slight rise to 57.1 per cent in 2023–24, up from 56.0 % the previous year.
- **Unemployment Rate (UR)** - UR for individuals aged 15 and above in the usual status stands at 3.2 %.
- In rural India, the unemployment rate for men is 2.7 %, while urban men face a higher rate of 4.4 %.
- **Female UR** - In rural regions, it is just 2.1 %, while urban centres report a much higher 7.1 %.
- **High Rural Labour Force Participate Rate** - LFPR stands at 60.1 %, with rural areas reporting a higher participation rate of 63.7 %, compared to 52 % in urban regions.
- High rural participation is driven by necessity rather than opportunity, with much of the workforce engaged in small-scale subsistence farming.
- **High Rural Women LFPR** - Rural women have an LFPR of 47.6 % compared to their urban counterparts, where the rate drops to 28%.
- In rural areas, women are predominantly self-employed in agriculture, which does not necessarily lead to better income or job security.
- **High Youth Unemployment** - For individuals aged 15 to 29, the unemployment rate stands at 10.2 %.
- Rural male youth unemployment is 8.7 %, while in urban areas, it rises to 12.8 %.

What are the causes for the labour market issues?

- **Dominance of agriculture** - Agriculture has long been a key source of jobs, particularly for rural populations, but the sector's productivity and potential for economic growth remain limited.
- The reliance on agriculture in rural areas limits opportunities for diversification and income growth.
- **Seasonal Agriculture** - The seasonal nature of agricultural work often leaves workers underemployed during non-harvest periods, contributing to rural labour market volatility.
- While farm employment provides a safety net for many rural households, it often translates to lower income levels and fewer opportunities for skill development.
- **Cultural Barriers** - Gender disparity in both LFPR and UR reflects the cultural and economic barriers that prevent women from accessing formal sector jobs in cities.
- **Exploitative nature** - Rural women's self-employment is primarily in small-scale farming, limiting their participation in more diversified and higher-paying sectors.
- **Inequal Resource Accessibility** - Resources such as credit, land, and market linkages remain limited for women, further entrenching their roles in low-productivity agricultural activities.
- **Defective Education System** - This high rate of urban female youth unemployment underscores the mismatch between the education system and the job market.
- **Lack of Opportunities** - As more young people pursue formal education, particularly in urban areas, the job market has not kept pace in creating opportunities that match their qualifications.
- **Skill Mismatch** - Many young women find themselves overeducated and underemployed, struggling to find jobs that align with their skill.
- **Under employment** - The rise in rural areas can be attributed to agricultural work, where underemployment remains widespread.
- **Capital Intensive Manufacturing** –It result in low employment creation despite high 7% economic growth.

What lies ahead?

- Better vocational training and education reform to bridge labour market gap and ensure that young people, particularly in urban areas, are better prepared for the jobs available in the market.

- Create more inclusive & dynamic labour markets.
- Promote labour-intensive industries to generate jobs.
- Support the growth of micro, small, and medium enterprises (MSMEs) as job creators.
- Foster a culture of entrepreneurship and provide resources to support startups.
- Promote balanced regional development to reduce migration and create job opportunities in rural areas.

8.2 PM Gati Shakti National Master Plan

Why in News?

PM Gati Shakti program celebrated third anniversary of the launch of the initiative.

What is PM Gati Shakti Program?

- **PM Gati Shakti** – It is the **National Master Plan for Multi-modal Connectivity**, launched on October 13, *2021* aimed at transforming India's infrastructure and connectivity.
- **Aim** - Provide seamless and efficient connectivity for the movement of people, goods, and services across various modes of transport, thereby enhancing last-mile connectivity and reducing travel time.
- **Integrated Scheme** - It incorporates the infrastructure schemes of various Ministries and State Governments.
    - **For Ex:** Bharatmala, Sagarmala, inland waterways, dry/land ports, and UDAN.
- **District-Level Integration** - A District Master Plan (DMP) portal is being developed to extend it to the district level to aid district authorities in collaborative planning, infrastructure gap identification, and scheme implementation.
- The DMP portals for all the country's districts will be developed in a phased manner and completed by March 31, 25.
- **Digital Master Planning** - IT employs advanced technology and GIS-based spatial planning tools to monitor and manage infrastructure projects.
- **Progress** – It has on boarded 44 Central Ministries and 36 States/UTs and a total of 1,614 data layers have also been integrated.
- **State Integration** - All 36 states and UTs have developed state master plan (SMP) portals, aligned with the PM Gati Shakti NMP platform, to synchronise infrastructure assets and enhance regional development.

What are the achievements of the program?

- It has resulted in numerous achievements across various sectors, significantly improving project planning, speed, and execution.
- **Identifying Infrastructure Gap** - 156 Infrastructure Gaps relating to first and last-mile connectivity issues of major sectors of the economy, such as, Coal, Steel, Fertilizer, Ports, Food and Public Distribution have also been identified.
- **Roads and Railways** - The Ministry of Road Transport and Highways (MoRTH) planned over 8,891 km of roads using NMP, while the Ministry of Railways (MoR) used NMP to plan more than 27,000 km of railway lines.
- **Petroleum and Natural Gas Pipeline Planning** - Ministry of Petroleum and Natural Gas (MoPNG) streamlined the process for Detail Route Survey (DRS), reducing the time required to create reports from 6-9 months to one day using electronic DRS (eDRS).
- **Green Energy Corridor** - Using NMP principles, a 13 GW renewable energy project from Leh (Ladakh) to Kaithal (Haryana) achieved optimal alignment of the 'Green Energy Corridor' for inter-state transmission.

- **Disaster Management** - Goa used the NMP platform to develop a disaster management plan for flood-prone areas along the Amona River.
- **Educational Development** - The Uttar Pradesh government employed the State Master Plan (SMP) portal to identify locations for new schools in underserved areas via the ***Pahunch Portal.***
- **Coastal Corridor Planning** - Gujarat planned its 300 km coastal corridor using NMP, which reduced the number of NoC permissions required for clearance from 28 to 13.
- **Skill Development** - The Department of School Education and Literacy used the NMP portal to link PM Shri Schools with local industries for district-specific skill training.
- The Ministry of Skill Development & Entrepreneurship utilized NMP to identify suitable locations for new training institutes near economic clusters.
- **Health Planning** - The Ministry of Health and Family Welfare identified internet shadow areas and mapped sites for new healthcare facilities using NMP.
- **Expanding Anganwadis** – It helped in effectively planning the locations of Anganwadi Centres and more than 10 lakh Anganwadi Centres have been mapped on the National Master Plan.
- **Scheme Integration** - The Ministry of Rural Development integrated schemes such as PMGSY and PMAY-G for better asset planning and implementation.
- **Tribal Development** - The Ministry of Tribal Affairs identified infrastructure gaps for Particularly Vulnerable Tribal Groups (PVTG) using the PM JanMan portal.
- **Universal Broadband** - Gati Shakti Sanchar portal was launched to facilitate faster rollout of telecom infrastructure and facilitated the rapid deployment of 5G services across the country on October 1, 2022.

> ***Gati Shakti Sanchar portal*** *is a Centralised Right of Way (RoW) Portal that enables applicants from Telecom /Infrastructure / Internet Service Providers (TSP/IP/ISPs) to apply for RoW approvals.*

What are the its benefits?

- **Integrated Planning** - The 'whole-of-government' approach involves 44 Central ministries and 36 States and Union Territories for coordinated project execution.
- **Faster Project Execution** – It facilitated coordinated planning and execution of infrastructure projects.
- **Eliminating Silos** - Network Planning Group (NPG) to synchronise efforts across ministries has eliminated silos that have hindered project efficiency.
- **Lower Logistics Cost** – The seamless multimodal connectivity improved the logistical efficiency in the movement of goods and people across various transport modes—roads, railways, ports, and air travel.
- **Increased Competitiveness** – Improved logistics efficiency and reduced logistics cost have increased the competitiveness of Indian industry.
- This initiative has ensured seamless movement of goods, addressed bottlenecks within the supply chain
- **Better Opportunities** – Large scale implementation of projects have created direct and indirect employment and livelihood opportunities.
- **Sustainable Logistics Network** - PM Gati Shakti is also focused on building smart green solutions for sustainable infrastructure and promoted environmental responsibility aligned with national climate goals.

What lies ahead?

- Taking PMGS to the international level and promoting the use of PM Gati Shakti and geospatial technology in the integrated planning of infrastructure in neighbouring countries.
- Granting non-government players access to non-sensitive shareable data relevant to the planning of infrastructure projects.

8.3 2024 Economics Nobel prize

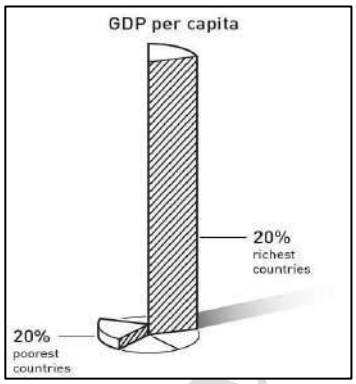
Why in News?

The 2024 Economics Nobel prize was awarded to U.S. economists Daron Acemoglu, Simon Johnson and James A. Robinson "for studies of how institutions are formed and affect prosperity."

Why some countries are rich while others are poor?

- **Global Economic Disparity** - The richest 20% of countries in the world today are 30 times richer in terms of average income than the poorest 20%.

- **Great Divergence** - Industrial revolution led to the vast difference in living standards between the East and the West.
- **Causes of Economic Disparities**
  - Western colonialism
  - Disparities in natural resource endowment
  - Climate / Geography
  - Intelligence
  - Historical accidents
  - Institutional Difference - Differences in the quality of economic and political institutions
  - Rule of Law
- **Institutional Difference** - Differences in the quality of economic and political institutions.
- Societies with a poor rule of law and institutions that capitalise on its population with an exploitative intent neither generate growth nor change for the better.



*The book **"Why Nations Fail: The Origins of Power, Prosperity, and Poverty"** written by Daron Acemoglu and James A. Robinson.*

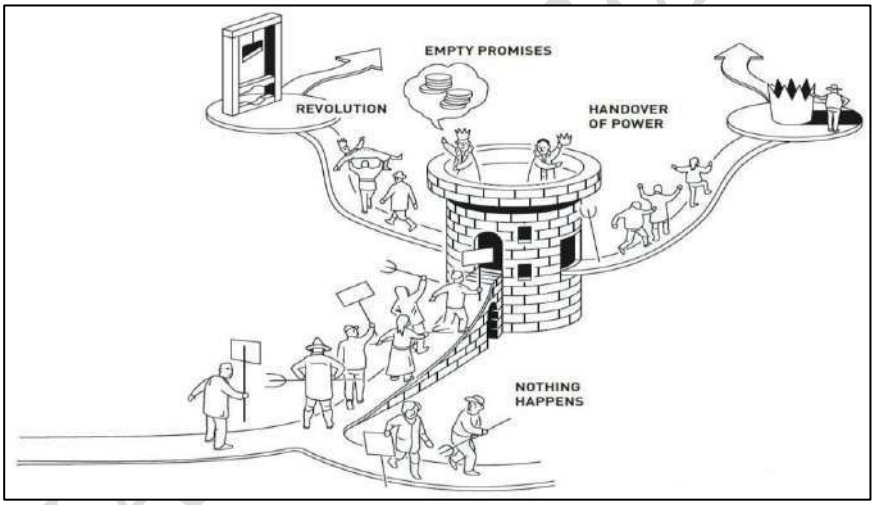
What are Inclusive and Extractive institutions?

Characteristics	Inclusive Institutions	Extractive Institutions
Property Rights	They secure private property rights and democracy.	They insecure private property rights.
	They prevent the State from seizing the property of honest citizens.	They legalize expropriation of properties from citizens.
Citizens	They incentivize citizens to work hard without the fear of expropriation.	They affect individual incentives negatively.
	They encourage citizens to grow and develop.	They capitalise on its population with an exploitative intent.
Economic Growth	They lead to general economic prosperity.	They cause economic stagnation.
	They promote long-run economic growth and higher living standards.	They cause economic degradation and poverty.
Political Freedom	Enables political freedom.	Lack of political freedom
Rule of law	Better	Poor
Benefits	Long-term benefits for everyone.	Short-term gains for the people in power.
Colonial History	When Europeans colonised large parts of the globe, the institutions in those societies changed.	
	These are set up by colonists to settle for the long-run.	These are setup by colonists when they did not want to settle in a certain country.
	They were introduced in countries that were poor and sparsely populated when they were colonised.	They were introduced in countries that were rich and densely populated when they were colonised.
	Example: USA	Example : India

	Here British set up inclusive institutions that promoted long-term economic prosperity and encouraged investment.	Here British set up institutions to plunder the maximum resources within a short span of time.
Incidence of disease	The places where diseases were most dangerous for Europeans now have dysfunctional economic systems and the most poverty, as well as the greatest corruption and weakest rule of law.	

How Democracy evolves out of extractive institutions?

- **Personal Gain** - When the rulers of a country are able to safely extract sufficient resources for their personal gains, extractive institutions are created.
- **Lack of Compulsion** - They have little reason to bring in political and economic reforms (or inclusive institutions) that can benefit the wider population over the long run.
- **Commitment Problem** - The ruling elites do not believe the population will compensate them for the loss of economic benefits with the new system.
- In such cases, extractive institutions may prevail for a really long time as long as the masses do not revolt against the status quo.
- **Conflict** - Difference over how resources are allocated and who holds decision-making power in a society (the elite or the masses) arises.
- **Revolt** – When people up rise against extractive institutions, some rulers may decide to yield to popular demand and set up inclusive institutions to aid economic growth.



- **Democracy** – At the end of revolution, power is transferred to people, resulting in democracy.

8.4 Securing India's Digital Future

Why in News?

Gujarat Police recently uncovered a large-scale cyber fraud operation, who were running a nationwide “digital arrest” scam.

What is the need for cyber financial security?

- **Digital India** - India is one of the largest global consumer markets, with shoppers going more digital every single day.
- **Expanding Fintech Inclusion** - India is leading in fintech inclusion, with an fintech adoption rate of 87%, significantly higher than the global average of 64%.
- **Growing Digital Lending** - Digital lending market valued at $270 billion in 2022, expected to grow at a CAGR of 22% to reach $1.3 trillion by 2030.
- **Increasing Digital Payments** - India currently leads the world in digital payments with more than 40% of payments made digitally amounting to Rs.10 billion in January 2023.
- **Digital Shift** - The affinity to shop and pay online has created an immense shift in Indian retail, most noticeable with the rise of D2C businesses nationwide.
- **Cyber Fraud** - Digital payment frauds in India saw a more than fivefold jump to Rs 14.57 billion (Rs 1,457 crore) in the year that ended in March 2024.
- **Public Trust** – Increased cyber fraud could lead to an erosion of public trust in digital businesses.

What are the types of cyber financial fraud?

- As the Financial Services sector continues to advance technological innovations, scammers employ various deceptive tactics to obtain sensitive information and money from individuals.

- **KYC Fraud** - Scammers impersonate as Bank officials or government representatives, target customers through deceptive text messages or calls to lure into providing personal / sensitive / financial information.
- **Customer Care Fraud** - Scammers manipulate search engine results to display fake customer care numbers or call as customer care representatives and ask sensitive information.
- **Lottery Fraud** - Victims receive Fake notifications claiming they've won a lottery, but they need to pay fees or provide personal details to claim the prize, resulting in financial loss.
- **Card Fraud** - Fraudster posing as Bank representative, may call & ask for sharing Card Number, Expiry Date, CVV, PIN, OTP etc. under false pretext or fabricated scenarios.
- **UPI Fraud -** Fraudsters persuade users to make fund transfers or payments to unknown UPI IDs or disclose sensitive UPI credentials such as UPI ID, PIN, OTP, etc., enabling them to carry out fraudulent transactions.
- **Electricity Bill Scam** - Fraudster sends fake message threatening disconnection of services due to unpaid bills.
- **Task Based Job Fraud** - Scammers approach individuals, with lucrative work-from-home opportunities and convince them to invest.
- **Digital Arrest Fraud** - Cybercriminals coerce victims into paying large sums to avoid fake criminal charges investigation for money laundering or drug smuggling.

***Fintech** refers to the integration of information communication technology into financial services to improve and automate the delivery and use of financial services.*

How fintech can make businesses safer?

- **Identity verification –** They leverages advancements in biometric security, such as face recognition software, to make the opening of digital accounts safer through accurate identity verification.
- **Risk Management -** AI-backed algorithms can scan thousands of transactions in real time to identify payments & accounts linked to fraudulent activities.
- **Proactive Risk Profiling –** They can create risk profiles for accounts with a high chance of fraudulent activity.
- **Data Encryption** - They use advanced encryption techniques to protect sensitive financial data, ensuring that information is secure during transmission and storage.
- **Secure Payment Processing** - They provide secure and efficient payment processing solutions, reducing the risk of payment fraud and ensuring that transactions are processed safely.
- **Compliance and Regulatory Support** - They help businesses stay compliant with regulatory requirements, ensuring that they adhere to industry standards and best practices for security

What are the measures taken in India?

- **National Cyber Security Policy –** It was established in 2013, this policy provides a framework for protecting critical information infrastructure and enhancing cybersecurity awareness.
- **CERT-Fin (Computer Emergency Response Team for Financial Sector)** – It was launched in 2017, this specialized unit works towards strengthening cyber security in the financial sector.
- **RBI Cybersecurity Framework -** The Reserve Bank of India (RBI) issued comprehensive guidelines for financial institutions to enhance their cybersecurity posture.
- **Cyber Swachhta Kendra**: A botnet cleaning and malware analysis centre that provides free tools to citizens and organizations to secure their systems.
- **National Critical Information Infrastructure Protection Centre (NCIIPC)** – It was established to protect critical information infrastructure in various sectors, including banking and finance.
- **Information Technology Act, 2000** – It provides legal framework for addressing cybercrime and electronic commerce.
- **Cyber Surakshit Bharat Initiative** - A programme to educate & enable the Chief Information Security Officers (CISO) & broader IT community to address the challenge of cybersecurity.
- **Indian Computer Emergency Response Team (CERT-In)** – It is the national agency for responding to computer security incidents.
- **Digital Personal Data Protection (DPDP) Act 2023** – It provides for the processing of digital personal data in a manner that recognizes both the rights of the individuals to protect their personal data.
- **National Cybercrime Reporting Portal (NCRP)** – It facilitate victims/ complainants to report cybercrime complaints online.

- **Chakshu facility on Sanchar Saathi portal** - It facilitates citizens to report the suspected fraud communications with the intention of defrauding telecom service users.

What lies ahead?

- With better security products, fintech can enhance public trust in digital India to catalyse the country's economic growth further.
- By building on this foundation, fintech has the potential to emerge as the anchor of India's digital safety.

8.5 Impact of food inflation on overall inflation

Why in News?

In September, the Consumer Price Index surged to 5.5 %, while food inflation crossed 9.2 %.

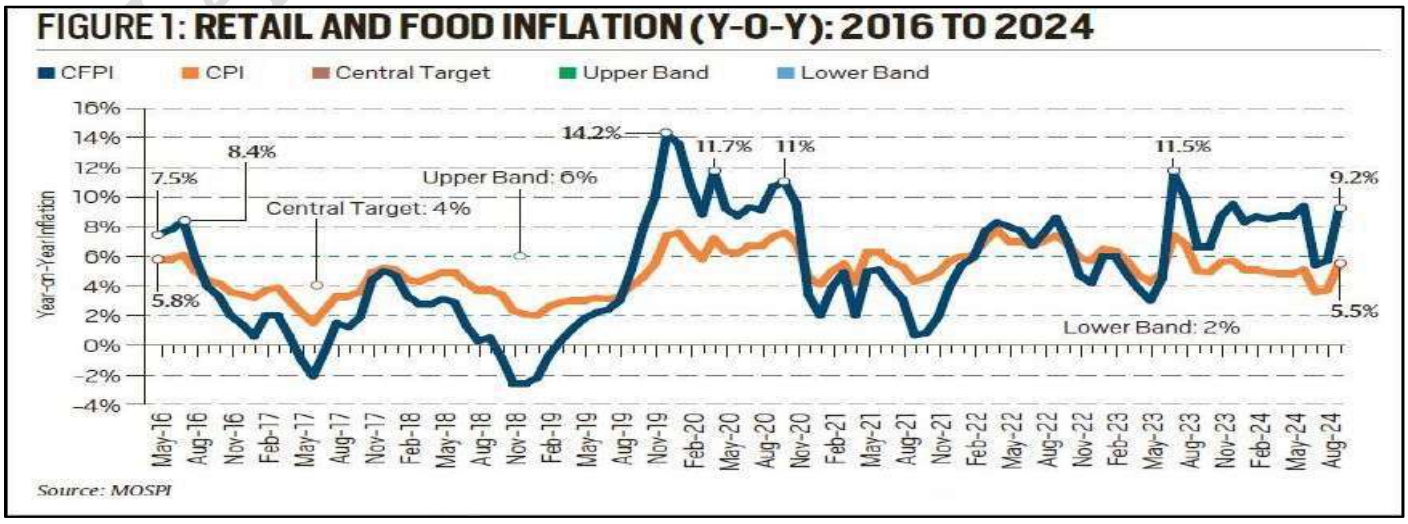
What is Consumer Price Index (CPI)?

- **Consumer Price Index (CPI)** – It is a measure of change in retail prices of goods and services consumed by defined population group in a given area with reference to a base year.
- **Released by** - Ministry of Statistics and Programme Implementation (MoSPI).
- **Basket of Goods and Services** - It represents the level of living or the utility derived by the consumers at given levels of their income, prices and tastes.
- **Share of Consumer Food Price Index in CPI** - 39%.
- **Share of Food and Beverages in CPI** – 45%.
- **Share of Tomato, Onion, Potato (TOP)** - These three vegetables make up 4.8% of the food and beverages group and ***2.2% of the overall CPI***.
- **Components of CFPI** - Out of 12 sub-groups contained in 'Food and Beverages' group, CFPI is based on ten sub-groups, excluding 'Non-alcoholic beverages' and 'Prepared meals, snacks, sweets etc.'
- **Impact of food inflation on CPI** – In the past 100 months, CPI inflation exceeded the 4 % target 72 % of the time, and in 28 % of the cases, it surpassed the upper threshold of 6 %.
- **Ineffectiveness of Monetary Policy** - Greater the proportion of food in overall CPI, the harder it becomes for monetary policy alone to control inflation.

In September 2024, vegetable inflation contributed a staggering 63 % to the food inflation (CFPI), with year-on-year price increases of 42.4 % for tomatoes, 66.2 % for onions, and 65.3 % for potatoes.

What are the reasons for the price fluctuation in TOP crops?

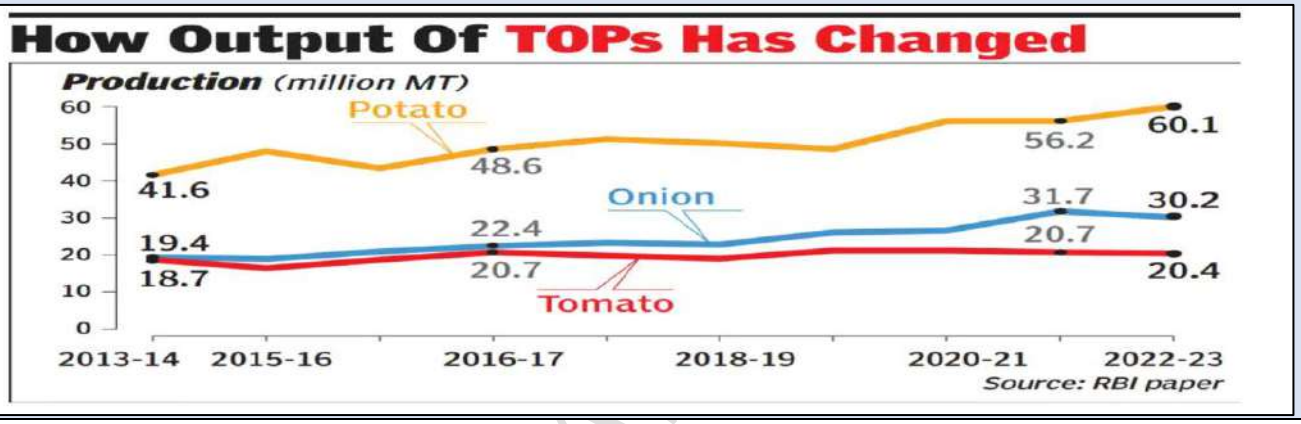
- **Short crop cycles** - During lean seasons, supply shortages lead to high prices, whereas bumper harvests during peak seasons lead to distress prices.
- **Perishable nature** – Tomato is highly perishable and Onion is semi perishable.
- **Storage challenges** - Among the three growing seasons, only the Rabi onion can be stored from March to October, serving as a buffer during lean months.
- **Regional production concentration** – It makes supply chains vulnerable to disruptions caused by weather events such as heatwaves and floods.



- **Structural Challenges** - Issues in the supply chain, such as delays in transportation or distribution, can lead to temporary shortages and price hikes.
- **Adverse climate conditions** - Unseasonal rains, droughts, and extreme temperatures can significantly impact crop yields.
- **Fluctuating Price Cycle** - It follows the classic "cobweb model" of price cycles, where short supply quickly pushes up prices due to their perishable nature.

Status of TOP production in India

- 2022-23 production estimates
  - **Tomatoes** - 20.4 million metric tonnes (MMT)
  - **Onions** - 30.2 MMT
  - **Potatoes** - 60.1 MMT
- ***Largest producer*** of onions, contributing 28.6% of global production.
- ***2nd -largest producer*** of tomatoes and potatoes.



What are the policy recommendations by RBI to curb price volatility?

- **Agricultural Market Reforms -** Encouraging the development of private mandis to provide farmers more competitive options for selling their produce.
- Improving the functioning of existing Agricultural Produce Market Committees (APMCs).
- **Futures Trading -** Reintroducing potato futures trading, which was banned in 2014, and exploring the possibility of launching onion futures to enhance price discovery and reduce market risks.
- **Storage Expansion -** Developing cold storage infrastructure across the country to prevent losses during peak production.
- **Processing and Productivity -** Investing in processing facilities and increasing crop productivity to stabilize supply and reduce wastage

Cold storage for potatoes is concentrated in Uttar Pradesh, while Maharashtra dominates onion storage, highlighting the need for a more distributed network.

What lies ahead?

- Create a dedicated agency, staffed with experts focused exclusively on these crops.
- Replace old food weights in CPI with new ones, which are likely to be about 5-6 % points less, to reflect the reality better.
- Converting at least 10 to 15 % of tomato production into paste and puree and dehydrating onion into products like flakes and powder.

8.6 Changes in India's Exchange Rate Regime

Why in News?

Over the past few years, the Reserve Bank of India (RBI) has radically altered the nation's exchange rate policy, shifting from a relatively flexible regime to an inflexible one.

What is exchange rate?

- **Foreign Exchange Rate** - Forex Rate is the price of one currency in terms of another and it links the currencies of different countries to compare international costs and prices.
- **Determination of the Exchange Rate** - It can be determined through
    - Flexible Exchange Rate
    - Fixed Exchange Rate
    - Managed Floating Exchange Rate
- **Flexible Exchange Rate** - This exchange rate is determined by the market forces of demand and supply.
- **Benefits** - In a completely flexible system, the Central banks do not intervene in the foreign exchange market.

> ***Depreciation*** *is the increase in exchange rate meaning that the price of foreign currency (dollar) in terms of domestic currency (rupees) has increased.*
>
> ***Appreciation*** *is the price of domestic currency (rupees) in terms of foreign currency (dollars) increases.*

- **Fixed Exchange Rates** - In this exchange rate system, the Government fixes the exchange rate at a particular level.
- **Managed Floating** - It is a mixture of a flexible exchange rate system (the float part) and a fixed rate system (the managed part).
- Under this system, also called dirty floating, central banks intervene to buy and sell foreign currencies in an attempt to moderate exchange rate movements.

> ***Devaluation*** *in a fixed exchange rate system is the increase in exchange rate to make the domestic currency cheaper.*
>
> ***Revaluation*** *is the decrease in exchange rate to make domestic currency costlier.*

- **Three-pronged strategy of RBI**
    - Allowing depreciation when capital outflows put downward pressures on the rupee.
    - Allowing appreciation when particularly rapid export and productivity growth created upwards pressure.
    - Building up reserves during episodes of strong capital inflows.

What are the recent changes in India's Exchange rate policy?

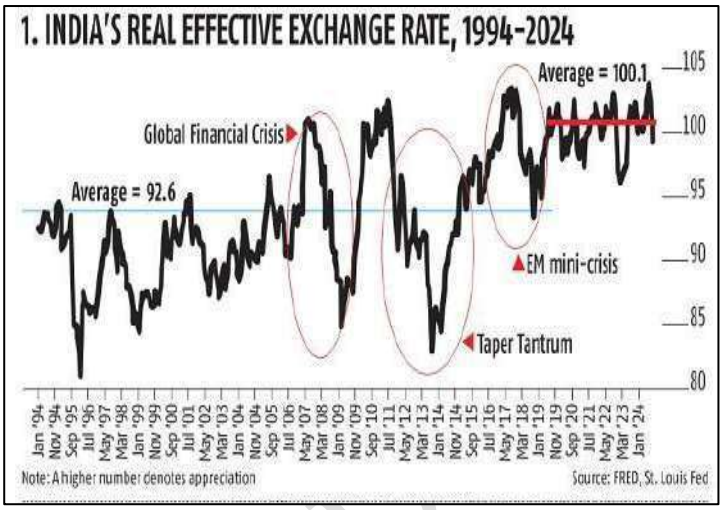
- Reserve Bank of India (RBI) has been shifting from a relatively flexible regime to an inflexible one.
- **Depreciation Control -** After 2019, the RBI embarked on a policy of selling reserves during periods of downward pressure, to limit the depreciation of the rupee.
    - From February to October 2022, RBI sold $105 billion in reserves to prevent depreciation after the US Federal Reserve started to raise interest rates aggressively to fight inflation.
- **Impacts of the changes** - The shift has had important implications for the nation's competitiveness, its export performance, economic growth, and external resilience.
- Average level of the real exchange rate has been 10% stronger since 2019 than it was during the 1994-2018 period.
- **Loss of competitiveness** – The rigidness of depreciation affected the competitiveness of the relative price of Indian goods and services at international markets.
- **Declined Export Growth** - Non-oil export growth has been quite subdued, averaging just 4½% a year in dollar terms between 2018-19 and 2023-24.

> ***The real exchange rate (RER)*** *between two currencies is the product of the nominal exchange rate (the dollar cost of a euro, for example) and the ratio of prices between the two countries.*

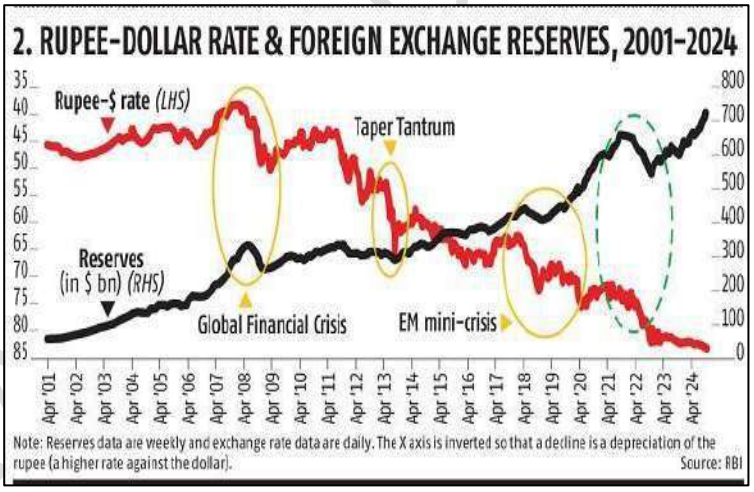
Why exchange rate volatility is essential for economic flexibility?

- **Reduced stress on Forex Reserve** – The floating system gives the government more flexibility and they do not need to maintain large stocks of foreign exchange reserves.
- **Automatic BoP Management** - Movements in the exchange rate automatically take care of the surpluses and deficits in the BoP.
- **Responsiveness** - It allowed the exchange rate to respond to cyclical market forces and adjust for differences in inflation between India and its trading partners.
    - During the boom from 2002 to 2011, the rate appreciated by 16% thereby dampening the excess demand and inflation that emerged during this period.
- **Maintain External Competitiveness** - From 1994 to 2019 the real effective exchange rate oscillated around a stable level, helping the country's export sector to thrive and compete in foreign markets.

- **Foreign exchange reserves buildup** - The strategy has allowed India to build up its foreign exchange reserves over the longer-term.
    - From June 2002 to September 2018, reserves swelled from $59 billion to over $400 billion as the RBI absorbed large capital inflows.
- **Crisis Management** - During the Global Financial Crisis, the Taper Tantrum, and the EM panic, the RBI largely aimed to smooth the adjustment, rather than deplete its reserves trying to fight depreciation.
    - **The taper tantrum** refers to a period of market volatility in 2013 triggered by the US Federal Reserve's announcement to gradually reduce its bond-buying program.



- **Financial Shock Absorber** - In good times, the rupee appreciates, which crimps the economy and vice versa to stabilise the macroeconomy.
- **Difficulties in Price Fixation** - Deciding the correct exchange rate is analytically and politically difficult.
- **Wastage of Public Money** - A fixed exchange rate acts like government subsidy mechanism for private persons in currency risk management at the cost of public money.
- **Moral Hazards** – Protecting private sector from currency risk makes them take on more currency risk and make the country's system vulnerable.
- **BCD Trinity** - Floating system is essential to build a sophisticated bond-currency-derivatives (BCD) nexus, with an inflation target.



What lies ahead?

- Ensure a balanced approach between floating system and the currency stability.
- Create a framework similar to inflation target framework based on volatility range to intervene with the exchange rate system.

9. AGRICULTURE

9.1 Urban Farming

Why in News?

Urban farming, powered by Agriculture 4.0, is ushering in a new era of food production by integrating advanced technologies.

What is Urban Farming & Agriculture 4.0?

- **Urban Farming** – It is the practice of cultivating crops, livestock, or types of food in an urban environment.
- It takes advantage of available spaces in cities, such as rooftops, balconies, community gardens, and vacant lots.
- **Need for Urban Farming** - As urban populations grow, cities are embracing innovative solutions to ensure fresh, sustainable food for all.

- Urban farming is expected to play a critical role in addressing global food security challenges, particularly in cities, where 68% of the world's population is expected to reside by 2050.
- **Agriculture 4.0** - It is the use of Internet of Things (IoT), Big Data, Artificial Intelligence and Robotics to improve farming more precise, productive and efficient.
- **Smart Urban Farming** - Smart technology is at the heart of urban farming's rapid advancement.
- **Internet of Things (IoT)** - It allows for real-time monitoring of environmental conditions such as soil moisture, light levels, and temperature to optimize plant growth.
- **Potential** - By 2028, the global smart agriculture market is projected to reach $25.4 billion, driven by the increasing adoption of IoT and precision farming techniques.

What are the urban farming methods?

- **Rooftop Farming –** It utilizes the underutilized space on rooftops, this urban Farming method involves growing crops in containers or raised beds.
- **Vertical farming** - Vertical farming allows crops to be grown in stacked layers, optimising limited space and enabling year-round production.
- **Community gardens** - They are collaborative spaces where individuals or groups come together to cultivate plants collectively.
- These gardens are typically located on shared land, such as parks or vacant lots.
- **Hydroponics** - Hydroponic systems use nutrient-rich water instead of soil, conserve water while providing higher crop yields in smaller areas.
- **Aquaponics** - The practice of producing fish in tanks and soilless plant culture are combined in aquaponics.
- The aquaponics plants are naturally fertilized by nutrient-rich fish-raising water, and the plants also aid in the fish's water purification.
- **Indoor farming** – It is the cultivation of crops within enclosed structures, such as warehouses or shipping containers by controlling environmental factors like temperature, light, and humidity.
- Vertical farming, smart irrigation systems, and automated greenhouses are becoming integral to the future of food production in urban environments.
- **Microgreen farming** - It is the practice of growing microgreens for commercial purposes in a small space, such as a backyard.

What are its benefits?

- **Increased Food Production** - Urban farming allows for the cultivation of fresh produce in areas where traditional agriculture is limited.
- **Improved Food Quality** - Access to fresh, pesticide-free produce, ensuring higher nutritional value and reducing health risks associated with chemical residues.
- **Enhanced Food Security** - Urban farming strengthens food security in urban areas, by reducing dependence on external food sources, particularly during times of crisis or disruptions in the supply chain.
- **Environmental Development** - Rooftop gardens utilise otherwise unused space, regulating building temperatures, improving air quality, storm water management, and reduction of the urban heat island effect.
- **Environmental Sustainability** – It promotes sustainable practices such as composting, rainwater harvesting, and waste reduction, contributing to a greener and more resilient urban ecosystem.
- **Community Engagement** - Engaging in urban farming fosters a sense of community and social cohesion.
- **Eco sensitization** - Urban agriculture provides an opportunity for individuals to connect with nature, learn about agriculture, and develop a deeper appreciation for the food they consume.
- **Skill Development** - Community gardens and shared spaces can serve as platforms for knowledge exchange and skill-building.

- **Economic Opportunities** - By cultivating and selling their produce locally, individuals can create small-scale businesses, contributing to their financial stability and reducing unemployment rates.

What are the challenges?

- **Limited Space** - Rapid urbanization has led to a reduction in open spaces, making it difficult to establish large-scale farms.
- **Soil Contamination** - Urban areas often suffer from soil contamination due to industrial activities, pollution, and improper waste disposal.
- This contaminated soil can negatively impact crop quality and pose health risks to consumers.
- **Water Management** - Urban farming requires efficient water management, as water scarcity is a prevalent issue in many Indian cities.
- **Regulatory Challenges** - Obtaining necessary permits, adhering to zoning regulations, and addressing potential conflicts with existing urban infrastructure pose challenges for aspiring urban farmers.

What lies ahead?

- Create adequate policy supports to promote urban farming.
- Create awareness among people about the methods and benefits of urban farming.
- Enable funding and technological support to make urban farming a successful commercial initiative.

9.2 Food Loss and Waste (FLW)

Why in News?

The United Nations has designated September 29 as the International Day of Awareness of Food Loss and Waste (FLW).

What are the Causes of Food Loss and Waste (FLW)?

- Food loss largely occurs during harvesting, threshing, drying and storage stages, predominantly due to low levels of mechanisation and inadequate logistics infrastructure.
- **Inadequate Cold Chain Infrastructure** - Around 49.9 MMT of horticultural crops are lost annually due to poor cold chain infrastructure.
- **Inadequate Storage Infrastructure** - Post-harvest losses account for approximately 10 % of total food grain production due to poor and inadequate storage infrastructure.
- **Drawbacks of Jute bag** – Jute is water and labour-intensive crop, and its use leads to frequent rodent attacks and pilferage in tropical climates.

> *The **Jute Packaging Material Act (JPMA, 1987)** mandates using jute bags for packaging 100% foodgrains and 20% of sugar.*

- **Low Mechanization** - Only 4.4 % of cultivator households in India owned tractors, and a mere 5.3 % owned either power tillers, combine harvesters, or threshers.

> *Small and marginal farmers constitute over 86 % of Indian agricultural households.*

- **High Cost of Machines** - Small and marginal farmers often cannot afford to buy costly machines.
- **Regional Inequality** - 97 % of paddy-producing households use combine harvesters in Punjab, whereas It is only 10 % in Bihar.
- **Ineffective Traditional Methods** - Traditional sun drying methods are fraught with risks, like addition of foreign matters, uneven drying, and exposure to moisture, which can lead to mycotoxin contamination.
- **Cultural Factors** – Most of the Indian Socio and Religious events are associated with food feast with high food wastes.

What are Impacts of Food Loss and Waste?

- **Affects Global Food Systems** - Food loss and waste Threatens the sustainability of our food systems.
- **Disturbs Food Security** - Food loss and waste negatively affect food security by reducing the availability of fresh produce.
- **Affects Health**– Reduced availability and increased cost makes the vulnerable people to reduce their consumption and take low quality less nutritional food.
- **Increases food cost** – Reduction in food availability increases the cost of food.

- **Wastage of Resources** - When food is wasted, all the resources that were used to produce this food — including water, land, energy, labour and capital — go to waste.
- Agriculture consumes nearly 70%of the worlds freshwater, and when food is lost, so are critical water resources.
- **GHG Emission** - Disposal of food loss and waste in landfills leads to greenhouse gas emissions, contributing to climate change.
- Food loss alone accounts for 6% of global emissions.
- **Economic Loss** - The total monetary value of food lost is close to ₹1.52 lakh crore ($18.41 billion), which is about 3.7% of the gross value added (Agri GVA) to the agricultural sector in the country.
- **Reduces Farmers Income** – Loss of quality results in lower price for produce and wastage of produce is loss of income potential for farmers.

Global Status of Food loss and waste (FLW)

- Food loss and waste (FLW), amounts to about 30 % of the global production.
  - ***13.2 %*** of global food production is lost between harvest and retail.
  - ***17 %*** of food is wasted between retail and feeding people.

India's Status of Food loss and waste (FLW)

- All-India post-harvest loss survey by NABCONS, 2022.
- **Highest percentage of food losses**
  - Fruits - 8.1%
  - Vegetables - 7.27%
  - Plantation crops - 7.18%
- **Other Crops**
  - Livestock produce - 1.29%
  - Cereals - 4.44%
  - Oilseeds - 5.66%
  - Eggs - 6.03%
  - Pulses - 6.36%

What are the benefits of reducing food wastes?

- **Reduced greenhouse gas emissions -** Reducing FLW by at least 50 %, help reduce at least 8 to 10 % of the world's greenhouse gas (GHG) emissions
- **Conserved resources** - By reducing waste, we conserve valuable resources like water, land, and energy.
  - Reducing FLW by at least 50 %, help reduce 38 % of total energy usage.
- **Waste Management -** By reducing food waste, the amount of waste that ends up in landfills can be decreased to improve our environment and public health.
- **Preserved biodiversity -** Reducing waste can help protect ecosystems and species.
- **Cost savings -** Households, businesses, and communities can save money by reducing food waste.
- **Increased food security -** Reducing the food wastage will benefit the 700 million people suffering from hunger and reduce the cost of food.
- **Enhanced agricultural profitability -** By reducing waste, farmers and food producers can improve their profitability and financial stability.
- **Achieving SDG 12** – Reducing food waste helps in achieving UN Sustainable Development Goal (SDG) targets 12.3.1 (halving food loss) and 12.3.2 (halving food waste).
  - Sustainable Development Goal 12 is Responsible consumption and production.
- **Improved health -** Reducing food waste can lead to healthier diets as people have access to a wider variety of fresh, nutritious foods.

What are the measures taken by the Government?

- Government has taken measures for the modernization of Agri systems thorough out the supply chain.
- **Improving Storage** - Government of India has launched a major grain storage plan to expand the storage capacity by 70 MMT over the next five years.
- If implemented properly, it holds the potential to reduce post-harvest losses at the storage level.
- **Improving logistics and cold chain infrastructure** - Pradhan Mantri Kisan Sampada Yojana (PMKSY) provides subsidies for the transportation/storage of eligible crops.
- Integrated Cold Chain and Value Addition Infrastructure scheme promotes cold chain facilities without any break from the farm gate to the consumer.
- **Enhancing Rural Infrastructure** - Rural Godown Scheme specifically focuses on improvement in storage infrastructure in rural and remote areas to reduce storage losses.

- **Conducting Studies** - FAO in collaboration with the National Institute of Food Technology, Entrepreneurship and Management (NIFTEM), is undertaking a study to enhance India's agrifood resilience.
- It will identify points of loss within the food supply chain, quantifying the losses, and evaluating the greenhouse gas (GHG) emissions resulting from food loss.

What lies ahead?

- Enhancing technological interventions across the value-chain to prevent food loss between harvest and retail.
- Use combined harvesters to reduce paddy losses compared to those relying on traditional manual methods.
- Encourage Farmer Producer Organisations (FPOs) and Custom Hiring Centres (CHCs) to promote farm mechanisation through group leasing arrangements.
- Enhance the availability of proper drying, storage infrastructure, solar dryers and dehydrators to reduce losses and extend the shelf-life for perishables.
- Re-visit the Jute Packaging Material Act (JPMA, 1987) to allow the use of airtight bags to lower the storage and transit losses.
- Encourage community led initiatives like Zero food wastage of Dana Committee by Dawoodi Bohras in Pune.

9.3 National Agriculture Code

Why in News?

The Bureau of Indian Standards (BIS) has begun the process of formulating a National Agriculture Code (NAC), on the lines of the existing National Building Code and National Electrical Code.

What is National Agriculture Code (NAC)?

- **NAC** – It is a standard for agriculture practices like preparation of fields, micro irrigation and water use.
- It will cover the entire agriculture cycle, and will also contain a guidance note for future standardisation.
- It will incorporate emerging agricultural technologies, novel farming practices, and varying regional conditions across India.
- **Nodal Authority** - Bureau of Indian Standards (BIS)
- **Objectives –** It will serve as a guide for farmers, agriculture universities, and officials involved in the field to
    - Promote quality and best practices in the agriculture sector.
    - Create an implementable national code covering recommendations for agriculture practices taking agroclimatic zones, crop type, till agrifood value chain into consideration.
    - Act as an enabler of quality culture in Indian agriculture by providing the required reference to policy makers.
    - Create a comprehensive guide for the farming community to ensure effective decision making in agricultural practices.
    - Integrate relevant Indian Standards with recommended agricultural practices.
    - Address the horizontal aspects of agriculture such as SMART farming, sustainability, traceability and documentation.
    - Aid in the capacity building program organized by agriculture extension services and civil society organisations.

> *The **BIS** is the national body which sets standards for different products across various economic sectors.*

- **Features** – It will incorporate emerging agricultural technologies, novel farming practices, and varying regional conditions across India.
- **Two Parts of NAC**
    - The first will contain general principles for all crops.
    - The second will deal with crop-specific standards for the likes of paddy, wheat, oilseeds, and pulses.
- **Coverage of NAC** - It will cover all agriculture processes and post-harvest operations from Crop selection, Land preparation to Harvesting/threshing and Record maintenance

- **Input Management Standards** - Use of chemical fertilisers, pesticides, and weedicides, as well as standards for crop storage and traceability.
- **Emerging areas -** Natural farming, organic farming, as well as the use of Internet-of-Things in the field of agriculture.
- **Standardized Agriculture Demonstration Farms**- These are experimental sites for testing and implementing various agricultural practices and new technologies in accordance with Indian Standards.
- They will be created in selected agriculture institutes in the country.
- **Developed by** - Bureau of Indian Standards (BIS)

What are the benefits of NAC?

- **Improve Agri Processes** -It will ensure best practices from crop selection to the storage of agricultural produce.
- **Enhance Efficiency** - Optimum utilization of resources & latest technologies.
- **Better Standardization** - Areas which are lacking standardization will be identified and standards will be developed for them.
- **Improve Quality** – It would act as an enabler of quality culture in Indian agriculture by providing the required reference to policy makers and guidance to the farming community.
- **Agricultural Transformation** - It holds immense potential to transform India's agricultural sector by creating a more conducive environment for farmers to thrive.
- **Improve Rural Livelihood** – It promote efficient and sustainable agricultural practices, the NAC can significantly improve the livelihoods of millions of people in rural India.
- **Environmental Impact** - Development of new and innovative methods of crop production will reduce the environmental impact of agriculture.

What are the challenges in implementing NAC?

- **State-Level Autonomy** – Since Agriculture is a state subject, implementing a national level code for agriculture might have resistance from states.
- **Diverse Regulations -** Harmonizing diverse state agricultural regulations with the NAC can be challenging.
- **Limited Warehousing and Cold Storage –**A lack of adequate warehousing and cold storage infrastructure can hinder the implementation of the NAC.
- **Poor Transportation Networks -** Inefficient transportation networks can increase the cost of transporting agricultural produce, affecting farmers' profitability.
- **Farmer's Illiteracy -** Many farmers may not be aware of the NAC's provisions or how they can benefit from it.
- **Digital Divide -** Many farmers, especially in rural areas, lack access to modern technology and this can hinder the adoption of digital tools and platforms that are essential for the NAC's success.

What lies ahead?

- Promote collaborative effort among central government, state governments, farmers, and other stakeholders.
- Provide training to farmers on the NAC and its standards.
- Giving financial assistance to institutes for providing training to farmers.

9.4 Equitable Agrifood Systems for Food Security

Why in News?

World Food Day 2024 was observed on October 16 with the theme "Right to foods for a better life and a better future".

What is equitable food system?

- **Food system** - It encompasses every stage of food production and consumption from growing, harvesting, processing, packaging, transporting, marketing, consuming, and disposing.
- **Stakeholders of food system** - It involves farmers, processors, retailers, consumers, and even policy makers, each playing a role in influencing the flow and quality of food.

- **Equitable food system** - It is a framework that ensures access to safe, nutritious, and culturally appropriate food to all individuals while promoting fairness and justice throughout the food supply chain.

- **Production** - Network of farms, ranches, and fisheries that use natural resources, capital, labor, and other inputs to cultivate food
- **Processing** - Network of factories and facilities that transform agricultural goods into a range of food products for consumption
- **Distribution** - Network of aggregators and shippers responsible for transporting food products across the supply chain by land, air, and sea
- **Retail** - Constellation of stores of all kinds and direct-to-consumer and other operational models that transact the final sale of food products to customers and consumers
- **Recovery, recycling, and waste** - Network of municipalities, companies, and nonprofits that handle remainder, discarded, expired, and unused food from numerous end points along the supply chain.
- **Significance of equitable food system** - Addressing inequalities and empower marginalised communities by prioritising the right to food and nutrition security is essential for peaceful, prosperous communities.

How India's food system evolved?

- Once a food-deficient nation, India has made significant strides in food security over the past 60 years and has transformed into a food-surplus country.
- **Increase in Food Availability –** Green Revolution, White Revolution, Yellow Revolution, Gold Revolution, Blue Revolution have increased the Cereal, Milk, Oil , Horticulture, Fish availability in India.
- **Food Research** - Agricultural research institutes that play a crucial role in advancing agricultural practices, improving crop yields, and addressing food security challenges.
    - Indian Agricultural Research Institute (IARI), New Delhi
    - Indian Council of Agricultural Research (ICAR), New Delhi
    - National Dairy Research Institute (NDRI), Karnal, Haryana
    - Indian Veterinary Research Institute (IVRI), zatnagar, Uttar Pradesh
    - National Institute of Agricultural Economics and Policy Research (NIAP), New Delhi
    - Indian Institute of Horticultural Research (IIHR), Bengaluru, Karnataka
    - Central Arid Zone Research Institute (CAZRI), Jodhpur, Rajasthan
    - Indian Institute of Pulses Research (IIPR), Kanpur
    - Indian Institute of Rice Research (IIRR), Hyderabad
    - National Bureau of Plant Genetic Resources (NBPGR), New Delhi
- **Supply Chain** - FCI procurement, Public Distribution System (PDS), APMC Markets are a crucial food distribution mechanism for ensuring food security.

- **Food Affordability** – Minimum Support Price mechanism ensure the availability food at affordable price and income security for farmers.
- **Food Safety** - Food Safety and Standards Authority of India (FSSAI) regulates the food quality and safety in India.
- **Right to Food** - A key pillar of India's food security is the National Food Security Act (NFSA) of 2013, which provides food entitlements to over 800 million citizens.
- **Nutritional Security** – India has approved the distribution of fortified rice from July 2024 to December 2028 to address nutritional deficiency especially Anaemia.
- PM POSHAN Scheme aims to enhance the nutritional status of children in government schools.

What are the challenges in achieving equitable food system?

- India's agricultural sector is the cornerstone of its economy.
- **Population Growth** – Feeding nutritiously the current population of about 1.4 billion and an annual growth rate of 0.9% is a huge challenge.
- **Fragmented Land Holdings** - Of its 93.09 million agrarian households, approximately 82% are small and marginal farmers holding less than two hectares of land.
- Fragmented landholding limits smallholder farmers' adoption of modern techniques, reducing productivity and income.
- **Natural resource degradation** - Overusing groundwater strains water tables while chemical fertilizers and monocropping harm soil and agricultural productivity.
- **Market Access Limitation** - Many smallholder farmers need help accessing markets effectively due to infrastructure limitations and supply chain inefficiencies.
- **Poverty & Inequality** –Rural poverty and inequality affects the participation and distribution of agricultural system.
- **Climate change** - Erratic weather patterns pose risks to agriculture productivity.
- **Infrastructure** - Inadequate infrastructure for storage, processing, and transportation of food affects the food supply chain system.

What lies ahead?

- Addressing food inequality and ensuring that everyone has access to nutritious food are essential steps.
- Facilitating better links between production and markets, farmers can increase their incomes and reduce food waste.
- Enhancing access to appropriate technologies is vital.
- Building resilience of farming system through sustainable agricultural practices such as water conservation and soil health restoration.

Quick Facts

- **Cereal Production** – Launched in 1967 it creased the food availability by tripling the cereal production while only increasing the cultivated area by about 30%.
- **Milk Revolution** - Operation Flood was launched in 1970 increased the milk production from 20 million tonnes to over 70 million tonnes.
- **White revolution 2.0** has been launched in 2024 to empower women, fight malnutrition, increase milk procurement, and strengthen cooperatives.
- **Oil Revolution** – Yellow Revolution was launched in 1986- 1987 to increase the production of edible oil, especially mustard and sesame seeds to achieve self-reliance.
- **Fish Revolution** – Blue Revolution was launched in 1985-1990 during the 7th Five-Year Plan to develop, manage, and promote fisheries to double the farmers' income.
- **Horticulture Revolution** - Golden revolution between 1991 and 2003 aimed to increase the production of honey and horticulture.

9.5 Agricultural Productivity in India

Why in news?

India's agriculture productivity has been stagnated when compared to other countries that led to low contribution to economy over the years.

What is agricultural productivity?

- **Agricultural productivity** –It is measured as the ratio of agricultural outputs to agricultural inputs.
- It can be defined as a measure of efficiency in an agricultural production system which employs land, labour, capital and other related resources.

Status of Agricultural Productivity in India

- **Low yields** – It remain far below global standards.
- Over the past two decades, crop production in India has made minimal progress.

Crops (yield per hectare)

Crops	India	Other nations
Cotton	479 kilograms	China-1990 kgs
Maize	6100 kilograms	U.S.- 11,000 Kgs
Soybean	1200 kilograms	Brazil-3600 kgs

- **Modest improvement** – In 2010, *soybean* yield was 1006 kilograms per hectare, increasing to 1200 kilograms by 2024.
- **Marginal growth** – *Pulses* rose from 625 kilograms per hectare in 2010 to just 776 kilograms by 2020.
- **Bare minimal growth** – In 2004, cotton production stood at 470 kilograms per hectare, and by 2024, it had barely shifted, reaching just 446 kilograms.

What are the reasons for stagnated/ low productivity?

***Agriculture** employs more than 50% of India's workforce but it accounts only 14% of India's GDP, and about 13 % of exports.*

- **Increase in small land holdings –** Larger amount of agricultural area has been *fragmented into smaller pieces of land*, which makes capital-intensive technology improvements difficult.
    - *Over 92% of Indian farmers work on tiny and marginal* land of approximately 1-2 acres per farmer.
- **Overdependence on monsoon** - Nearly 60% of Indian agriculture is dependent upon unpredictable monsoons.
    - Only about 51% of the agricultural area cultivating food grains is covered by irrigation.
- **Slow Adoption of High Yielding Varieties** – While the Indian agriculture market is full of high-quality, high-yielding, and climate-resilient seeds, they are not utilized to the fullest potential.
    - As per data research, *only 35-40% of farmers are using* these seeds due to a lack of awareness and high prices (Because of the monopoly).
- **Imbalance in use of fertilizers –** It may lead to a loss of fertility in the soil over a period of time, affecting productivity
    - Chemical fertilizers that *use nitrogen instead of potash/phosphorus decrease efficiency* over time, which, in turn, requires more significant doses for equal effects.
- **Outmoded yields forecasts** – *Lack of accurate weather forecasting* makes agriculture prone to disasters.
- **Subsistence agriculture –** It limits the capacity of the country's full potential in agricultural productivity and opportunities for farmers to generate income and contribute to broader economic development.
- **Lack of access to quality seeds –** Quality seeds is another input necessary for agricultural productivity.
    - Good quality seeds account for 20%-25% of increased crop productivity
- **Inadequate storage facilities –** Every year, nearly 40% of India's fruit and vegetable output is wasted before consumption due to a lack of refrigerated transport or processing facilities near production sites.

How genetically modified crops can improve crop productivity?

- **Resist pests** – It protect the crops from infestation and ensure better yield.
- **Endure harsh weather conditions** – They are highly tolerant to high temperature and heavy rainfall
- **Extends shelf life** – They do not get spoilt easily.
- **Increase crop production** – Wider acceptance of GM technology could lead to doubled or even tripled production across various crops.
    - It could boost crop production by 100% to 150% in India.
- **Saves money** – It reduce input costs and ultimately increase farmers' profits.

Status of GM Crops in India

- **Research activities** – Since 1986, the Indian government has granted approvals and allocated funds for GM research.
    - For example, Indian Council of Agricultural Research (ICAR) is conducting research in this field.
- **Breakthrough development** - Development of GM mustard by Dr. Deepak Pental from Delhi University.
- **Regulatory body** - *Genetic Engineering Appraisal Committee (GEAC)* oversees the research.
- It functions in the Union Ministry of Environment, Forest and Climate Change as per the Rules, 1989, under the Environment Protection Act, 1986.
- **Crops** – Indian government approved GM Bt Cotton in 2002.
- **Challenges** – There is greater opposition to GM crops fuelled by misinformation and unfounded fears.
- Outdated policies prevent the adoption of cutting-edge technology like GM seeds.

To know more about GM crops, click here

*Using **GM technology**, China have achieved cotton yields of 1900 kilograms per hectare, while American farmers produce 11,000 kilograms of maize per hectare through the use of GM seeds.*

Why agricultural productivity is important?

- **Ensures food security** – It is essential for domestic consumption.
- **Efficient livestock management** – It is needed for preparing animal feed.
- **Promotes clean economy** – Agricultural residues can be used to prepare ethanol that can blended with petrol and diesel.
- **Increase exports** – It helps in making India trade surplus and improve Forex reserves.

What lies ahead?

- Create public awareness to reduce fear on misconception about GM crops.
- Focus on promoting advanced agricultural technologies and encouraging investments in the sector.
- Formulate right policies to overcome agricultural stagnation, enhance crop yields, and to secure a stronger position in the global agricultural trade.

10. ENVIRONMENT

10.1 Indianizing Common Practice Standards

Why in news?

Recent research suggests for Indianizing common practice standards in carbon markets so that the agroforestry sector could contribute an additional carbon sink of over 2.5 billion tons of CO_2 equivalent by 2030.

What is Common Practice?

- **Common Practice** – It refer to the established guidelines and benchmarks used to measure, report, and verify carbon emissions reductions and other related activities

- It is a key criterion used to assess whether a project is contributing any additional environmental benefits beyond what is typically done for the region.
- **Role** – It plays a vital role in climate finance realm.
- According to carbon standards such as Verra's Verified Carbon Standard (VCS) or the Gold Standard
    - If an activity is deemed "common practice", it may not qualify for carbon credits, as it is not seen as contributing additional environmental benefits beyond the norm.
- It ensures that carbon credits are issued only for emissions reductions that does additional benefits beyond usual targets.
- **Verified Carbon Standard (VCS) Program** – It is the world's most widely used greenhouse gas (GHG) crediting program. It drives finance toward activities that reduce and remove emissions, improve livelihoods, and protect nature.
- **Global practices** – It often *reflects the realities of large-scale agricultural practices* found in regions such as Latin America, Africa, or US, where landholdings are extensive and contiguous.

> ***Carbon credits*** *is a carbon trading mechanism, which allows the owner to emit a certain amount of carbon dioxide or other greenhouse gases (GHGs).*

- **Significance –** It helps to *ensure transparency, accountability, and credibility* in carbon markets and climate initiatives.

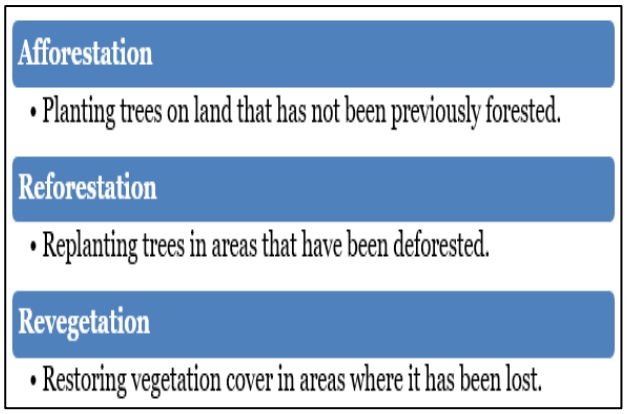
What are the challenges of common practice in India?

- **Small and fragmented landholdings** - Recent data indicate that **86.1% of Indian farmers** are small and marginal, with landholdings of less than two hectares.
- **Non-systematic agroforestry practices** – These farmers often engage agroforestry in a non-systematic, scattered manner, planting trees alongside crops or on small patches of fallow land.
- **Lacks additionality criteria** – Indian agroforestry practices may not meet this criteria set by current carbon standards because they are perceived as "common" within the Indian context.
- **Exclusion of farmers** – It effectively excludes a large number of Indian farmers from participating in ARR carbon finance projects.
- Thus it denies them the opportunity to earn additional income from carbon credits.

> ***Agroforestry*** *is the interaction of agriculture and trees, including the agricultural use of trees.*

Why we need India centric approach?

- **Dominance of agroforestry** – India's vast potential in the agroforestry sector is a *unique opportunity to integrate with carbon finance projects.*
- **Scope for integrating with ARR initiatives** – Agroforestry can be linked with Afforestation, Reforestation, and Revegetation (ARR).
    - The Energy and Resources Institute (TERI) has demonstrated the potential of ARR projects in India, spearheading 19 projects across seven States, benefiting over 56,600 farmers.



- **Higher potential** - There is a *possibility to expand the area under agroforestry* from the current 28.4 to 53 million hectares by 2050.
    - Agroforestry accounts for 8.65% of India's total land area and contributes 19.3% of the country's carbon stocks.

What are the benefits of Indianizing common practices?

- **Formalizes agroforestry** – It enables a more systematic and sustained approach to agroforestry.
- **Improves agriculture** – It can help address issues such as low productivity, dependence on monsoons, and environmental degradation.
- **Creates additional income -** Enabling a greater number of farmers to participate in carbon finance projects, provides them with *additional income streams* while contributing to India's climate goals.

- Participating in ARR projects presents a pathway to *income diversification*.
- **Enhances rural livelihoods** – By acknowledging the fragmented nature of Indian agriculture, they enhances *rural livelihoods*.
- **Higher carbon sequestration** - *Accommodate the fragmented, small-holder model* prevalent in India would unlock the vast potential for carbon sequestration.
- **Environmental benefits** - ARR projects deliver crucial environmental benefits, such as enhancing soil fertility, improving water retention, and mitigating erosion, thereby bolstering agricultural productivity and ensuring long-term sustainability.
- Thus it drives sustainable development.

***Carbon sequestration** is the process of capturing and storing atmospheric carbon dioxide.*

What lies ahead?

- International carbon finance platforms should revise the standards to better align with the realities of Indian agriculture.
- International standards should evolve to reflect the specific conditions of the Indian subcontinent.
- Revise the 'Common Practice' guidelines to be more inclusive of Indian agroforestry practices.

10.2 Asian Elephant Conservation

Why in News?

Interim Elephant Census report has highlighted declining elephant population across India.

What are the features of Asian Elephants?

Asian Elephants

- Asian Elephant is the natural heritage animal of India and the largest mammal living on the land of Asia.
- **Scientific name** - Elephas maximus
- **Gestation period** - 22 months
- **Weight** - 3,000-6,000 kg
- **Height**
  - Males - up to 9 feet
  - Females - up to 7.9 feet
- **Lifespan** - 48 years (average in the wild)
- **Tusks** - Larger in males, smaller or absent in females
- **Intelligence** - Highly intelligent, known for empathy, mourning, and communication
- **Social Structure** - Matriarchal herds, males generally solitary
- **IUCN Red List** – Endangered
- **Wildlife Protection Act 1972** - Schedule I
- **CITES** - Appendix I
- **Population** -There are about 50,000-60,000 Asian elephants in the world.
- Indian Population More than 60% of the world's elephant population is in India.
- **Distribution** - The current distribution of wild elephant in India is now restricted to four general areas
  - North-eastern India,
  - Central India,
  - North-western India,
  - Southern India.
- Karnataka has the highest number of elephants (6,049)

- Assam (5,719) and Kerala (3,054).
- **Elephant reserves**- There are 33 elephant reserves in India, latest being Terai Elephant Reserve in Uttar Pradesh.

How Elephant census is conducted?

- **Elephant Census** – It is a synchronized census conducted region wise.
- It is conducted ***every 5 years*** by the ***Wildlife Institute of India*** (WII), an autonomous body under the ministry.
- **Census Methods**
  - Direct (head) count - Forest divisions is divided into sample blocks ranging from 4 to 6 sq km.
  - Indirect (dung) count
  - waterhole count method – Identifying waterbodies frequented by the elephants.
  - DNA profiling
  - Camera traps
  - Statistical modelling based on mark-recapture
- Till 2017 Direct and Indirect method only used and Scientific estimation is being used in this years' census.

ELEPHANT NUMBERS IN INDIA (2012-2023)

States	2012	2017	2022-23	Change
Tamil Nadu	4015	2761	3136	13.6%
Karnataka	6068	6049	6013	-0.6%
Kerala	6117	5706*	2785	-51.2%
Maha (W Ghat)	4	6	27	350%
Western Ghats	**16204**	**14522**	**11961**	**-17.6%**
WB (South)	0	194	31	-84%
Jharkhand	688	679	217	-68%
Odisha	1930	1976	912	-54%
Chhattisgarh	247	247	451	82.6%
Madhya Pradesh	0	7	97	1286%
Maha (Gadchiroli)	0	0	36	NA
Andhra Pradesh	41	65	120	84.6%
Central & Eastern	**2906**	**3168**	**1864**	**-41%**
Uttarakhand	1346	1839	1792	-2.6%
Uttar Pradesh	291	232	257	11%
Bihar	0	25	13	-48%
Shivalik-Gangetic	**1637**	**2096**	**2062**	**-1.6%**
Haryana	0	7	0	NA
Himachal Pradesh	0	7	0	NA
A&N	0	25	NA	NA
India (Except NE)	**20747**	**19825**	**15887**	**-20%**
Arunachal Pradesh	890	1614	Pending	NA
Assam	5620	5719	1031^	NA
Megalaya	1811	1754	Pending	NA
Nagaland	212	446	Pending	NA
Mizoram	0	7	Pending	NA
Manipur	0	9	Pending	NA
Tripura	59	102	Pending	NA
WB (North)	647	488	423^^	NA
North East	**9239**	**10139**	**9866#**	**NA**

* Revised count. Initial count was 3054
# NE figures are extrapolated from 2017, count pending
^ Only in Manas TR | ^^ Only in Buxa TR Data: MoEF/WII

Regional Elephant Population Decline and Threats		
Region	**Declining % (Compared with 2017 Estimate)**	**Threats**
Central Indian and Eastern Ghats	41 %	• Unmitigated mining • Linear infrastructure construction • developmental projects
Southern West Bengal, and	84%	
Jharkhand	68%	
Orissa	54%	
Western Ghats	About 18 %	• Commercial plantations (coffee and tea) • Farmland fencing • Human encroachment
Kerala -	Nearly 51% (2,900)	
Shivalik-Terai population in Uttarakhand and Uttar Pradesh	2%	• Encroachments • Forest clearing • Monoculture • Invasive species • Intensified agriculture

		• Linear infrastructure
North East	Data Not Available	• Human habitations • Tea plantations • Mines, oil refineries • Linear infrastructure

What are the impacts of declining elephant population?

- **Human Animal Conflict** – Threats have pushed elephants to venture into historical but currently unoccupied areas fuelling human-elephant conflicts.
- **Retaliatory Killing** - In some cases, conflicts can escalate to retaliatory killings of elephants, further exacerbating their population decline.
- **Economic Losses** - Human-elephant conflicts can result in significant economic losses for farmers and communities, especially in areas where agriculture is a primary livelihood.
- **Habitat Degradation** - As elephant populations decline, their role in shaping and maintaining ecosystems becomes compromised.
- **Disruption of Food Chains** -Their decline can disrupt food chains, affecting predator populations and overall ecosystem balance.
- **Reduced Seed Dispersal** - Elephants play a vital role in dispersing seeds, helping to regenerate forests and maintain plant diversity.
- **Loss of Cultural Heritage** - Elephants have deep cultural significance in India, and their decline represents a loss of cultural heritage.
- **Reduced Tourism Revenue** - Elephant tourism is a significant source of income in many parts of India.
- **Impact on Traditional Practices** - Some indigenous communities rely on elephants for their livelihoods and cultural practices.

Elephants are ecosystem engineers and keystone species influencing vegetation structure and seed dispersal.

What are the elephant's conservation initiatives?

- **Area Conservation** - There are 33 elephant reserves in India aimed at conserving their population.
- **Project Elephant** – It was launched in 1992 to protect elephants, their habitat and corridors, address issues of man-animal conflict and welfare of captive elephants
- **Surveillance** - Monitoring of Illegal Killing of Elephant is launched in 10 elephant reserves since 2003.
- **Stop Poaching** - Anti-poaching units have been formed to patrol elephant habitats and apprehend poachers.
- **Prevent Wildlife Crime** - Special Elephant task forces have been set up to address specific threats to elephant populations, such as ivory smuggling.
- **Compensation** – Community compensation schemes are in place to reimburse farmers for crop damage caused by elephants.
- **Surveys** - Regular elephant surveys are conducted to assess elephant population trends and distribution.

What are the strategies to conserve elephant population?

- Strengthening elephant corridors and connectivity, restoring habitat, mitigating developmental projects, and ensuring the support of local communities for elephant conservation.
- Focused estimation exercise to comprehensively assess occupancy and abundance..
- Develop early warning systems to alert communities of approaching elephant herds.
- Establish community-based anti-poaching units to monitor and protect elephant habitats.

10.3 Tiger Conservation

Why in News?

Recently National Tiger Conservation Authority gave instructions to states to start the process of relocation from core areas of tiger reserves.

What are the Tiger conservation initiatives in India?

Tiger

- **Tiger** - It is a top predator and is at the apex of the food chain.
- The presence of tigers in the forest is an indicator of the well-being of the ecosystem.
- Tigers are both a Flagship and Umbrella species.
- Flagship species they are important for conservation and as Umbrella species, conservation of tigers leads to conservation of other species.

Conservation Status of Tiger

- IUCN – **Endangered**
- Wildlife (Protection) Act, 1972 - **Schedule I**
- CITES - **Appendix I**

- India is home to around ***75%*** of the global tiger population.
- **Current Tiger Population** – 3700
- Largest tiger population of 785 is in Madhya Pradesh, followed by Karnataka (563) & Uttarakhand (560), and Maharashtra (444).
- Highest number of Tiger is found in Jim Corbett (260) followed by Bandipur (150), Nagarhole (141), Bandhavgarh (135).

- **Project Tiger** – It was launched by the Central government on April 1 1973 in a bid to promote conservation of the tiger.
- First launched at the Jim Corbett National Park.
- Centrally Sponsored Scheme of the Ministry of Environment, Forests and Climate Change.
- **National Tiger Conservation Authority (NTCA)** - It a statutory body under the Ministry of Environment, Forests and Climate Change was established in 2005 to manage tiger reserves and lead tiger conservation efforts.
- **Tiger reserves** - They were set up as a part of Project Tiger initiated in 1973 and are administered by the NTCA.
    - **Number of Tiger Reserves** – 55(As on August 2024)
- Nearly 75% of the world's tiger population can now be found in India and tiger reserves in the country span 75,000 square kilometres.
- **The Tiger Census** - It is held once in every 4 years by National Tiger Conservation Authority (NTCA) in association with state forest departments and the Wildlife Institute of India.
- **MSTrIPES** - Monitoring System for Tigers: Intensive Protection and Ecological Status

*Andhra Pradesh's **Nagarjuna Sagar Srisailam Tiger Reserve** is the country's largest tiger reserve, covering 3,296.31 sq. km and Manas Tiger Reserve in Assam is the second largest with an area of 2,837.1 sq. km.*

- It creates a database and analyses the information to provide inferences for better management of tiger reserve.
- **International Big Cats Alliance (IBCA)** - It is an international collaboration to conserve 7 big cats namely Tiger, Lion, Leopard, Snow Leopard, Cheetah, Jaguar and Puma.
- **Tiger Corridors** – It enables the tigers move freely between the protected areas.

What is the Significance of Tiger Conservation?

- **Balancing Ecosystem** - Since Tigers are the apex predators in their ecosystems, their conservation regulates prey populations and helps maintain a healthy balance in the ecosystem.

- **Biodiversity** - Protecting tigers ensures the conservation of a wide range of other species within their habitats, as their presence indirectly supports the survival of many other animals.
- **Habitat Preservation** - Tiger conservation efforts benefitted in conserving sub-Himalayan forests, tropical rainforests, savannahs and mangroves.
- **Ecotourism** - Tiger reserves attract tourists from around the world, generating significant revenue for local communities and the national economy.
- **Sustainable Livelihoods** - Ecotourism can provide alternative livelihoods for local communities, reducing their dependence on activities that might harm tiger habitats.
- **National Symbol -** The tiger is a symbol of India's rich biodiversity and cultural heritage, representing strength, courage, and beauty.

What are the negative impacts of tiger conservation plan?

- **Impact on Other Species** - Altering and manipulating habitats to favour tigers, does not necessarily help other species that share the tiger's habitat.
- **Extinction of Caracal** - Rare caracal of open savannahs and rocky stretches, were silently disappeared in early 2000s form Sariska Tiger Reserve due to the plantation of *vilayati kikar*, an invasive tree.
- **Decline of Antelope** - Neglect of rich microhabitats such as the riverine forest abutting perennial streams, led to the decline of the four-horned antelope.
- **Ecological Change** - Construction of numerous artificial waterholes for improving tiger sightings increased the soil moisture in this naturally dry forest, leading to changes in vegetation.
- **Social Impact** - Local hostility in several tiger reserves due to lose of access to resources and livelihood once the tiger reserve come into place.
- **Loss of Identity** - Local residents became "illegal" overnight when the tiger reserve was established.
- **Legal Ambiguities** - Contradictions between the Wildlife Protection Act, 1972 and the Forest Rights Act, 2006 undermine the conservation efforts inside protected areas.
- The direction by the National Tiger Conservation Authority (NTCA) to declare critical tiger habitats is considered to be in contravention of the Forest Rights Act.

What are the challenges in Tiger conservation?

- **Development Challenges** – Fragmentation by rampant infrastructure development such as Highways, dams and industries threaten a number of tiger reserves across.
- **River Interlinking impact** - 58 sq. km of savannah in Panna tiger reserve will soon be submerged by the Ken-Betwa Interlinking Project.
- **Hydroelectric projects** – These projects in the vicinity of Dibang tiger reserve will likely affect tigers and their movement.
- **Unplanned development** - It threatens to create habitat islands that will not support most wild species, let alone large carnivores such as tigers.
- **Rural to Urban Transformation** - Rapid rural-to-urban transformation also has consequences for biodiversity.
- **Urban Expansion** - Suburban built-up spaces are closing in on not just tiger reserves, but also other protected areas.
- **Loss of Agri buffer** - Agricultural habitats that once formed buffer habitats between the forest and the city, and aided wildlife dispersal, are fast disappearing.
- **Inadequate Settlements** - Large-scale evictions, without attention to socio-cultural, ecological and economic particularities can only result in continuing the trend of inadequate resettlements.

What lies ahead?

- Consider the long-term sustainability of tiger conservation effort.
- Include Social viewpoints and ecological aspect with the conservation plan.
- Enhance the relocation package, keeping up with the changing needs of livelihood security.
- Increase the participation and absorbing of local tribes into wildlife management.
- Share the tourism proceeds with local villages.

10.4 Waste Water Reuse

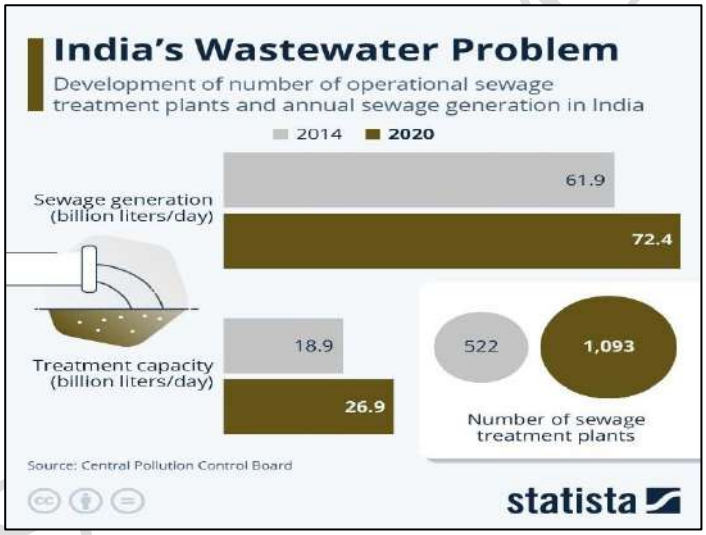
Why in News?

Depleting freshwater sources, erratic rainfall patterns and growing water scarcity underscores the need to adapt innovative water management solutions.

India has only 4% of the world's fresh water resources despite a population

What are the needs for water reuse?

- **Depleting Freshwater Sources** - Surface water abstractions are reaching unsustainable levels leading to deterioration of the environment.
- **Water Pollution** - Disposal of domestic sewage from cities and towns is the biggest source of pollution of water bodies in India.
- **Erratic rainfall patterns** – Climate change is disrupting normal weather patterns, leading to droughts or excessive rainfall in different parts of India.
- **Growing water scarcity** - According to a 2019 report by the National Institution for Transforming India (NITI Aayog), India's water demand will exceed supply by a factor of two by 2030.
- **Increasing Population** – By 2050, 50% of the country's population will be in urban cities posing challenges for urban wastewater management.
- **Resource Utilization** - The failure to reuse treated wastewater also underutilises the substantial capital invested in sewage treatment plants.



What are the benefits of treated water?

- **Ground Water Boost** – It can be used to recharge groundwater to improve groundwater levels and quality.
- **Agricultural Growth** – Use of treated wastewater address irrigation needs of agriculture and improve productivity which results in increased farmers income.
- **Economic Growth** – It can be used in livestock and fish production.
- **Boost Circular Economy** – Water recycling systems support a circular economy in the water sector.

***National water quality standards** on sewage treatment for discharge into surface water bodies are prescribed by CPCB.*

- **Economic Potential** - Wastewater sector in India is *developing at a rate of 10-12 % each year* and is likely to exceed $4 billion.
- **Conserving water and Money** - Wastewater recycling in thermal power plants can yield a monetary benefit of on average Rs 300 million per year and water savings of nearly 10 million cubic metres a year.
- **Nutrient Recycling** - Nutrients found in wastewater like nitrogen, phosphorus and potassium if recovered can be used to reduce reliance on synthetic fertilisers.
    - Sewage generated from class I and II cities across India 6,400 million litres per day has a nutrient load of about 2,500 tonnes.
- **Local Body Financial Autonomy** – Local bodies *can generate an additional annual revenue* by selling treated water.

What are the challenges?

- **Inadequate Treatment** - only 28 % of the total sewage generated is effectively treated
- **Insufficient infrastructure** - There remains a *gap of 22939 MLD (78.7%)* between sewage generation and installed sewage treatment capacity.
    - All Class I cities and Class II towns together generate an estimated 29129 MLD sewage (as per population in 2001 census) and the installed sewage treatment capacity is only 6190 MLD.
- **Low Reuse** - a mere 3 % of this treated wastewater is used beneficially and most of it discharged into water bodies or used for non-essential purposes such as irrigating public parks.
- **Absence of Guidelines** – Sector wise quality standards of treated water reuse have not been issued.

- Different sectors have distinct requirements of processed water quality ranging from biological treatment to reverse osmosis or ultrafiltration to meet quality standards.
- **Inadequate Research and Technologies** - R&D initiatives are deficient and require boosting of investment to foster innovation.
- **Lack of Private Participation** – Almost all of the sewage treatment plants are run by the government and public sector.
- **Inadequate Skilled Personnel** – There is huge requirement of human resources in operation, maintenance and research side of water treatment sector.
- **Socio-cultural Barriers** – Caste, Class differences and public misconception often prevent the acceptance of reused water.
- **Financial Constraint** - The high capital costs of setting up wastewater treatment facilities and advanced technologies, such as zero liquid discharge, discourages industries and municipalities from embracing it.

What needs to be done to improve waste water reuse?

- To encourage greater water reuse, India must prioritise infrastructure development, implement sound policies and allow private sector participation.
- Encourage states and local bodies to adopt National Framework on Safe Reuse of Treated Water.
- Encourage private sector participation through Public- Private Partnership (PPP) models to cover through technology selection, fund rotation, and execution.
- Setup water reuse benchmarks for industries to promote wastewater reuse and resources recovery, without compromising on product quality.
- Implement policies to incentivise industries, research institutions and universities to undertake R&D initiatives on innovative water treatment technologies, water efficiency practices.
- Higher tariffs for non-recycled water will encourage municipalities and housing societies to adopt recycled water for non-potable purposes.
- Similar to carbon credits, entities that use treated wastewater could receive water-use credits, which could be monetised or traded with other developers.

Quick Facts

Sewage Treatment Plants Technologies

- Activated Sludge Process (ASP)
- Sequencing Batch Reactors (SBR)
- Extended Aeration (EA)
- Up flow Anaerobic Sludge Blanket (UASB)
- Moving Bed Biofilm Reactor (MBBR)
- Fluidized Aerobic Bed Reactor (FAB)
- Waste Stabilization Pond (WSP)
- Oxidation Pond (OP)
- Zero Liquid Discharge
- Others (Aerated Lagoon (AL), Bio-Tower, Electro Coagulation (EC) etc.)

10.5 Common Property Resources (CPR)

Why in News?

Declining area and quality of community property resources highlight the need for conserving it.

What are Common Property Resources?

- **Common Property Resources** - CPRs are community-owned lands consisting of local natural resources like forests, pastures, and water bodies.
- **Types of CPRs**

- **Land Resources** - Panchayat lands, Government revenue lands, Village common lands, Village thrashing lands
- **Forest Resources**-Unclassified Forest lands, woodlands and wastelands
- **Water Resources** - River banks, Tanks and Natural lakes, Groundwater, Wetland and mangrove areas

- **Ownership** – Government land under the ownership of local bodies or Community.
- **Collective Usage** – It is accessible to all community members for grazing, collecting fodder, fuelwood, and other minor forest products.
- Common Property Land Resources in total geographical area - ***15 %.***

What are the significances of CPR?

- **Economic Security** - For landless and marginal farmers, CPRs are a lifeline, providing resources to support their livestock, upon which they heavily rely for income.
- **Food Security** – They provide uncultivated food to the community, bio resources to the local people.
- **Tribal Livelihood Security** - Tribals, particularly vulnerable tribal groups and other traditional forest dwellers rely on forests and common resources for their livelihoods.
- **Ecological Benefit** – They hold significant bio diversity by supporting wild animals, birds and flora.
- **Knowledge Management** – They act as preserver of traditional knowledge on natural resources.
- **Livestock Management** – 40 to 70 % of the green fodder consumed by animals in the country comes from CPR such as non-cultivated land, pastures, public land, barren land, fallow land and forests.
  - India currently faces a **35-40 %** deficit in dry and green fodder.
- **Resource for Households** - CPRs offer materials like fuelwood and medicinal plants, reducing household expenses and promoting well-being.

What are the threats faced by CPR?

- **Encroachment** –Privatization of CPR lands by allotting to housing and other non-agricultural uses or by formalizing illegal encroachments.
- **Population Growth** - Rapid population growth increases the demand for resources, often leading to unsustainable exploitation.
- **Degradation** – Changes in the character of the CPR due to over unsustainable use, natural disasters and climate change.
- **Invasive Species** - Invasive shrubs such as *Lantana camara* hinder fodder production in CPR lands.
- **Legal and Management Issues** - Ambiguities in legal frameworks and management practices often hinder the effective conservation and use of CPRs.
- **Development Activities** – CPR lands are often diverted for development needs like roads, bridges and industrial establishments.
- **Cultural Changes** - Shifts in cultural practices and values can impact how communities manage and use common resources

What can be done to conserve CPR?

- A mission mode approach can be implemented for the conservation and management of CPR.
- Grant villagers right to use, manage and protect the resources under the Community Forest Resource Rights.
- Strengthening the Public Land Protection Cell (PLPC) to protect and free the land from encroachment.
- Eradicate invasive species from CPR lands to restore its effective usage.
- Create an ecological register to document the available resources, trees, plants, uncultivated food, forest produce, herbs, birds and other wildlife.
- Empower gram sabhas to reclaim community forest resource rights for forest land and approach the District PLPC to take appropriate action on the encroached areas.
- Use of schemes like Mahatma Gandhi National Rural Employment Guarantee Scheme for the protection and development of CPR lands.

10.6 Biodiversity Decline in Protected Areas

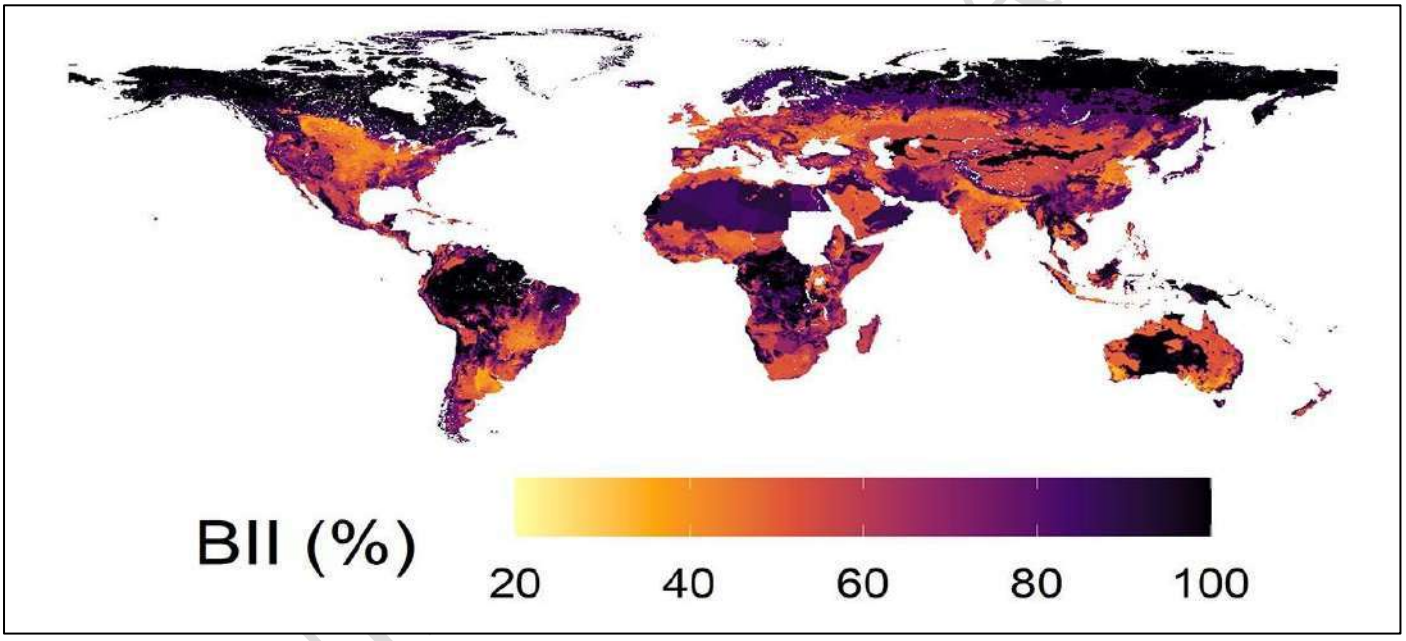
Why in News?

Biodiversity is declining more quickly inside key protected areas than outside them, according to a new study by the Natural History Museum (NHM), London.

How much has the biodiversity declined across the globe?

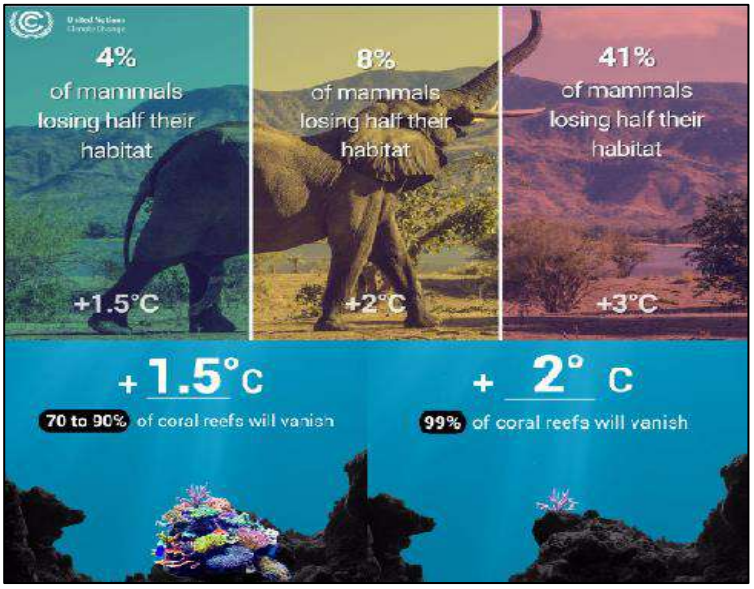
- **Biodiversity** – It is the 'diversity' of life on Earth at all levels, from genes to ecosystems and it includes diversity within species, between species and of ecosystems.
- **Global Biodiversity** - Of 8-20 million species of organisms in Earth, only about 2 million eukaryotes have been recognized and named so far.
- **Biodiversity Intactness Index (BII)** - It estimates how much of a region's natural biodiversity is still left on average.
- **Global Biodiversity Decline** - The index has decreased by 1.88 % points globally between 2000 and 2020.
- **Biodiversity decline in Critical Biodiversity Areas (CBAs)**
  - Unprotected areas within CBAs - 1.9 %
  - Protected areas within CBA - 2.1 %

Critical Biodiversity Areas (CBAs) are Ecosystems and areas such as wetlands that are crucial for biodiversity and 22% of which is protected.



What are the reasons for the biodiversity decline in protected areas?

- **Lack of Ecosystem Approach** - Many of the protected areas are not designed to safeguard the whole ecosystem but only certain species.
- **Ecosystem Degradation** - Habitat loss affects species abundance, genetic diversity, species richness, species distribution.
  - *53% of land in India is under conversion* for urban, industrial, and agricultural purposes.
- **Inadequate Conservation Measures** - Merely designating more areas as protected "will not automatically result in better outcomes for biodiversity.
- **Mining** – Proximity of oil, natural gas, and other hydrocarbons exploration and mining areas to protected areas.



- **Pollution** - Pollution from nearby industrial activities can degrade habitats and harm wildlife within protected areas.
- **Insufficient Enforcement** - Lack of stringent enforcement of protection laws allows illegal activities like poaching and logging to continue.
- **Climate Crisis** - More frequent and intense droughts and wildfires have severely impacted the protected areas.

What are the significances of protected areas for biodiversity?

- **Habitat Preservation** - They safeguard critical habitats, ensuring the survival of various species by protecting the environments they depend on.
- **Biodiversity Hotspots** - Many protected areas are biodiversity hotspots, rich in unique species that might not be found elsewhere.
- **Genetic Diversity** - Protected areas maintain genetic diversity by preserving a wide range of species and their genetic variations, which is essential for the resilience of ecosystems.
- **Species Preservation** - By maintaining natural habitats, protected areas help preserve endangered and threatened species, allowing them to recover and increase their populations.
- **Research and Monitoring** - They provide opportunities for scientific research and monitoring, helping us understand ecological processes and develop effective conservation strategies.
- **Climate Change Mitigation** - By preserving forests and other ecosystems, protected areas help mitigate climate change driven biodiversity loss.

What lies ahead?

- Conduct region-specific analysis to determine the specific reasons for landscape deterioration within protected areas.
- Focus on 30×30 commitment made by countries at Biodiversity COP15 to put at least 30% of the world's lands and oceans under conservation by 2030.
- Promote ecosystem level conservation activities along with species conservation efforts.
- Strict enforcement of guidelines regulating mining activities in protected areas as well as Eco Sensitive Zones.
- Prohibition of mining activities in National Parks and Wildlife Sanctuaries ("Protected Areas") shall also extend to an Eco sensitive area up to one kilometre ("km") from the boundary of the Protected Area.

Quick Facts

- **India's Biodiversity** - India has tremendously rich in species and ecosystem diversity in.
  - **Number of Biogeographic zones** - 10
  - **Number of Fauna Species** - Over 1,03,258
    - Endemic Fauna - 28,948 (28% of the total fauna)
  - **Number of Flora Species** - 55,048.
    - Endemic Plants – 12,095
- **India's Protected Areas** – There are 106 National Parks and 572 Wildlife Sanctuaries, which constitute 1.36% and 3.86% of the total area, respectively.
- Gujarat boasts the largest expanse of protected areas, spanning 17,098 km², equivalent to 8.72% of its state area.
- In terms of the proportion of total state area, Sikkim, Chandigarh, Ladakh, and Goa lead, with over 20% of their territories designated as protected areas.

India's Floral Species Diversity and Endemism – 2021

Major Groups	Number of Species	No. of Endemic Species	No. of Threatened Species
Flowering Plants			
Gymnosperms	82	12	12
Angiosperms	21,984	4,556	416
Non-flowering Plants			
Bryophytes	2,800	640	7
Pteridophytes	1,314	74	2
Others			
Virus & Bacteria	1,269	26	
Algae	9,008	1,965	
Fungi	15,602	c. 4240	1
Lichens	2,989	c. 582	
Total	**55,048**	**12,095**	

Source: Botanical Survey of India, Kolkata.

India's Faunal Species Diversity and Endemism – 2021

Major Groups	Number of Species	No. of Endemic Species	No. of Threatened Species
Protozoans	3,557	645	
Invertebrates	92,741	27,125	135
Chordates, Cephalochordates and Urochordates	6,960	1,178	540
Of which			
Fishes	3,496	500	228
Amphibia	443	296	75
Reptilia	706	255	54
Birds	1,346	81	89
Mammals	432	46	94
Total	**1,03,258**	**28,948**	**675**

Source: Zoological Survey of India, Kolkata, 2022.

- **Increase in Protected Areas** - There has been around 72% increase in the number and around 16% increase in area for the Total Protected Area during the period 2000 to 2023.

11. SCIENCE & TECHNOLOGY

11.1 National Supercomputing Mission

Why in News?

Recently, Three PARAM Rudra supercomputers worth Rs 130 crore have been inaugurated.

What is a supercomputer?

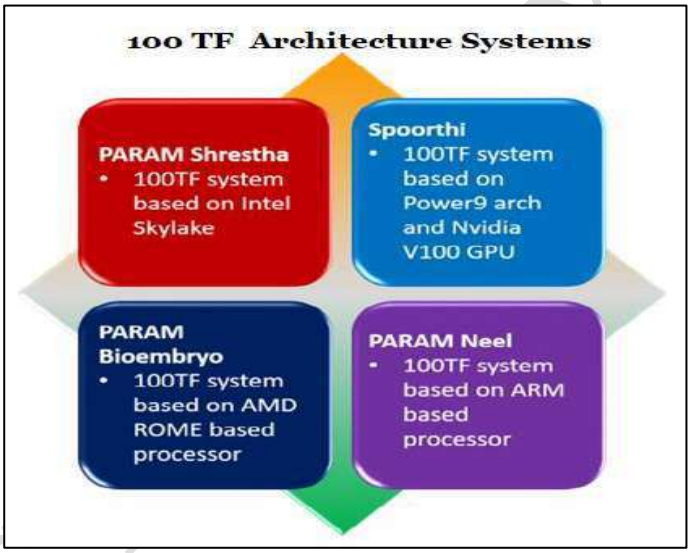
- **Supercomputer** - It is a large computing system designed to solve complex, scientific and industrial challenges, which tend to be time-consuming and computation-intensive.
- **Floating-Point Operations per Second (FLOPs)** - It is a measure of high-performance computing capability such as processing power, efficiency.
- They are a certain kind of mathematical
- A petaflop is thus equal to a thousand TFLOPs or 1015 FLOPs.
- **Physical Size** - They take up a large room worth of space in the form of multiple rows with racks holding computer nodes with many cores.
- **High Performance Computing (HPC) system** - It is made up of several such supercomputers put together.
- New HPC Systems named ***'Arka' and 'Arunika'*** were deployed at Indian Institute of Tropical Meteorology (IITM) at Pune and the National Centre for Medium Range Weather Forecasting (NCMRWF) at Noida.
- **HPC applications** – They will be developed and deployed in areas of
    - Computational biology
    - Climate modelling, weather prediction
    - Engineering including CFD, CSM, CEM
    - Disaster simulations and management
    - Computational chemistry and material science
    - Discoveries beyond Earth (Astrophysics)
    - Big data Analytics

India's Supercomputer	Institute
PARAM Shivay	IIT BHU
PARAM Shakti	IIT Kharagpur
PARAM Brahma	Indian Institute of Science Education and Research, Pune
PARAM Yukti	Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore
PARAM Sanganak	IIT Kanpur
PARAM Pravega	Indian Institute of Science, Bangalore
PARAM Seva	IIT Hyderabad
PARAM Smriti	National Agri-Food Biotechnology Institute, Mohali
PARAM Utkarsh	CDAC, Bangalore
PARAM Ganga	IIT Roorkee
PARAM Ananta	IIT Gandhinagar
PARAM Porul	NIT, Trichy
PARAM Himalaya	IIT Mandi
PARAM Kamrupa	IIT Guwahati
PARAM Siddhi	AI CDAC, Pune
PARAM Rudra	Giant Metrewave Radio Telescope, Pune
	Inter-University Accelerator Centre, Delhi
	SN Bose National Centre for Basic Sciences, Kolkata
Mihir	NCMRWF

What is National Supercomputing Mission?

- **Aim** –To enhance the capabilities of Indian academic and R&D institutions by setting up a network of ***over 70 high-performance computing (HPC) facilities*** across the country.
- To boost India's supercomputing infrastructure amid increasing demand in sectors such as academia, researchers, MSMEs, and startups.

- It is a ***first of its kind attempt*** to boost the country's computing power.
- **Launched in –** 2015.
- **Developed by -** It is a collaboration between the Ministry of Electronics and Information Technology (MeitY) and the Department of Science and Technology (DST).
- **Implemented by -** The Centre for Development of Advanced Computing (C-DAC), Pune and the Indian Institute of Science (IISc), Bengaluru.
- **Network -** These supercomputers will also be networked on the National Supercomputing grid over the ***National Knowledge Network (NKN).***
    - The NKN is another programme of the government which connects academic institutions and R&D labs over a high-speed network.



- Academic and R&D institutions as well as key user departments/ministries would participate by using these facilities and develop applications of national relevance.
- Under the mission, the first indigenously assembled supercomputer, named PARAM Shivay, was installed at IIT (BHU) in 2019.
- **Human Resource Training -** To train personnel in high performance computational skills, dedicated learning centres with PARAM Vidya were established.
- **R&D systems** - The SANGAM Testbed, PARAM Shrestha, PARAM Embryo, PARAM Neel, PARAM Spoorthi, PARAM Sampooran, are presently operational.

What are the significances of the mission?

- **Indigenization** - The NSM has enabled indigenizing supercomputing technology in India.
- **Increased computational capability -** NSM has increased the computational capability for India as a whole.
- Since the launch of the programme, more than 20 supercomputing systems have been deployed nationwide.
- **Self-reliance -** Attain global competitiveness and ensure self-reliance in the strategic area of supercomputing technology.
- **Human Resource Development -** The Mission consists of development of highly professional and skilled human resource for meeting the challenges of development of these applications.
- **Improved Weather Forecasts –** The HPC systems tailored for weather and climate research will enhance the accuracy and lead time of predictions related to tropical cyclones, heat waves, droughts, and other critical weather phenomena.
- **Research Advancement -** It will help advance research in fields ranging from physics and cosmology to earth sciences.

What are the challenges?

- **Incomplete utilization of funds** – The funds allocated to the National Supercomputing Mission in India has not been used fully leaving vast resources unused.
- **Delays in Procurement** -The lengthy procurement procedures of supercomputers and the attached infrastructure.
- **Skill Shortages** - Lack of experts and trained personnels in HPC programming, system administration, data science, and others.
- **Inadequate Private sector participation** – Due to the high cost and long-term nature of the projects, Indian private sectors are hesitant to invest in the technology.
- **Technological Dependency -** India's reliance on foreign suppliers for crucial components like processors and memory chips makes it vulnerable to supply chain disruptions and potential technology restrictions.
- **Power Supply -** Ensuring a reliable and uninterrupted power supply for high-performance computing centers is crucial.

- **Cooling Systems -** The massive heat generated by supercomputers requires efficient cooling systems, which can be expensive and energy-intensive.
- **Cybersecurity Threats -** Supercomputing centers are potential targets for cyberattacks, and protecting them requires advanced cybersecurity measures.

What lies ahead?

- Addressing these challenges requires a multi-faceted approach.
- Encourage private investments in research and development through public private partnerships and other partnership models.
- Conduct talent development programs in partnership with international organizations.
- Strengthen focus on cybersecurity in the domain of supercomputers
- By overcoming these hurdles, India can position itself as a global leader in supercomputing and leverage this technology for scientific advancement and economic growth.

11.2 MicroRNA and Gene Regulation

Why in News?

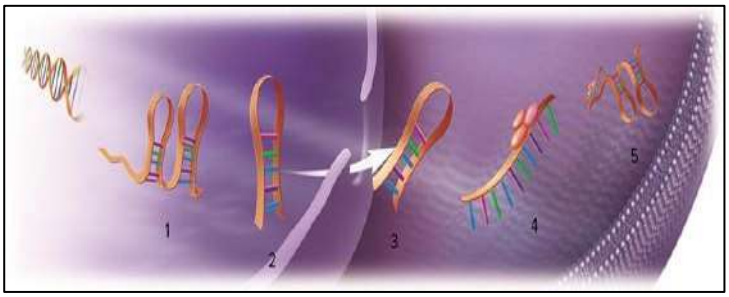
2024 Nobel Prize for Medicine was awarded to Ambros and Ruvkun for their discovery of Gene regulation by microRNA.

What is MicroRNA?

- **MicroRNA** - These are a new class of tiny RNA molecules that play a crucial role in gene regulation for nearly all multicellular organisms, including humans.
- Human genome codes for over one thousand microRNAs.
- **Function of MicroRNA** - It controls gene expression mainly by binding with messenger RNA (mRNA) in the cell cytoplasm during the transcription process.

> ***Gene expression*** *refers to whether a particular gene is making too much, too little or the normal amount of its protein at a particular time.*

- Instead of being translated quickly into a protein, the marked mRNA will be either destroyed and its components recycled, or it will be preserved and translated later.
- A single microRNA can regulate the expression of many different genes, and conversely, a single gene can be regulated by multiple microRNAs.
- **MicroRNA Production** - Cells have genes that encode the information for making microRNA.
- Cells make microRNA using a process that resembles the early steps of protein synthesis.
- The microRNA gene is activated, the DNA strand opens up and the gene is copied, or transcribed, in the form of RNA.



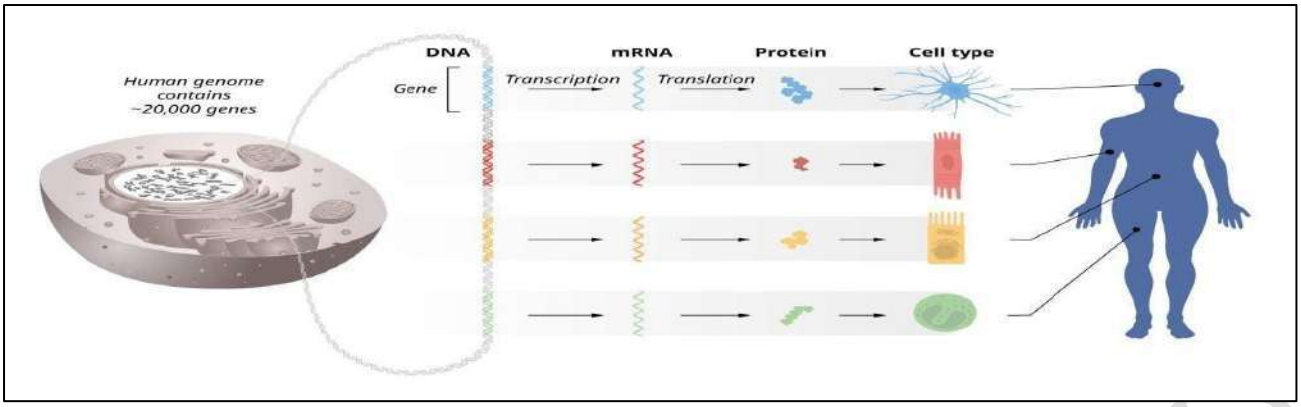
What is gene regulation?

- **Gene Regulation** – It is the fundamental principle governing how gene activity is regulated.
- Chromosomes inside the nucleus of each cell carry genetic information in the form of DNA.
- Every cell in the body has the same chromosome, containing same identical genes.
- But different cells need to use different genes depending on their function and Different tissues in the body create different proteins, depending on their specific functions.

> ***Transcription*** *is the flow of genetic information from DNA to messenger RNA (mRNA), and then on to the cellular machinery for protein production.*

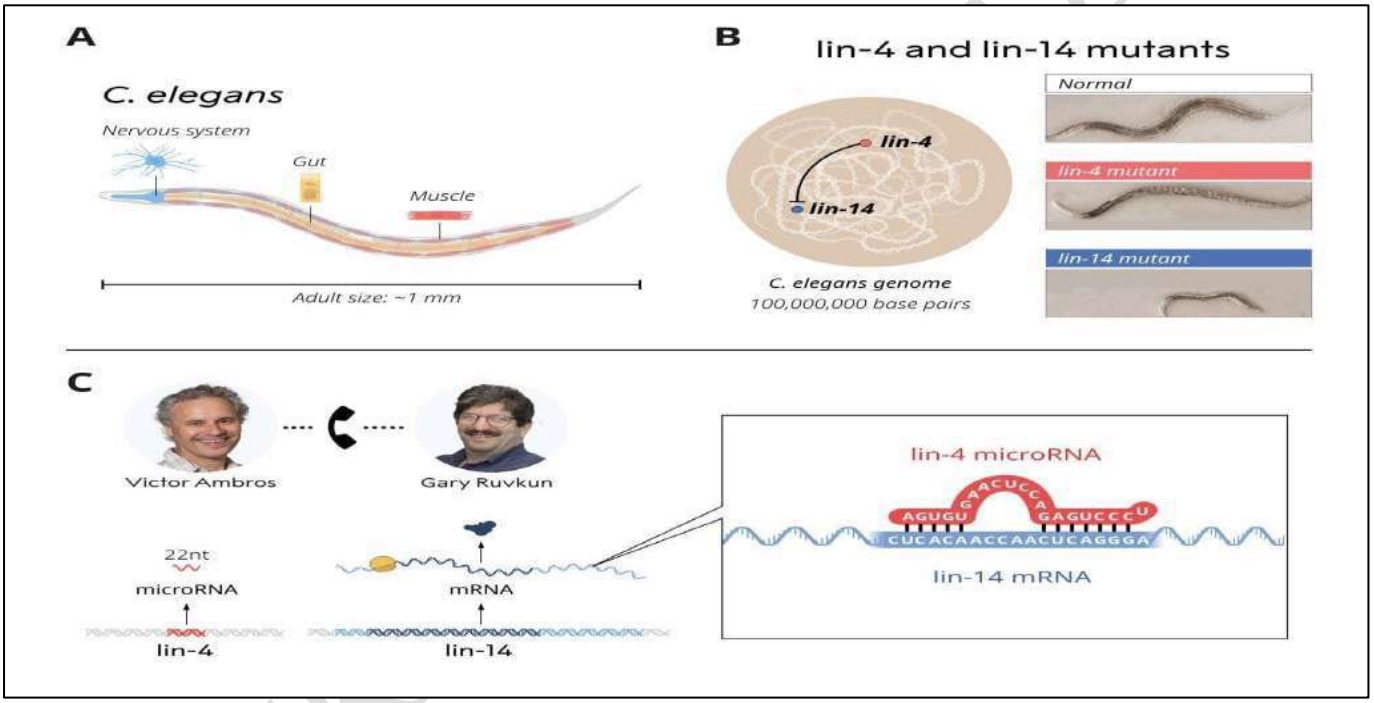
> ***Proteins*** *handle all kinds of important jobs in the body, such as making muscles contract or helping nerves communicate.*

- Gene regulation process helps each cell pick the right gene from its chromosome for its specific tasks and activate appropriate set of genes in each type of cell.
- This enables, for example, muscle cells, intestinal cells, and different types of nerve cells to perform their specialized functions.



How was it discovered?

- **C. elegans** – It is a small roundworm of length 1mm.
- Despite its small size, it possesses many specialized cell types such as nerve and muscle cells that are found in larger, more complex animals.
- It is a useful model for investigating how tissues develop and mature in multicellular organisms.

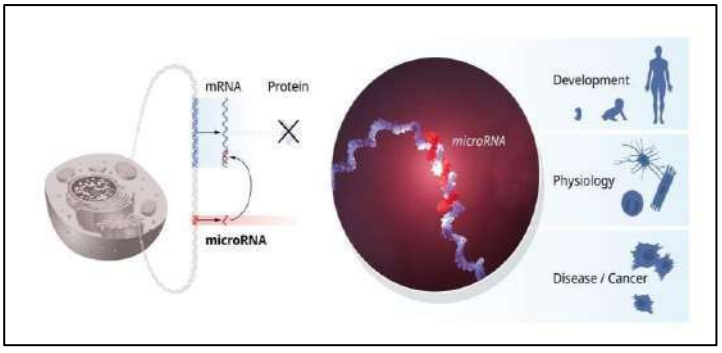


- Ambros and Ruvkun studied the two mutant gene strains of worms, lin-4 and lin-14 that displayed defects in the timing of activation of genetic programs during development.
- The lin-4 gene produced an unusually short RNA molecule that lacked a code for protein production.
- Using this short RNA , lin-4 gene acted as the negative regulator of the lin-14 gene by blocking it's activity.
- Over the following years, more than a thousand genes for different microRNAs in humans were discovered.

Andrew Z. Fire and Craig C. Mello, awarded the Nobel Prize in 2006, for RNA interference, where specific mRNA-molecules are inactivated by adding double-stranded RNA to cells.

What are the Significances of Micro RNA?

- Discovery of microRNA helped in understanding how bodies of complex organisms such as humans function work.
- **Role in Evolution** - Gene regulation by microRNA has enabled the evolution of increasingly complex organisms.
- **Role in Development** - MicroRNA enabled the differentiation of cells to form different types of cells.



- **Understanding diseases** - Faults in gene regulation can result in serious diseases like cancer, diabetes, or autoimmune conditions.
- Understanding gene regulation helps in understanding and potentially treating many of these conditions.
- **RNA production** - Cellular machinery for producing functional microRNAs is used to produce other small RNA molecules in both plants and animals, for example as a means of protecting plants against virus infections.

> ***Mutations*** *in one of the proteins required for microRNA production result in the DICER1 syndrome, a rare but severe syndrome linked to cancer in various organs and tissues.*

11.3 Artificial Neural Networks (ANN)

Why in News?

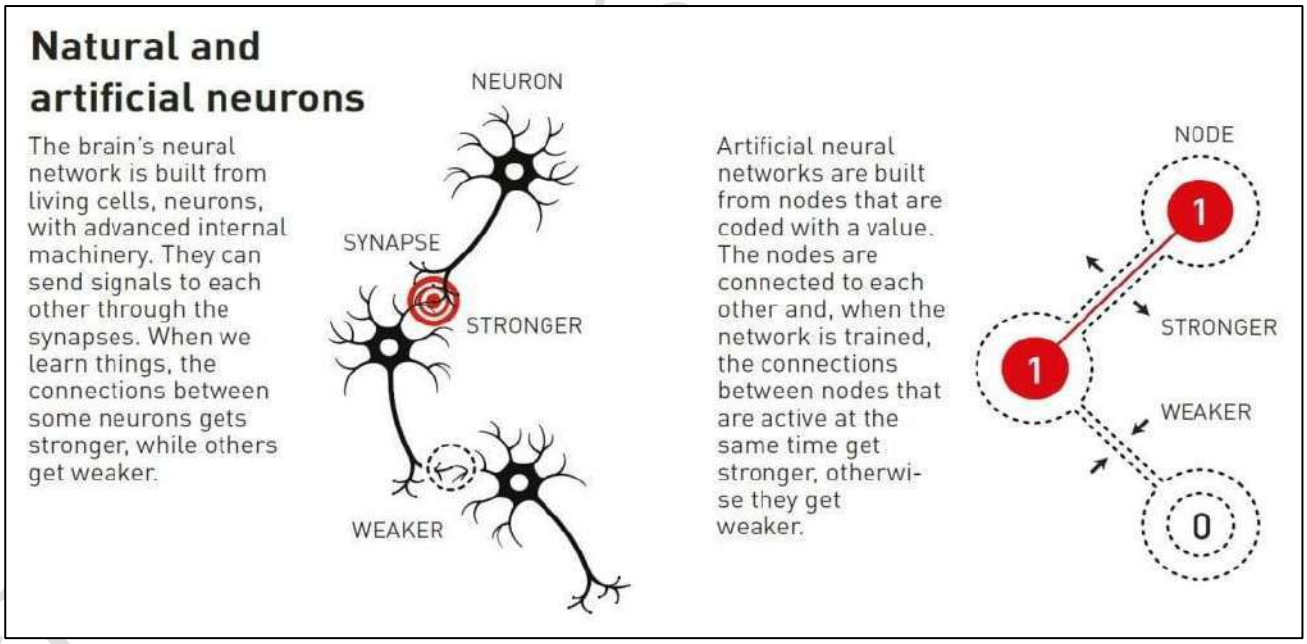
The 2024 Nobel Prize in physics has been awarded to John Hopfield and Geoffrey Hinton for foundational discoveries and inventions that enable machine learning with artificial neural networks.

What are Artificial Neural Networks (ANN)?

> ***John Hopfield*** *created an associative memory that can store and reconstruct images and other types of patterns in data.*

> ***Geoffrey Hinton*** *invented a method that can autonomously find properties in data, and so perform tasks such as identifying specific elements in pictures.*

- **Artificial Intelligence** – It is the ability of machines to perform cognitive functions like learn, analyse, interpret and make decisions like human intelligence through Neural Networks.
    - For example, interpreting a picture to identify the objects in it.
- **Artificial Neural Networks** – It is a network of connected nodes similar to the structure of the brain.
- Each node is a site where some input data is processed according to fixed rules to produce an output and the connection between nodes allows them to transfer input and output signals to each other.



- **Function** - These nodes influence each other through connections that can be likened to synapses in brain and can be made stronger or weaker.
- **Training** - The network is trained by developing stronger connections between nodes with simultaneously high values.

> ***Synapse*** *is the site of transmission of electric nerve impulses between two nerve cells (neurons) or between a neuron and a gland or muscle cell (effector).*

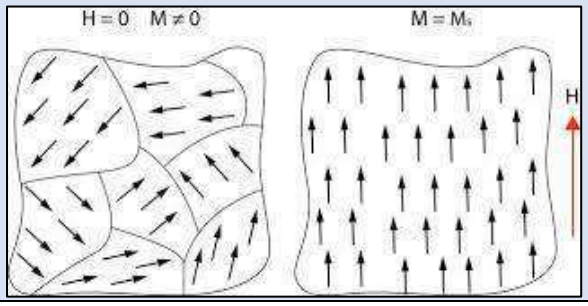
What is Hopfield Network?

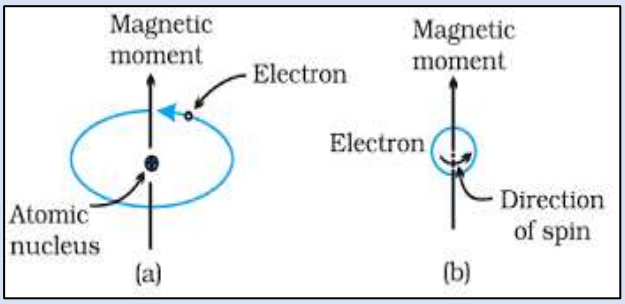
- **Hopfield Network** – Artificial Neural Networks is constructed using Hopfield network which is a type of recurrent neural network in which neurons learn and process information based on Hebbian learning.
    - Hebbian learning is an idea in neuropsychology that if one neuron repeatedly triggers a second, the connection between the two becomes stronger.

- It allowed researchers to translate ideas from statistical physics, neuropsychology, and biology to a form of cognition.
- It utilises the atomic spin property of magnetic materials to store patterns and for recreating them.

Atomic Spin

- It is the special characteristics of magnetic materials
- Atomic spin property makes each atom a tiny magnet.
- The spins of neighbouring atoms affect each other.
- This causes domains with spin in the same direction to form within materials.





- When the network is given an incomplete or slightly distorted pattern, the method can find the stored pattern that is most similar.
- When the network is 'taught' an image, it stores the visual in a 'low-energy state' created by adjusting the strengths of the nodes' connections.
- When the network encounters a noisy version of the image, it produces the denoised version by progressively moving it to the same low-energy state.
- **Training** - It is the process of updating artificial networks using Donald Hebb's hypothesis as one of the basic rules.
- **Associative Memory** - It is a special type of memory that stores set of patterns as memories for performing searches through data.
- When the associative memory is being presented with a key pattern, it responds by producing one of the stored pattern which closely resembles or relates to the key pattern.
- If a node is exposed to many texts, one set in English and the other its Tamil translation, it could use Hebbian learning to conclude "hand" and "*kai*" are synonymous because they appear together most often.

Donald Hebb's hypothesis *is about how learning occurs because connections between neurons are reinforced when they work together.*

What is Boltzmann Machine?

- **Boltzmann Machine** - It is the first simple deep-learning machines developed using a statistical physics technique.
- It is applied in the context of cognitive science to perform cognitive tasks, building on the principles of the Hopfield network.
- **Probability** - Boltzmann's equation predicts the most probable states based on the system's energy preference to that state.
- Hinton developed an ANN with a tendency to move towards some outcomes over others by using Boltzmann's equation to process its inputs.
- **Hidden & Visible Nodes** - Their network had a set of visible nodes, which could input and output information, and a set of hidden nodes that only interacted with other nodes.
- **Dawn of Generative AI** - The visible nodes worked like a Hopfield network whereas the hidden nodes modelled new possibilities using Boltzmann's equation.
- **Restricted Boltzmann Machines -** In this machine, hidden nodes were connected only to visible nodes, and vice versa which enabled more efficient learning.
- that some states are more probable than others because the system's energy *prefers* them.

What are the recent developments?

- **Transformer** – It is a two-part neural network that encodes and then decodes information, with valuable applications in object (including facial) detection and recognition.
- **Backpropagation** – It is a technique that allows unsupervised ANNs to upgrade themselves as they learn.
- **Long short-term Memory** – It enables ANNs to remember some information for a fixed number of steps.

11.4 Protein Structure Prediction and Computational Design

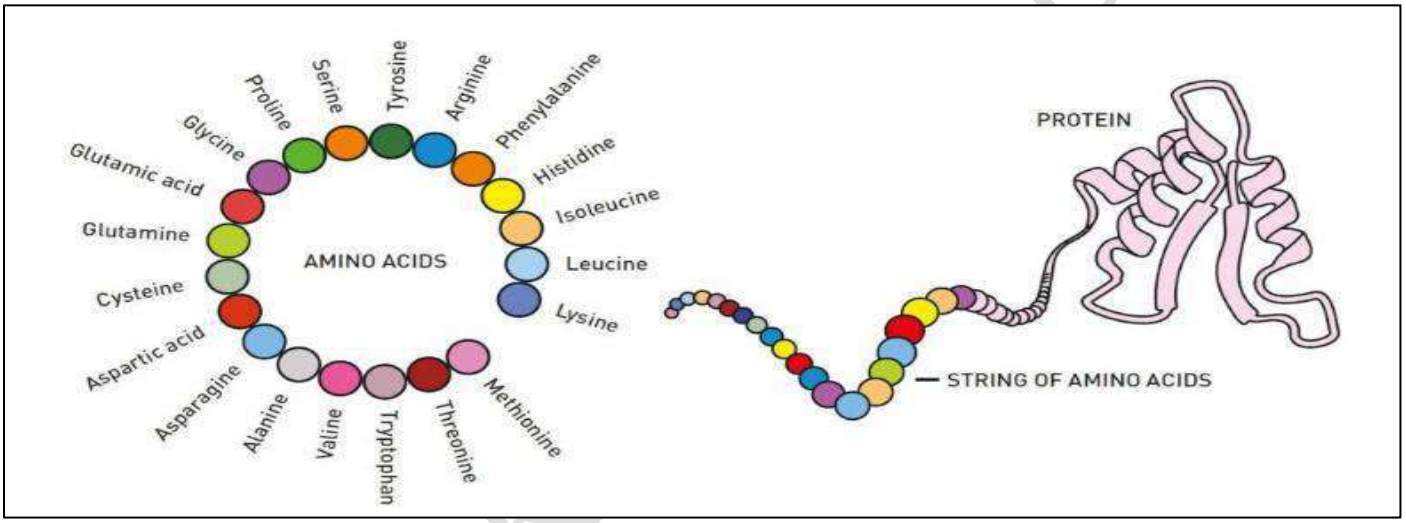
Why in News?

The Nobel Prizes for 2024 in Chemistry was awarded to David Baker "for computational protein design" along with Demis Hassabis and John M. Jumper "for protein structure prediction".

Haemoglobin *is a protein that transports oxygen and insulin helps absorption of glucose from blood.*

How does a protein find its unique structure?

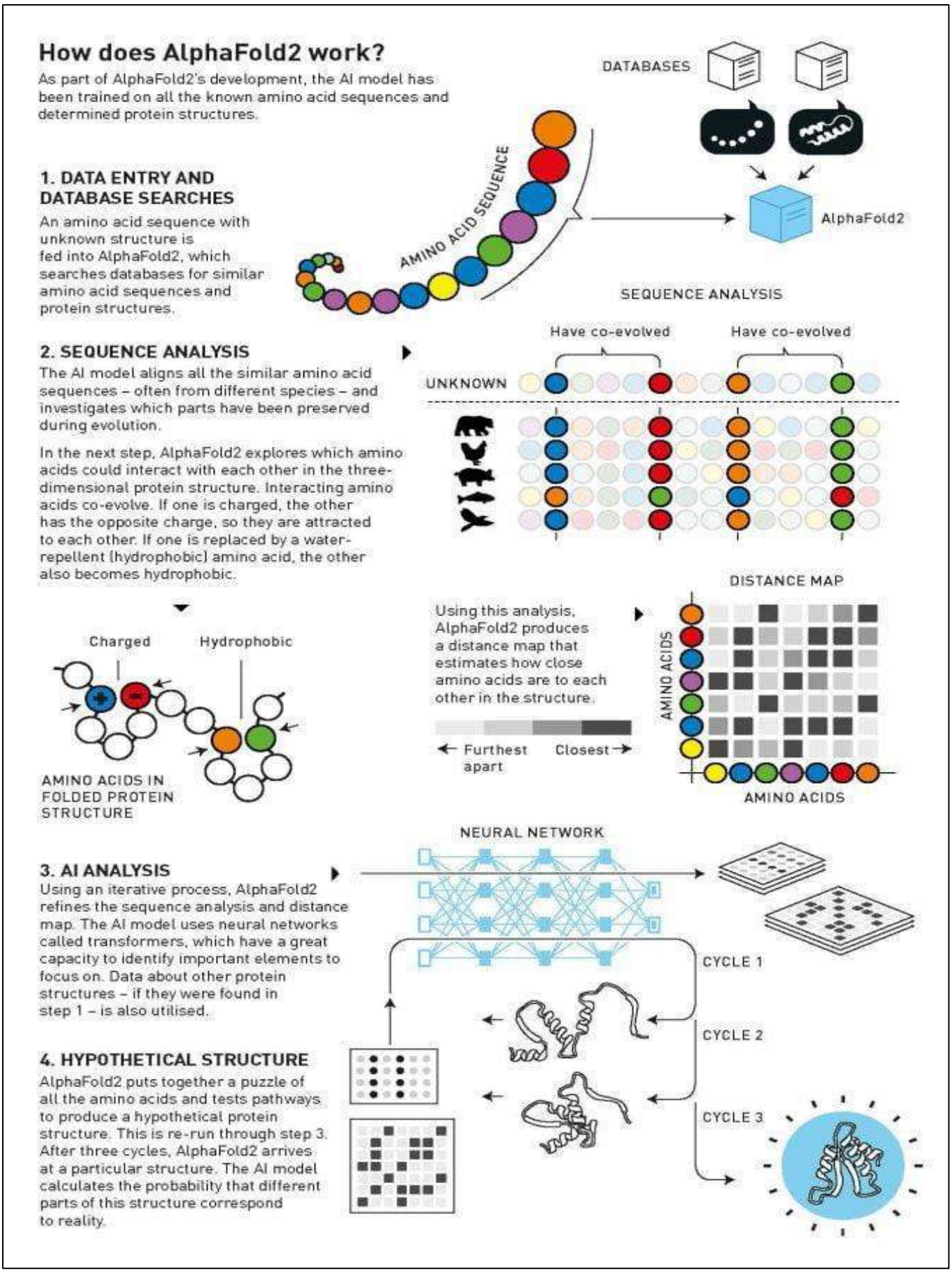
- **Proteins** - They are fundamental to almost all biological processes and are built from 20 amino acids joined into long strings.
- **Protein Structure** - The string of amino acids twists and folds into a distinct three-dimensional structure which gives proteins their function.
- All the information about how the protein folds is present in the amino acid sequence.



- Anything that impacts protein production can have consequences for human health.
- **Enzymes** - Certain kinds of proteins, called enzymes, can speed up biochemical reactions within the body, while others can provide structural support to cells and tissues.
- Then there are some proteins that help in immune response, while others can store nutrients or energy.
- **Decoding Proteins** - Traditional methods of decoding the structure of proteins, through x-ray crystallography, is a laborious and time-consuming process taking months/years.
- **Database** - Over the years, the structures of thousands of proteins have been catalogued and a database containing all known sequences of amino acids has also been created.

What are AlphaFold and Rosetta?

- **AlphaFold** – It is an artificial intelligence model that could predict the structures of millions of proteins.
- Hassabis and Jumper received the other half of the prize for developing this model.
- **Use of AI** – AlphaFold was upgraded using AI neural networks called transformers.
    - *AI neural networks* can find patterns in enormous amounts of data in a more flexible manner.
- AlphaFold2 was trained on the vast information in the databases of all known protein structures and amino acid sequences.
- The AI tool predicts the structures of proteins using known sequences of amino acids from the database.
- These predictions were then matched to catalogued protein structures in the other database.
- **Accuracy** - The AI model is not perfect, but it estimates the correctness of the structure it has produced, so researchers know the reliability of their prediction.

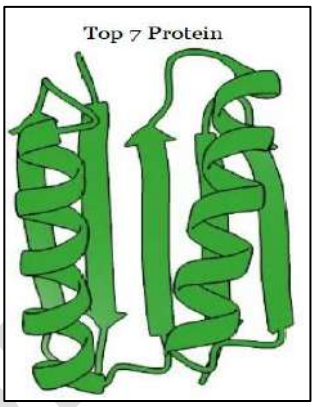


- **Rosetta** – It is the software developed by David Baker to predict protein structures by entering the amino acid sequences as input.
- **Creating New Protein Structure** – The Rosetta process is reversed to get the amino acid sequence for the desired protein structure, which enabled to create entirely new proteins.

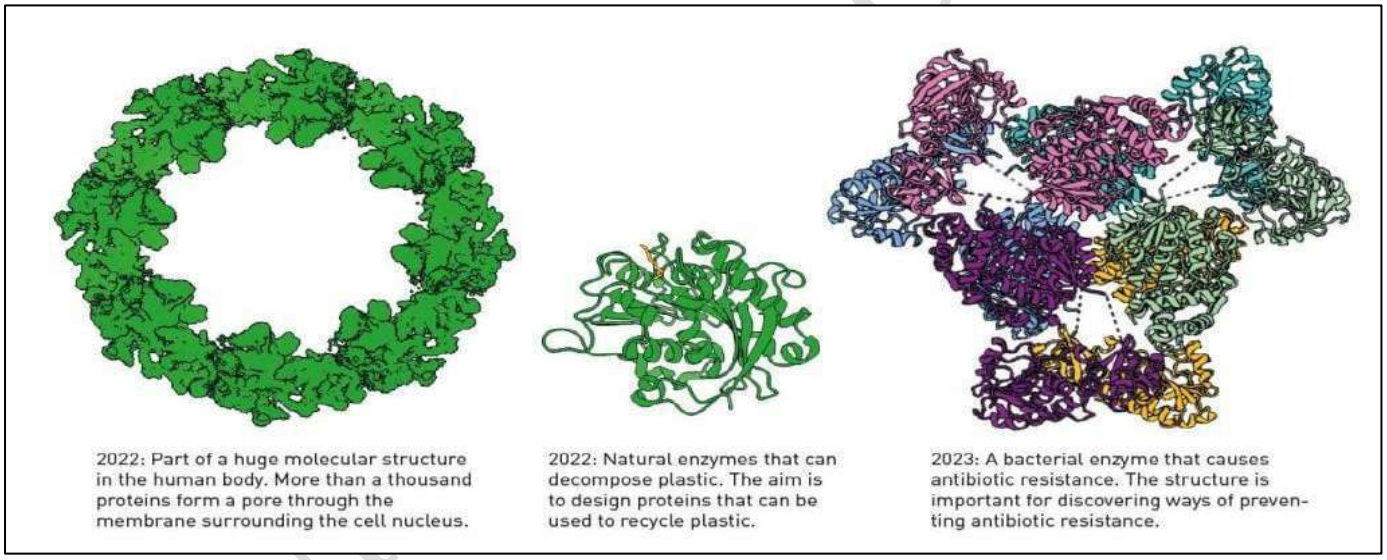
- The new proteins can perform functions that naturally-synthesised proteins are not designed to.
- **Top 7** - It was the first protein constructed by Rosetta that was entirely different to all known existing proteins.

What are the significances of this invention?

- **Better Understanding of Protein** – Their work enabled the better visualisation of protein structure and creating new proteins based on our requirements.
- AlphaFold2 has calculated the structure of all human proteins and predicted the structure of virtually all the 200 million proteins that researchers have so far discovered when mapping Earth's organisms.
- **Time Saving** – Calculating the protein structure took years once and now takes just a few minutes.
- **Better Understanding of Life** - It allows us to better understand how life functions.
- **Clarity on Diseases** – Knowing the relation between protein structure and amino acids , helped in understating some diseases.
- **Understanding Antibiotic Resistance** – Understanding the bacterial enzymes that cause antibiotic resistance will help in discovering ways to prevent it.



- **Plastic Decompostion** – Synthetic enzymes and proteins that can decompose plastic can be designed using this tool.
- **Development of Bioproducts** - The ability to create proteins can lead to new nanomaterials, targeted pharmaceuticals, more rapid development of vaccines, minimal sensors and a greener chemical industry.



11.5 Empowering India's Space Economy

Why in News?

The Union Cabinet has recently approved the establishment of a Rs.1,000 crore Venture Capital (VC) Fund dedicated to supporting India's space sector.

India's Space Economy

- Indian space economy is valued at approximately ***USD 8.4 billion.***
- It constitutes *a* ***2% share*** of the global space market.
- **India's Target** - To scale the space economy to USD 44 billion by 2033, including US $11 billion in exports amounting to 7-8% of the global share.
- **India's Startups in Space Sector** - Around 250 startups are currently operating across various segments of the space economy in India.

What is this venture capital fund?

> ***Venture capital (VC)*** *is a form of private equity and a type of financing for startup companies and small businesses with long-term growth potential.*

- **Aims**
  - To propel the growth of space startups.
  - To strengthen India's space economy.
  - To position the country as a global leader in space technology.
- **Launched by** - IN-SPACe (Indian National Space Promotion and Authorization Centre)

IN-SPACe

- The Indian National Space Promotion and Authorization Centre (IN-SPACe) was established in 2020 as part of the government's comprehensive space sector reforms.
- **Purpose**
  - To promote and oversee private sector involvement in space activities.
  - To serve as a key facilitator for space startups and businesses.
- To know more about , IN-SPACe , Click Here

- **Alignment with Atmanirbhar Bharat Goals**
  - Promoting innovation
  - Ensuring economic growth
  - Fostering self-reliance in high-tech industries
- **Need of the fund**
  - The high-tech space sector lacks critical risk capital, which is essential to sustain growth and enable Indian companies to compete internationally.
  - Traditional lenders often hesitate to support space-related startups, considering the high risk involved and the long-term horizon of returns.
- **Deployment of the Fund** – It will be deployed strategically over five years, supporting startups in various stages of growth.
  - **Growth Stage** - Investments will range from Rs. 10 crore to Rs. 30 crore.
  - **Later Growth Stage** - Investments will range from Rs. 30 crore to Rs. 60 crore.

Space Sector VC funds of other Countries

- **UK** - 30 million GBP Seraphim Space Fund
- **Italy** - 86 million Euro Primo Space Fund
- **Japan** - US $6.7 billion Space Strategic Fund
- **Saudi Arabia** - Neo Space Group (NSG) by Public Investment Fund (PIF).

What are the objectives of the fund?

- **Capital Infusion** - To encourage additional funding for later-stage development, instilling market confidence and providing early-stage financial support critical for growth.
- **Talent Retention** - To prevent startups relocate abroad due to better financial opportunities and to retain talent within India, preventing brain drain.
- **Domestic Development** - Fostering the growth of homegrown space companies.
- **Expansion of Space Economy** - To grow India's space economy by ***five times*** over the next decade, supporting the establishment of India as a major global player in space technology.
- **Technological Advancements** - To advance space technology, supporting the development of sophisticated solutions for both domestic and international markets.
- **Boosting Global Competitiveness** - To develop unique space-based solutions to reduce dependency on foreign technology and allow for stronger competition on a global scale.
- **Supporting Atmanirbhar Bharat** – To become self-reliant by fostering a robust domestic space economy with fewer dependencies on external technology.
- **Creating Innovation Ecosystem** - To encourage the development of new ideas, products, and technologies by nurturing startups and fostering collaborations between various sector.

- **Driving Economic Growth and Job Creation** - To boost economic activity and create thousands of direct and indirect jobs.

What are the benefits for this fund?

- **Achieve India's Space Vision** - The Rs. 1,000 crore VC Fund is structured to align with India's strategic vision for the space sector and supports the goals set forth in the 2020 space reforms.
- **Risk Support to Private Space Companies** – Private space companies operate in the high-risk, high-reward field of space technology.
- **Generate Direct Employment** - Jobs in high-skill areas like engineering, data analysis, software development, manufacturing, and other technical fields will increase.
- **Indirect Employment Opportunities** - Additional employment will also be generated in fields associated with logistics, professional services, and supply chain management.
- **Strengthening India's Space Workforce** - Fostering skilled workforce in the space sector to build a sustainable talent pool.
- **Economic Growth** - Expansion in the space ecosystem with innovation-centric economy that supports self-reliance and sustainable development.

To know more about India's private space sector boom, click here.

12. ENERGY

12.1 Energy Security & Clean Energy Transition of India

Why in News?

India aspires to be a developed nation by 2047 with inclusive, people-centric sustainable growth and improved living standards, without compromising public health or increasing emissions.

What are India's energy demands to meet the goals of 2047?

- India is the third-largest producer and consumer of electricity worldwide.
- **Energy needs** - Total energy demand is expected to double in 25 years.
- **Per capita energy consumption** – It is to increase from *0.43 tonne of oil equivalent (toe)* in 2022 to 0.8 toe by 2047.
- **Electricity demands** - The share of electricity in overall energy demand will increase from 18.3% in 2022 to 40.3% in 2047.
- **Per capita electricity consumption** - *It is to increase* from 1,331 *kilowatt-hour (kWh)* in 2023 to 3,675 kWh in 2047.

> *The **green energy transition** is a shift from an energy mix based on fossil fuels to one that produces very limited, if not zero, carbon emissions, based on renewable energy sources.*

How India can meet its energy needs sustainably?

- By 2047, the ambition is for every Indian to have access to all forms of modern clean or green energy.
- **Implementing Life** - ***Lifestyle for Environment principles*** can supply energy in sustainable manner while delivering quality of living standards equivalent to that of developed nations.
- **Robust energy markets** – It can enable the *development of requisite infrastructure* to ensure doorstep delivery across the country.
- **Transforming the rural economy** – It will *remove the developmental distance in energy* services between the urban and the rural.
    - Currently, 56% of rural households rely on traditional biomass, such as wood, dung cakes, charcoal and crop waste, for cooking.
- It is hoped this will completely shift to cleaner fuels by 2047 while in urban areas, a 100% switch to relatively low carbon intensive fuels such as gas will be achieved much earlier.
- **Electric cooking** – It is expected to catch pace, with about 15% households in rural areas and 20% in urban areas shifting to induction cooking by 2047.

To know about Green Energy in India, click here

What are the drivers of energy security?

- Energy security continues to play a pivotal role in shaping India's energy transition.
  - India imported 88.9% of crude oil, 43.3% of natural gas and 25.04% of coal in 2023.
- **Reduced fossil fuels** - With a greater thrust towards adoption of clean and green fuels, India's consumption of fossil fuels will not see much increase.
- **Increase in share of clean energy** – It is expected to increase from 16% in 2022 to *40% of total primary energy mix by 2047.*
- **Natural gas** – Its supply is expected to *increase more than 3.5 times by 2047*.
- India's offshore exploration together with the expansion of domestic gas infrastructure will play a crucial role in this regard.
- **Nuclear energy** - The ratio of actual energy generated to the maximum possible energy it could generate — of 80-90% has a critical role to play in providing low-emission baseload power.
- **Small Modular Reactors** – SMR with power capacity of up to 300 MWe are gaining attention.
- Recently, a public-private partnership was announced for research and development towards setting up ***Bharat Small Reactors***.

What are challenges in green transitions?

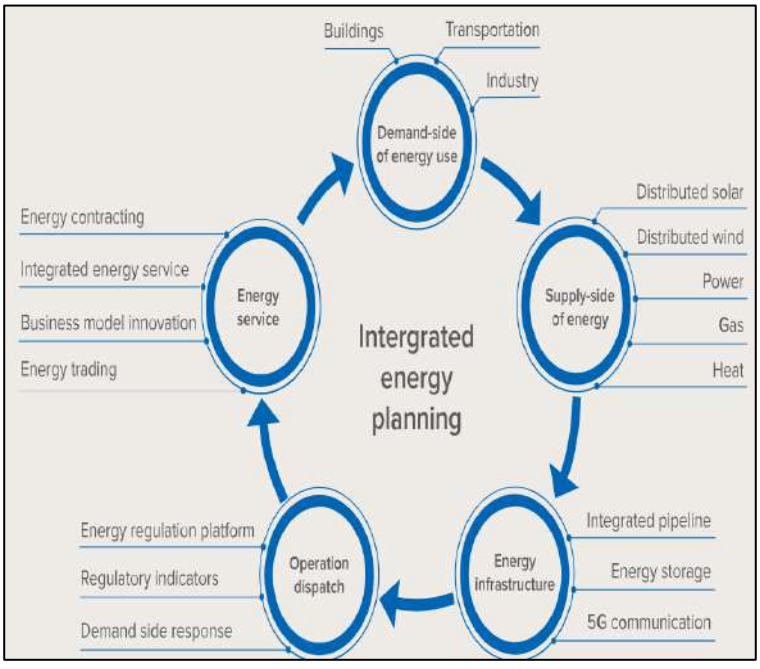
Notably, China supplies 70% of graphite and 60% of rare earth elements today while the Democratic Republic of the Congo supplies 70% of cobalt and Australia supplies 55% of lithium.

- **Mineral issues** – Critical mineral extraction is heavily concentrated.
- The level of concentration is even higher for processing, with China dominating across the board.
- **Nuclear technology** – It comes with its own risks and *long gestation*.
- **Solar and wind power** – They needs further attention as it is *impacted by infrastructure issues*.
- The *increased cost* of creating this excess capacity coupled with system integration costs raises tariffs and disruption anxieties.
- **Pricing issues** - Energy subsidies not just put *additional burden on the exchequer* but also promote *inefficient consumption.*
- Further, *cross subsidy distorts* the true cost of electricity and puts Indian industry at a disadvantage compared to its global competitors.

Cross-subsidization *is a pricing strategy where a business charges more to one group of consumers to make up for lower prices for another group.*

How emission and growth can be balanced?

- India's per-capita primary energy consumption must grow significantly to meet the aspirations of its growing economy and population.
- Formulate an *integrated energy planning*.
- Ensuring energy efficiency and conservation.
- Increasing the share of renewables to support rising electricity demand.
- Reducing energy poverty by fixing the urban-rural energy gap through a people-centric approach.
- **Policy inputs** – NITI Aayog has formed several inter-ministerial working groups to develop a roadmap for achieving a net zero economy by 2070.
- **People-centric Energy Transition** - Niti Aayog collaborates with the Ashoka Centre to co-design this futuristic roadmap & facilitate convergent thinking across the ecosystem.



- **Importance** – It leads to a *low-cost transition pathway* for sustainable development.

To know about India's Nationally Determined Contribution, click here

What lies ahead?

- India needs to diversify its import basket of countries of critical minerals.
- There should be strong extraction and manufacturing to avoid shifting from fuel dependency to mineral dependency.
- Newer delivery models like Direct Benefit Transfer, if implemented in a phased manner, leads to large energy efficiency gains.
- The subsidy burden may be reduced with faster penetration of solar rooftops, smart meters, feeder segregation and the modification of consumer demand for energy through various methods and behavioural change.

12.2 Nuclear Power for Big Tech

Why in News?

Google announced the "first corporate agreement" to buy nuclear energy from multiple small modular reactors (SMR).

What is the need for nuclear power in tech companies?

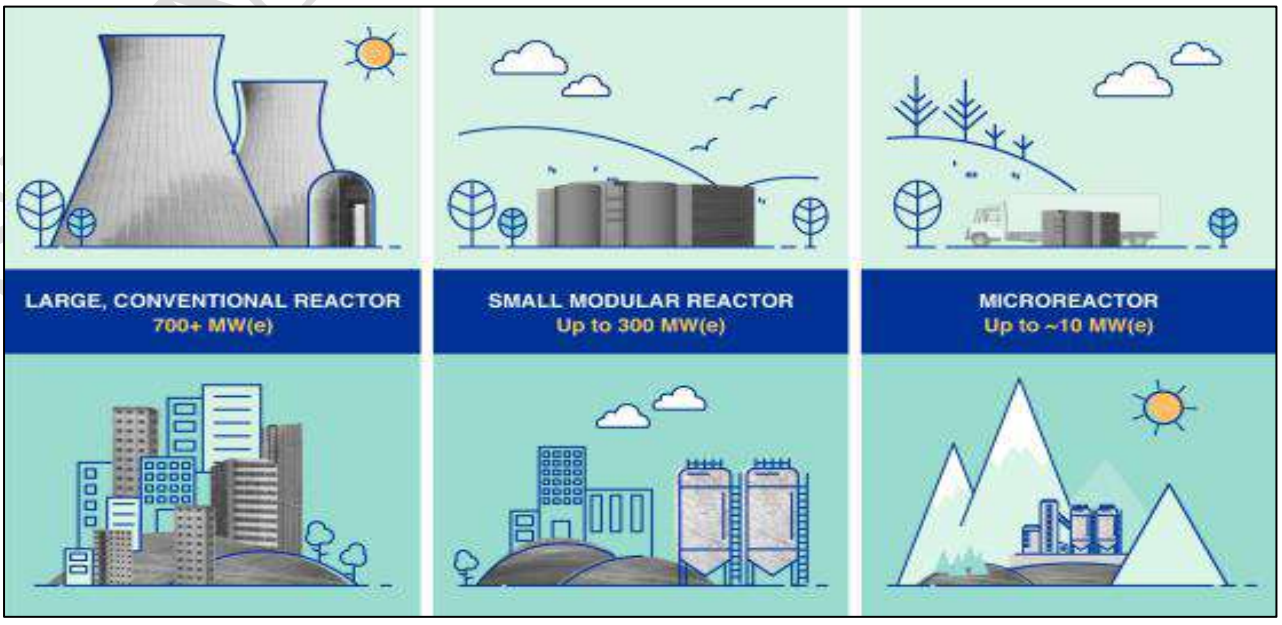
- **Artificial Intelligence** - Training AI models and keeping them online requires a huge amount of energy.
- **Increasing Demand** - AI market is expected to grow at 25-35 %.
- **Managing Data Centres** - Maintaining growing data centres are energy-hungry tasks.
    - At present, data centres worldwide consume 1-2% of overall power, but this percentage will likely rise to 3-4% by the end of the decade.

> *A **ChatGPT** query needs nearly 10 times as much electricity to process as a Google search.*

- **Reduce GHG Emission** – Relying on fossil fuels emits huge amount of greenhouse gases.
    - Google admitted that its total global greenhouse gas emissions rose by 13% in 2023 year-over-year.

What are the benefits of small modular reactors?

- **Small Modular Reactors** - SMRs are advanced nuclear reactors designed to be smaller and more flexible than traditional large reactors.
- **Size and Capacity** - SMRs have a power output of up to 300 MW (electric) per unit, which is about one-third the capacity of traditional reactors.
- **Lower costs** – They have lower building and operational costs.
- **Compact Designs** – They can function in areas unable to withstand larger or older nuclear power plants that require huge volumes of water.
- **Safer** - Components of SMR can be manufactured in a factory and then assembled closer to where power is needed, reducing the safety risks compared to their larger, more complex predecessors.



- **Reliable** – Nuclear energy can be availed *round the clock without supply chain and feed interruption*.
- **Clean Energy** – Nuclear energy is carbon free and do not directly emit greenhouse gases.
- **Better Power Output** – Nuclear energy has high power intensity than any other renewable sources.
- **Faster Deployment** - Smaller sizes and modular designs further help the tech giant in faster deployment cycles.

What are the challenges in adopting nuclear energy?

- **High Initial Costs** - Building nuclear power plants requires significant capital investment, making it a costly option compared to other energy sources.
- **Regulatory Hurdles** - Obtaining regulatory approvals for nuclear projects can be a lengthy and complex process, involving stringent safety and environmental standards.
- **Public Perception** – Nuclear energy projects are often met with opposition from public and civil society groups.
- **Technological Complexity** - Operating and maintaining nuclear reactors require highly skilled personnel and advanced technology, adding to the operational challenges
- **Waste Management** - Handling and disposing of nuclear waste is a major challenge due to its long-term radioactivity and potential environmental hazards.
- **Long Construction Time** - Nuclear plants take a long time to construct, often a decade or more, which can delay the benefits of the investment.
- **Reputation problem** - Public memory of past nuclear accidents and crises that span generations.
- For example, Ukraine's ***Chernobyl explosion (1986) and Japan's Fukushima accident (2011***) resulted in extensive environmental destruction that lasted for years.
- **Natural Disaster Threat** – Fukushima Incident demonstrates how natural disasters beyond human control such as a tsunami can lead to a devastating nuclear accident.
- **Earthquake Threat** - Nuclear infrastructures are highly vulnerable to earthquakes.

What lies ahead?

- Continued investment in advanced nuclear technologies for enhanced safety, efficiency, and flexibility compared to traditional reactors.
- Collaboration between governments, private companies, and research institutions can accelerate the development and deployment of nuclear technologies.
- Streamlining regulatory processes and providing clear guidelines can help reduce the time and cost associated with nuclear projects.
- Educating the public about the benefits and safety of nuclear power can help build support for nuclear projects

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