VISIONIAS
INSPIRING INNOVATION

Environment

Classroom Study Material 2021

(September 2020 to September 2021)

www.visionias.in
+91 8468022022
DELHI | JAIPUR | PUNE | HYDERABAD | AHMEDABAD | LUCKNOW | CHANDIGARH | GUWAHATI

ENVIRONMENT

Table of Contents

Previous Year Questions	A reference sheet of syllabus-wise segregated previous year questions from 2013-2020 (for the Environment Section) has been provided. In conjunction with the document, it will help in understanding the demand of the exam and developing a thought process for writing good answers.	

A NOTE FOR THE STUDENTS

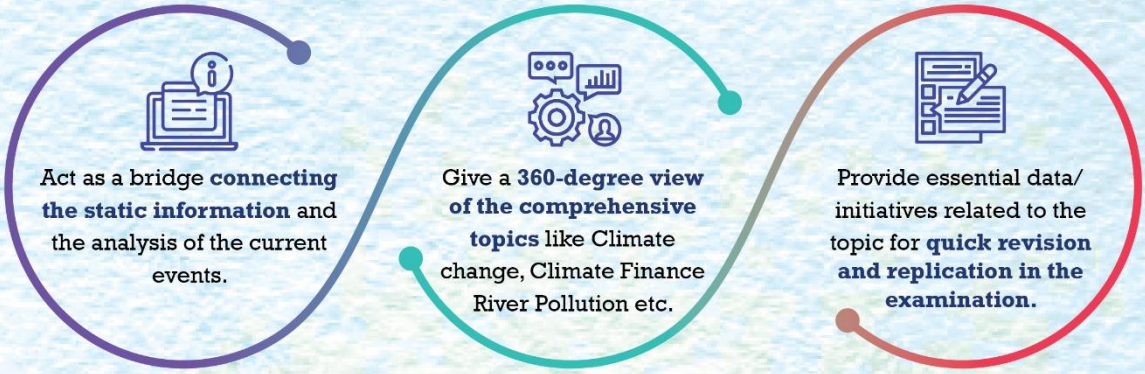
Dear Students,

Every year with Mains 365 documents, we aim to provide consolidated content keeping in mind the demand of the exam and the corresponding needs of the students. This necessitates keeping pace with changing pattern of the examination.

Over the course of last 3-4 years, the nature of questions in the Mains examination has changed significantly. Questions are becoming more conceptual, and more holistic in nature (i.e., having an amalgamation of both static and current parts), for e.g. the question on draft Environmental Impact Assessment (EIA) Notification, in Mains 2020 examination.

In this context we have made following additions in the document:

- **Topic at glance:** Topic at glance have been added to the Mains 365 Environment document. These topic at glance seek to:



- **Infographics:** Infographics have been added in the document in a manner that they can readily be replicated in the examination through flowcharts, pie charts, maps etc., thereby improving the presentation of the content in the answers.
- **Previous year questions:** A QR code to the syllabus-wise segregated Previous Year Questions has been provided for student's reference. These will act as a guiding light for developing a thought process required for writing good answers.
- **Data bank:** Essential data has been given separately in articles which makes it easier to be utilised in the answers.
- **Concepts in brief:** In certain section few keywords in News have been given brief. These can be utilised in making effective connections between current affairs and static content.

The document seeks to not only provide a one stop solution for Environment Current Affairs but it also seeks to develop a coherent thought process required for effective and well presented answer. Therefore, the articles in the document are not only to be read for content but also for understanding and adopting good practices of answer writing.

We hope that the coverage of the content in an organized manner will assist you in performing well in the examination.

Knowing is not enough; we must apply. Willing is not enough; we must do.

-Johann Wolfgang von Goethe

All the best!
Team VisionIAS

1. CLIMATE CHANGE

CLIMATE CHANGE AT-A-GLANCE

STATUS OF CLIMATE CHANGE:IPCC'S SIXTH ASSESSMENT REPORT

Human influence has unequivocally warmed the atmosphere, ocean and land and is responsible for observed increases in greenhouse gas (GHG) concentrations since around 1750.

IMPACTS OF CLIMATE CHANGE

- **Climate zones have shifted poleward** in both hemispheres.
- **Increases in the frequency of compound extreme events** like heatwaves and droughts on the global scale since the 1950s.

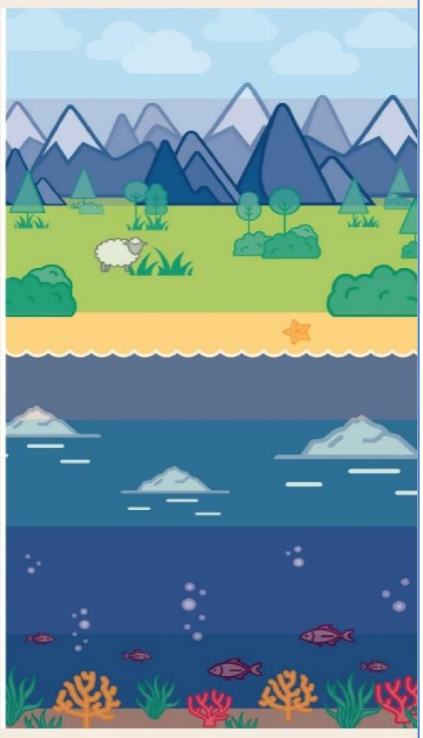
Global retreat of glacier since the 1950s is unprecedented in the last 2000 years.

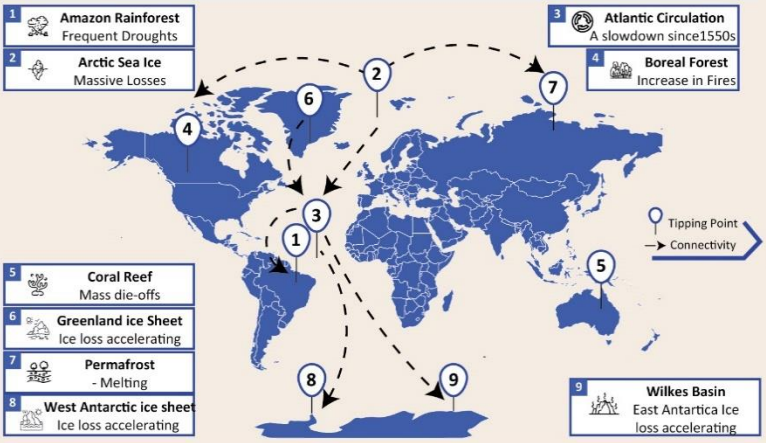
Growing season has on average lengthened by up to two days per decade since the 1950s in the Northern Hemisphere extratropics.

Human-caused global surface temperature increase from 1850–1900 to 2010–2019 is estimated to be 1.07°C, with larger increases over land than over the ocean.

The Arctic Sea ice area has decreased about 10% (in March) **to 40%** (in September) in between 1979–1988 and 2010–2019.

Global mean sea level increased by 0.20 m between 1901 and 2018
Average rate of sea level rise increased from 1.3 mm yr between 1901-1971 to 3.7 mm yr between 2006-2018.





Irreversible changes: Nine tipping points

- Tipping points are thresholds where a tiny change could push a system into a completely new state.
- Globally, there are nine "tipping points" where a changing climate could push parts of the Earth system into abrupt or irreversible change.

WAY FORWARD: LIMITING CUMULATIVE EMISSIONS WITHIN A CARBON BUDGET

- **Reaching net zero CO_2 emissions around or after 2050.**
- **Moving towards Net negative emissions:** Anthropogenic Carbon Dioxide removal (CDR) to remove CO_2 from the atmosphere and durably store it in reservoirs.
  - CDR may include natural approaches like planting trees or technological approaches like direct air capture and storage.
- **Strong, rapid, and sustained reductions in other greenhouse gas emissions** like methane (CH_4) emissions.
- **Enhancement of "clean" finance and investment.**
- **Scenario planning and Risk assessment for extreme weather events** like heatwaves and heavy precipitation.
- **Long-term monitoring of the potential irreversible changes.**

INTERNATIONAL AGREEMENTS TO COMBAT CLIMATE CHANGE

Montreal Protocol, 1987 and Kigali Amendment, 2016	▸ It originally required signatory countries to stop producing substances that damage the ozone layer, such as chlorofluorocarbons (CFCs). ▸ In 2016, parties agreed via the Kigali Amendment to also reduce their production of hydrofluorocarbons (HFCs), powerful greenhouse gases that contribute to climate change.
UN Framework Convention on Climate Change (UNFCCC), 1992	▸ Ratified by 197 countries, the landmark accord was the first global treaty to explicitly address climate change. It established an annual forum, known as the Conference of the Parties, or COP, for international discussions aimed at stabilizing the concentration of greenhouse gases in the atmosphere. ▸ These meetings produced the Kyoto Protocol and the Paris Agreement.
Kyoto Protocol (KP), 2005	▸ The Kyoto Protocol adopted, was the first legally binding climate treaty. It required developed countries to reduce emissions by an average of 5 percent below 1990 levels, and established a system to monitor countries' progress.
Paris Climate Agreement (PCA), 2015	▸ The agreement presently has 195 signatories.

KEY ASPECTS OF PARIS AGREEMENT

Long-term temperature goal
Limiting global temperature increase to well below 2°C above preindustrial levels and pursuing efforts to keep it below 1.5°C.

Global peaking and 'climate neutrality'
Reach global net-zero emissions (or carbon neutrality), where the amount of greenhouse gases emitted equals the amount removed from the atmosphere by 2050.

Mitigation
Binding commitments by all Parties to prepare, communicate and maintain a nationally determined contribution (NDC) to achieve above goals, which will be updated every 5 years.

Global Stocktake
To take place in 2023 and every 5 years thereafter, to assess collective progress toward achieving the purpose of the Agreement.

Voluntary cooperation/Market-andnon-market-basedapproaches (Article 6)
Mechanism for any cooperation that involves internationally transferal of mitigation outcomes.

Addressing Loss and damage
The Warsaw International Mechanism for Loss and Damage associated with the adverse effects of climate change.

Framework for Finance, technology and capacity-building support
Includes the Green Climate Fund (GCF).

Transparency, implementation and compliance framework
To facilitate implementation and promote compliance in a non-adversarial and non-punitive manner.

1.1. IMPACT OF CLIMATE CHANGE ON VULNERABLE SECTIONS

1.1.1. ON REFUGEES

About Climate refugees

The term was first coined to describe the increasing large-scale migration and cross-border mass movements of people that were partly caused by such weather-related disasters.

Challenges in tackling the Problem of Climate Refugees

> **Data Bank**
> Climate crisis could **displace 1.2 billion people by 2050.** (Institute for Economics and Peace (IEP)).

- **Lack of recognition in international conventions**: Climate refugees are **neither clearly defined** as a category **nor covered by** the 1951 Convention relating to the Status of Refugees (the 1951 Refugee Convention).
- **Climate migration is mainly internal:** When migration is internal, people moving are under the responsibility of their own state, they do not cross borders and are not seeking protection from a third country or at the international level and hence no need for refugee status.
- **Harder to identify the victims** of slower processes related to climate change like droughts, land degradation, water scarcity etc. than those of sudden natural disasters like cyclones, floods etc.
- **Isolating environment/climatic reasons is difficult**: Migration is often a combination of multiple humanitarian, political, social, conflict or economic factors interlinked with Climate change.
- **Growing xenophobic tendencies across the globe** poses a major hurdle in efforts towards climate migrants.
- **Creating a special refugee status for climate change related reasons** may lead to the exclusion of categories of people who need protection, especially the poorest migrants who move because of a mix of factors and would not be able to prove the link to climate and environmental factors.

> **India Specific Case:** Climate change might result in two types of displacement and migration in India.
> - Internal migration: Increased migration **within India** due to the effects of climate change such as, drought, desertification, sea level rise, water scarcity and low food productivity, and melting glaciers.
> - E.g. there is widespread displacement of lakhs of population in Assam every year due to flooding.
> - E.g. people from Marathwada region are moving to Mumbai due to drought.
> - **Immigration**: Climate change might lead to **increased flow of migrants from neighbouring countries** due to the accelerated effects of climate change.
> - **Bangladesh** is one of the world's most natural disaster-prone countries with an eroding Sundarban Delta, it is also seeing a constant rise in sea levels and incidents of salt-water intrusions.

Way Forward

- **Developing a conceptual framework** on how to identify climate refugees who have been displaced by climate change and what kind of protection and support needs to be provides to them.
- **Urging governments to incorporate the concept of human rights protection into the planning and implementation of climate change measures**, including-
  - preventing large-scale displacement,
  - responding to the needs of internally displaced persons and
  - promoting human rights-conscious planned relocation as a means of adapting to climate change.
- **Encourage the full use of all already existing bodies of laws and instruments**, both hard and soft law in humanitarian, human rights and refugee law, instruments on internal displacement, disaster management, legal migration and others.

International Conventions on Environmental Migrants

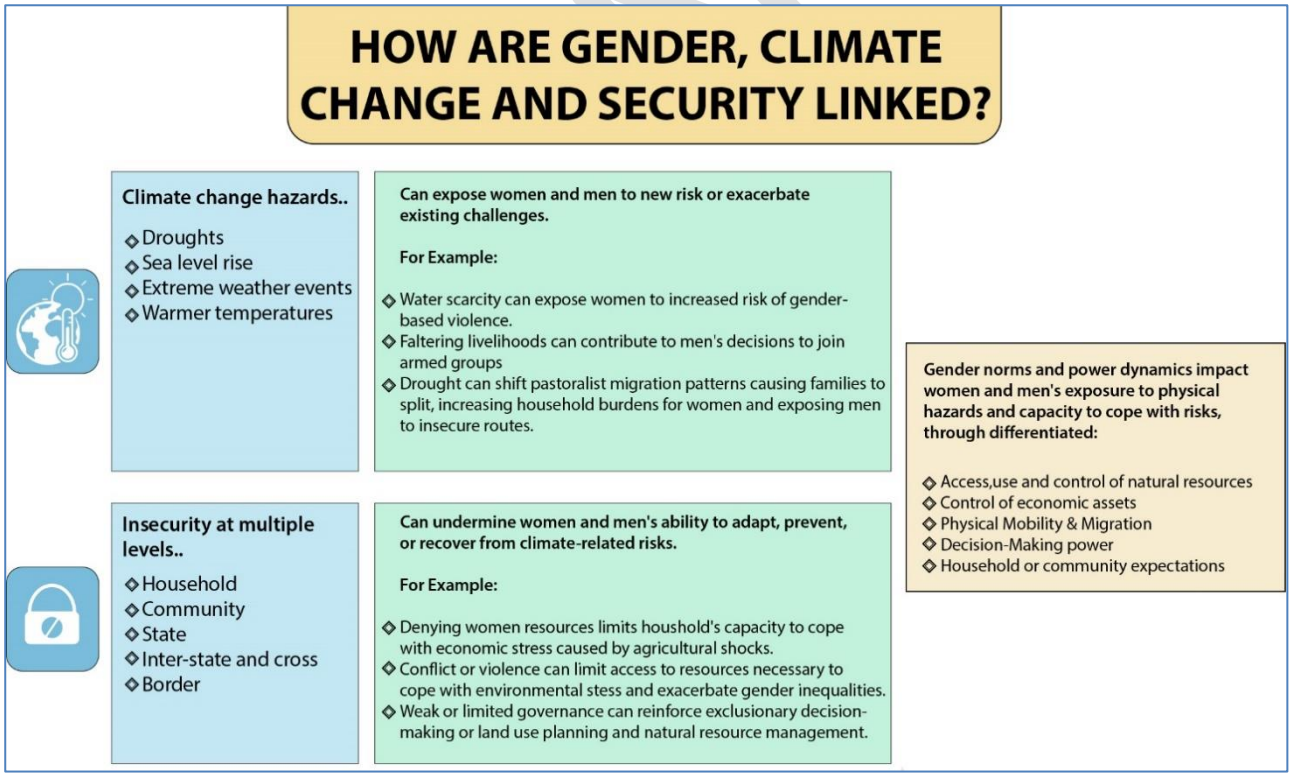
- **The Peninsula Principles on Climate Displacement Within States (2013):** The Principles provide a comprehensive normative framework, based on principles of international law, human rights obligations and good practice, within which the rights of climate displaced persons within States can be addressed.
- **Nansen Initiative Protection Agenda for Cross-Border Displaced Persons (2015):** It's a state-led consultative process to build consensus on a protection agenda addressing the needs of people displaced across borders in the context of disasters and the effects of climate change.
  - **Platform on Disaster Displacement (2016)** was launched to implement the recommendations of the **Nansen Initiative Protection Agenda**.
- **New York Declaration for Refugees and Migrants, UNHCR (2016):** It seeks to protect the human rights of all refugees and migrants, regardless of their status.
- **The Global Compact on safe, orderly and regular migration, 2018:** It is the first-ever UN global agreement on a common approach to international migration in all its dimensions. 'Climate refugees', migrants who move due to natural disasters and climate change, are now recognised under its Objective.
- **Climate Migrants and Refugees Project:** It aims to spread the word about this challenge, its potential impacts, and to seek out solutions and connections that will help the people most threatened by climate change live safe, dignified, and prosperous lives.

1.1.2. ON WOMEN

How does Climate Change disproportionately impact women?

Women are more vulnerable to the effects of climate change than men due to following factors-

- **Economic factors-**
  - They **constitute the majority of the world's poor**.
  - **They are more dependent for their livelihood on natural resources** that are threatened by climate change. For instant, a large number of women are engaged in farming activity in developing countries like India.
- **Political factors-**
  - **Limited access to and control** of environmental goods and services.
  - **Negligible participation in decision-making** and involvement in the distribution of environment management benefits.
- **Socio-cultural factors-**
  - Societal norms and childcare responsibilities prevent women from migrating or seeking refuge in other places or working when a disaster hits.
  - **Traditional and expanding responsibilities due to climate change can expose women to new security risks**: including sexual and gender-based violence, additional barriers to education and heightened burden of household responsibilities, such as collecting water or fuelwood in degraded environments.
    - **For example**- In urban Pakistan, women have experienced domestic violence for failing to manage households with depleting water supplies due to climate change.
  - **Climate change leads to increased violence against women** around the world, as the strain over limited resources reinforces existing power imbalances within communities and individual households.



Way Forward

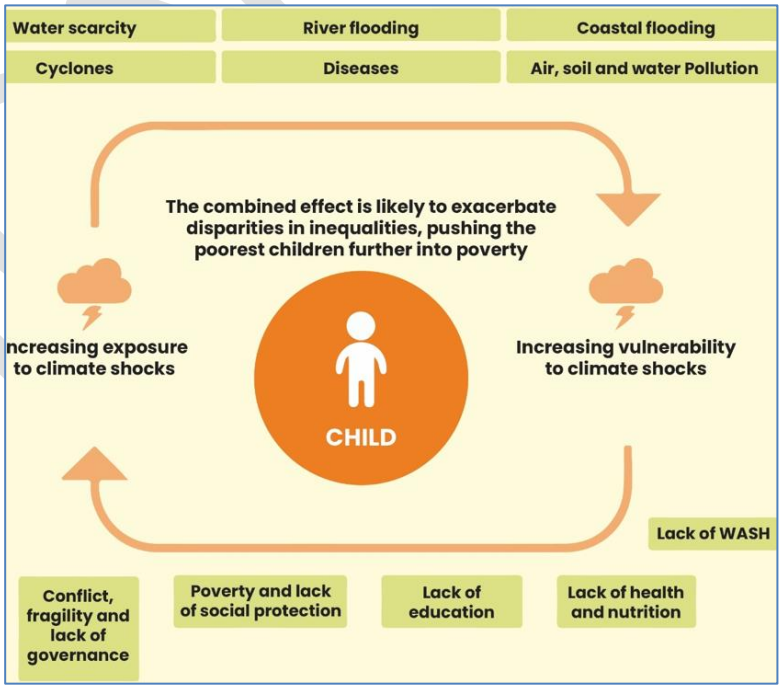
Women have historically developed knowledge and skills related to water harvesting and storage, food preservation and rationing, and natural resource management. In Africa, for example, old women represent wisdom pools with their inherited knowledge and expertise related to early warnings and mitigating the impacts of disasters.

Measures needed to fully utilise women's wisdom and help them adapt and mitigate for climate change, may include-

- **Flexible financing mechanisms** to reflect women's priorities and needs.
  - Dedicated investments in women's empowerment can be increased in sectors related to natural resources, including agriculture and rural development, energy access, and water and sanitation.
- **Encouraging active participation of women in the development of funding criteria and allocation of resources for climate change** initiatives is critical, particularly at local levels.
- **Technological developments related to climate change should take into account women's specific priorities, needs and roles, and make full use of their knowledge and expertise**, including indigenous knowledge and traditional practices.
- **Adaptation initiatives should identify and address gender-specific impacts** of climate change particularly in areas related to water, food security, agriculture, energy, health, disaster management, and conflict.
  - Important gender issues associated with climate change adaptation, such as inequalities in access to resources, including credit, extension and training services, information and technology should also be taken into consideration.
- **Integrate complementary policy agendas:** Policies to address climate-related security risks should systematically include gender dimensions.
  - **Some UN policy frameworks and global agendas** which present opportunities for integrated action are-
    - ✓ United Nations Framework Convention on Climate Change (UNFCCC)- Kyoto Protocol (1997), Paris agreement (2015), Lima Work Programme on Gender (2014)
    - ✓ 2030 Agenda For Sustainable Development
- **Expand the evidence base:** Deeper analysis of the gender dimensions of climate-related security risks is needed.

1.1.3. ON CHILD RIGHTS

How does Climate change impact children?



- **Children are more vulnerable than adults.**
  - **Physical vulnerability:** They are physically more vulnerable, and less able to withstand and survive shocks such as floods, droughts, severe weather and heatwaves.
  - **Physiological vulnerability:** Toxic substances, such as lead and other forms of pollution, affect children more than adults, even at lower doses of exposure.
    - ✓ They are **more at risk of death compared with adults from diseases** that are likely to be exacerbated by climate change, **such as malaria and dengue.**
- **Children lack access to essential services**, such as health, nutrition, education and social protection.
- **Climate policy often does not address the specific risks** that children face because of climate change.
- **Any deprivation as a result of climate and environmental degradation at a young age can result in a lifetime of lost opportunity:** Children are susceptible to be caught in a vicious cycle of increasing exposures and vulnerabilities and face an increase in their overall level of risk (see infographic).

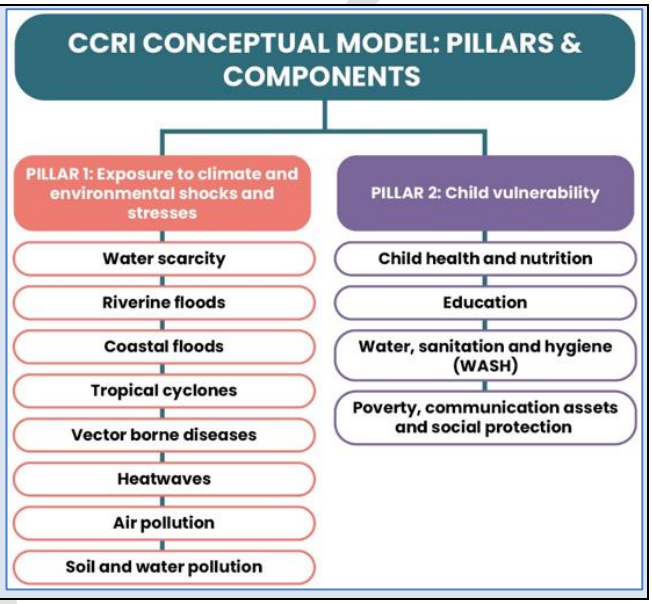
Way Forward

The only long-term solution to the climate crisis is a reduction of emissions to safe levels – reaching net-zero by 2050 in order to stay on course for warming that does not exceed 1.5°C. Other solutions to mitigate and adapt to impact of climate change on children-

- **Investing heavily in adaptation and resilience of social services**. Any adaptations must be based on a careful assessment of both the type and nature of the climate and environmental hazard, shock or stress, as well as the degree to which children are vulnerable.
  - Improving access to resilient WASH services could include, for example, comprehensive assessments of water resources, investing in diversifying water sources, using renewable energy, and working with local markets and the private sector to ensure that water and sanitation services have been constructed incorporating climate risks.
- **Understanding children's vulnerability** is critical to understanding the full extent to which climate and environmental hazards are likely to impact their well-being, and even their very survival.
- **Provide children with climate education and greens skills**, critical for their adaptation to and preparation for the effects of climate change.
- **Include young people in all national, regional and international climate negotiations and decisions**, including at COP26. Children and young people must be included in all climate-related decision making.

Children's Climate Risk Index' (CCRI)

- Recently a UNICEF Report introduced Children's Climate Risk Index' (CCRI) which **ranks countries based on how vulnerable children are to environmental stresses and extreme weather events.**
  - CCRI is structured according to **two central pillars** (Refer infographic).
  - India is among **four South Asian countries where children are at extremely high risk of the impacts of the climate crisis.**



1.1.4. ON INDIGENOUS PEOPLE

How does Climate Change impact Indigenous communities?

- **Climate related displacement**: could force people to leave the lands where their ancestors have lived for thousands of years, with direct impacts on mental health, social capital, food security, water supply etc.
- **Damaging links to nature**: Climate change–related damage to land, water, and life can negatively affect traditional knowledge related to cultivation, spiritual practices and ways of life.
- **Increased vulnerability to impacts from climate change due to systemic discrimination**: This results in the exacerbation of existing health issues, challenges in accessing care, systemic health care system inequity, and stresses from high rates of poverty and geographic isolation.
- **Issues related to climate action and policies**:
  - **Adaptation requires additional financial resources and the transfer of technological capacity** that most indigenous communities do not possess.
  - **Mitigation measures may have undesirable direct and indirect consequences** for indigenous communities.
    - For instance, certain agricultural initiatives may reduce greenhouse gas emissions but may lead to an increase in monoculture crops and plantations and an associated decline in biodiversity and food security.
  - **Lack of research** into the ways in which indigenous peoples are being affected by climate change only exacerbates their disadvantage and vulnerability.

Way Forward

Indigenous people have expertise are rooted in our long-standing relationship with nature and hold many of the solutions to the climate crisis. Following measure can be taken to utilise their traditional knowledge and help them overcome impacts of climate change-

- **Integrating with adaptation and mitigation efforts with other strategies crucial for indigenous communities** such as disaster preparation, land-use planning, environmental conservation and national plans for sustainable development.
- **Governments should ensure that meaningful consultation with the communities should take place**, by promoting and supporting the participation of Indigenous peoples in public policies, strategies, and other decision-making spaces.
- **A rights-based approach in conservation** will help ensure that IPs achieve full recognition of their land and resource rights.
- **Capacity building, including training and funding**, is critical to ensure that IPs can implement programs tailored to their specific needs.
    - Indigenous peoples' organizations can help in providing technical assistance to implement climate change adaptation plans and generate awareness.

1.2. WEAKENING OF ATLANTIC MERIDIONAL OVERTURNING CIRCULATION (AMOC)

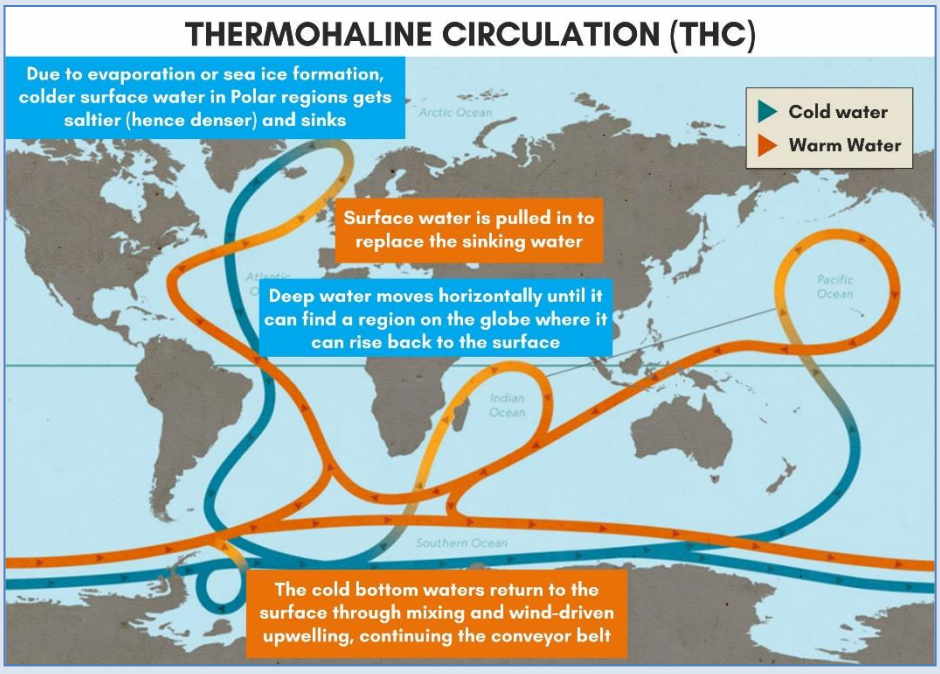
Why in News?

According to the **Sixth Assessment Report of the Intergovernmental Panel on Climate Change**, it is very likely that AMOC will decline over the 21st century.

About AMOC

- The AMOC is a **large system of ocean currents**. It is the Atlantic branch of the ocean conveyor belt or Thermohaline circulation (THC) and distributes heat and nutrients throughout the world's ocean basins.
- **Two main features of the AMOC:**
    - **Flow of warm, salty water in the upper layers of the ocean northwards from the Gulf of Mexico** (Orange line). This is made up of the "Gulf Stream" to the south and the "North Atlantic Current" further north.
    - **Cooling of water in the high latitudes of the Atlantic** makes the water denser. This denser water then sinks and returns southwards towards tropics and then to the South Atlantic as a bottom current (blue line). From there it is distributed to all ocean basins via the **Antarctic circumpolar current**.

Thermohaline circulation (THC)



- The theory for the thermohaline circulation pattern was first proposed by **Henry Stommel and Arnold Arons in 1960.**
- While winds drive ocean currents in the upper 100 meters of the ocean's surface, ocean currents also flow thousands of meters below the surface. These **deep-ocean currents** are driven by differences in the water's density, which is controlled by **temperature (*thermo*) and salinity (*haline*).** This process is known as thermohaline circulation.
- It is also known as the **Global Ocean Conveyor** or **Great Ocean Conveyor Belt.**
- The ocean's global circulation system plays a key role in distributing heat energy, regulating weather and climate, and cycling vital nutrients and gases.

Difference between Surface Ocean Currents and THC		
	Surface Ocean Currents	**THC**
Driven primarily by	Global wind systems that are fuelled by energy from the sun.	Horizontal differences in temperature and salinity
Speed	Relatively fast with speed of **about 5 to 50 cm per second**	Relatively Slow with typical speed of **1 centimetre per second**
Volume of water moved	Relatively less	Tremendous volumes of water are moved

Reasons for recent decline in the AMOC

The AMOC and THC strength has always been fluctuating. In the late Pleistocene (last 1 million years) during the extreme glacial stages, weaker circulation and slowdown in AMOC have been observed. But the **changes destabilising the AMOC** in the last 100-200 years are mostly linked to anthropogenic factors related to Global warming, such as-

- **Freshwater from melting Greenland ice sheets and the Arctic region**: It can make circulation weaker as it reduces the salinity and density of the water, making it unable to sink to the bottom.
- **Weakening of Gulf Stream.**
- **Dilution dues to increased rainfall and river runoff.**

Impact of decline of AMOC

- **Changes in regional Climate**: Gulf Stream, a part of the AMOC, is a warm current responsible for mild climate and rainfall at the Eastern coast of North America and Europe. Absence of a proper AMOC and Gulf Stream can lead to-
  - Decreased temperature and rainfall over Europe.
  - Prominent cooling over northern Atlantic region and neighboring areas, sea ice increases over the Greenland-Iceland-Norwegian seas and to the south of Greenland.
  - A significant southward rain-belt migration over the tropical Atlantic.
  - Increase in winter storms over Europe and stronger hurricanes in the US.
- **Sea level rise due to piling up of water at the US east coast.**
- **Socio-economic impacts**: on agriculture, wildlife, transport, energy demand and coastal infrastructure.
- **Severe consequences for Atlantic marine ecosystems**: Disruption of fish populations and other marine life in the North Atlantic ecosystem which are adapted to the existence of the overturning circulation and consequent conditions like the seasonal cycle, the temperature, the nutrient conditions.
- **Collapse of AMOC**: AMOC is one of the **nine "tipping points"**.
  - **Increase in the freshwater input could cause the AMOC to collapse into a state of reduced flow.** From this collapsed state, even if freshwater input into the oceans decreases to current levels, the AMOC may remain in a collapsed state. The ability of the system to not return to the initial state once the forcing is reversed is referred to as **hysteresis.**
  - This is mainly because the **AMOC is a self-reinforcing system.** The circulation itself brings salty water into the high-latitude Atlantic and the salty water increases the density. Thus, the water is able to sink because it is salty and it is salty because of the circulation.
- **Other impacts**: A collapse of the AMOC may induce causal interactions like-
  - Changes in ENSO [El Niño–Southern Oscillation] characteristics.
  - Dieback of the Amazon rainforest.
  - Shrinking of the West Antarctic Ice Sheet.
  - Southern migration of the ITCZ [Intertropical Convergence Zone] and the tropical rain belt.
  - Large warming of the Southern Ocean.
  - Weakening of the African and Asian monsoons and strengthening of Southern Hemisphere monsoons.

Indian ocean and AMOC

- Recent studies have found that **rising temperatures in the Indian Ocean can help boost the AMOC and delay slow down.**
- **Warming in the Indian Ocean generates additional precipitation**, which, in turn, draws more air from other parts of the world, including the Atlantic.
- The higher level of precipitation in the Indian Ocean **will reduce precipitation in the Atlantic**, leading to **increase salinity in the waters of the tropical portion of the Atlantic**.
- This saline water in the Atlantic, as it comes north via AMOC, **will get cold much quicker than usual and sink faster**, acting as a jump start for AMOC, **intensifying the circulation.**

Way Forward

There is a need to reconcile climate models with the presented observational evidence to assess how far or how close the AMOC really is to its critical threshold. This can be achieved by-

- **Improve long-term monitoring of the AMOC**: This monitoring would likely include observations of key processes involved in deep water formation in the Labrador and Norwegian Seas, and their communication with the rest of the Atlantic.
- **Improve understanding of past AMOC changes:** through the collection and analysis of those proxy records that most effectively document AMOC changes and their impacts in past climates.
- **Accelerated development of climate system models** incorporating improved physics and resolution, and the ability to satisfactorily represent small-scale processes that are important to the AMOC.

1.3. CLIMATE FINANCE

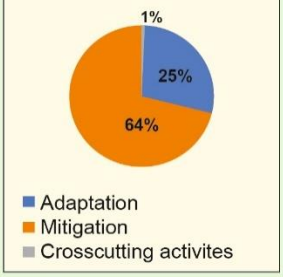
CLIMATE FINANCE AT- A- GLANCE

It refers to **local, national or transnational financing**—drawn from public, private and alternative sources of financing—that seeks to support mitigation (reducing GHG emissions) and adaptation (adapting to the adverse effects and reduce the impacts of a changing climate) actions that will address climate change.

Status

- **$1.6 to $3.8 trillion per year** required to remain within the 1.5°C to 2°C scenario. (IPCC report).
- **~USD 80 billion** of climate finance was mobilised by developed countries for developing countries in 2019.
- **Asia was the main recipient** of climate finance during 2016-2019.
- **India will require ~ ₹11 trillion per year from 2015 to 2030**, for effective climate action (MoEFCC).

Share in Climate Finance (2019)



Need of Climate Finance: Investments needed in-

Mitigation

- Renewable energy generation Green buildings
- Energy efficient transportation like e-vehicles
- Decarbonisation of Industries
- Alternative fuel technologies like biofules and green hydrogen
- Restoration of land and forests
- Carbon capture and sequestration technologies etc.

Adaptation

- Climate resilient infrastructure such as storm water drains, flood defenses etc.
- Developing resilient crop varieties
- Recover from Loss and damage due to extreme weather events
- Addressing needs of Small Island Developing States (SIDS)
- Climate Smart agriculture
- Rehabilitation of vulnerable populations etc.

Existing Sources of Climate Finance

Financial mechanisms under UNFCCC, the Kyoto Protocol and the Paris Agreement	▸ Global Environment Facility (GEF) manages two funds- Special Climate Change Fundand Least Developed Countries Fund. ▸ Adaptation Fund (AF) functioned under Kyoto Protocol. ▸ Green Climate Fund (GCF) aims to mobilise US$ 100 billion per year.
UN-backed international climate funds	▸ Clean Technology Fund (CTF) ▸ Climate Investment Funds (CIFs) ▸ UN- Reducing emissions from deforestation and forest degradation (REDD) ▸ Net Zero Asset Owner Alliance
Other international funds	▸ Climate Change Fund of Asian Development Bank (ADB) ▸ Forest Carbon Partnership Facility (FCPF)
National and local Sources of raising finances	▸ Allocations from National Governments: e.g., National Adaptation Fund for Climate Change (NAFCC) established by India ▸ Carbon pricing instruments includes mechanisms like- › Carbon market approaches like Emissions Trading Schemes › Carbon emissions tax approach

Challenges

- **Underfunding of adaptation**
- **Stress added by COVID-19 pandemic**: Diversion to emergency services and reduction in tax revenue.
- **Lack of 'investment ready' low-carbon/ climate-resilient projects**
- **Gaps in present global knowledge about climate finance:**
  - **Lack of common definitions** for central concepts.
  - **Limited awareness of national policymakers** on the existing mechanisms.
  - **A scarcity of demonstrable, tested models on climate finance delivery**.
  - **Low 'bankability' of climate action projects** due to lack of data about future returns and risks on investment.
- **Lack of adequate finance for least developed countries (LDCs) and small island developing states (SIDS)** to tackle loss and damage.

Way forward

- **Global efforts:**
  - **Multilateral development banks (MDBs) and development finance institutions (DFIs)** need to align their portfolios with the Paris Agreement.
  - **Standardizing definitions of climate finance.**
- **Developing additional funding mechanisms to compensate for loss and damage**: e.g., funds that can pool private and public investments from developed nations and global insurance mechanisms.
- **Efforts at Nation level:**
  - **Introducing carbon-pricing mechanisms, climate data systems, and criteria for assessing capital investments in green projects.**
  - **Building Incentive structures and mechanisms**, such as tax rebates, to promote private sector investment.
  - **Balancing investments in Climate adaptation and mitigation.**
- **Efforts at the level of Local Governments:** Integrating carbon pricing and other climate-smart metrics into decision making.

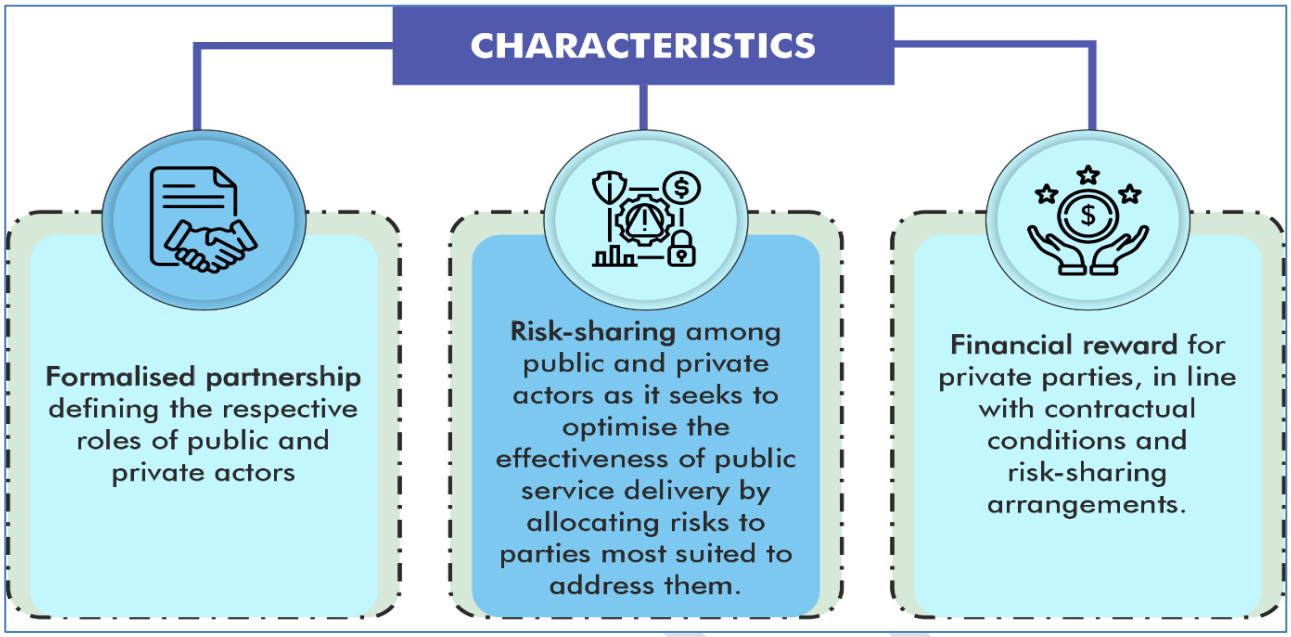
1.3.1. CLIMATE-SMART PUBLIC PRIVATE PARTNERSHIPS

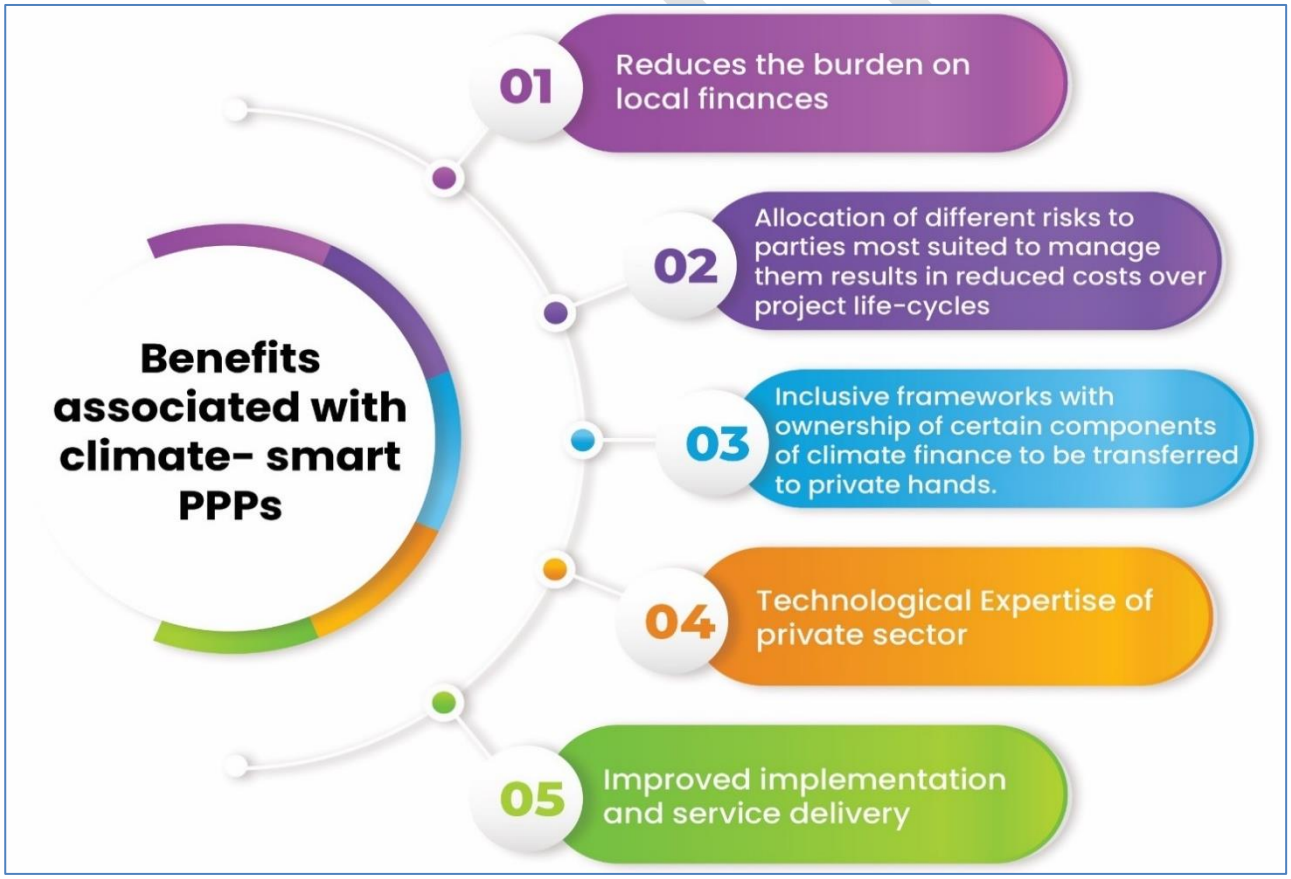
Why in news?

According to World Bank, implementing the **Paris climate agreement** and the transition to a **low carbon economy** require adequate climate finance and **Climate-Smart PPPs (Public Private Partnership)** has a key role to play in scaling up Climate finances.

What are Climate Smart PPPs?

According to **World Bank,** PPPs is 'a long-term contract between a private party and a government agency, for providing a public asset or service, in which the **private party bears significant risk and management responsibility'.** In this context, a climate-smart PPP is the one which has following characteristics:



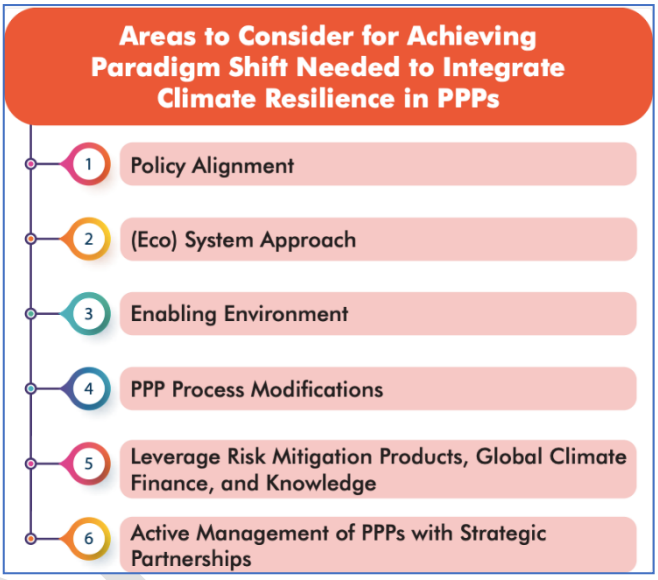


Some examples of Climate Smart PPP mechanism

- **P4G**, which stands for **Partnering for Green Growth and the Global Goals 2030,** is a global initiative that seeks solutions for climate action and green economic growth through **public-private partnerships** and aims to deliver on the **UN Sustainable Development Goals** and the **Paris Agreement.**
- The **Community Development Carbon Fund** is a PPP fund that overcame traditional limitations of carbon markets to support the financing of small-scale, pro-poor projects.
- In India, **National Action Plan on Climate Change (NAPCC)** looks into inclusive sustainable development and inclusion of civil society and PPP in the process.

What are the challenges associated with creation of Climate Smart PPPs?

- **Policy and regulatory uncertainty**: Unsupportive Environmental policy distorts the relative pricing of clean versus polluting projects and introduces **regulatory risk and uncertainty** for private investors.
- **Deterministic Contracts vs. Uncertain Events:** PPP contracts lack a flexible approach to deal with risks that have high uncertainties and unpredictability, such as climate risks.
- **Lack of a comprehensive list to capture all climate risks:** It exposes the PPP asset to not being able to qualify certain events (e.g., storm, hail damage) as relief or compensation events.
- **Lack of Insurance against climate risks:** Limited access and affordability of insurance, especially in developing countries, exposes PPP assets to long-term climate risks and dissuades investors from investing in such risky PPPs.
- **Procurement Bias:** Innovative resilience measures proposed by the private sector for managing climate risks might require additional compensation (e.g., to meet additional adaptation costs).
- **Conflict in priorities:** arising out of undefined and unallocated risks associated to climate change.



Way Forward

- **Supporting de-risking of private finance:** PPPs framework should provide long-term visibility and stability to investors.
- **Co-creation of PPP and early private sector involvement** to ensure that **transparent and effective financial mechanisms** are established, and that PPPs are developed in accordance with the characteristics and needs of all actors involved.
- **Proper Coordination**: Mobility programs whereby staffs are exchanged for a certain period between different organisations may be an effective way to build bridges and reconcile the languages and understandings of public and private actors.
- **Effective Risk sharing**: Increased joint risk-taking, supported by expert technical assistance, will support scaled up and accelerated deployment of climate finance.
- **Establishing Robust stakeholder consultation processes with end-beneficiaries** to deliver public services and ensure that climate finance PPPs address on-the-ground needs effectively.
- **Systematic evaluation of real examples of PPPs** will contribute to greater interest in their use and also help identify more success specific factors.

1.3.2. CLIMATE FINANCE AND SMALL ISLAND DEVELOPING STATES (SIDS)

Why in news?

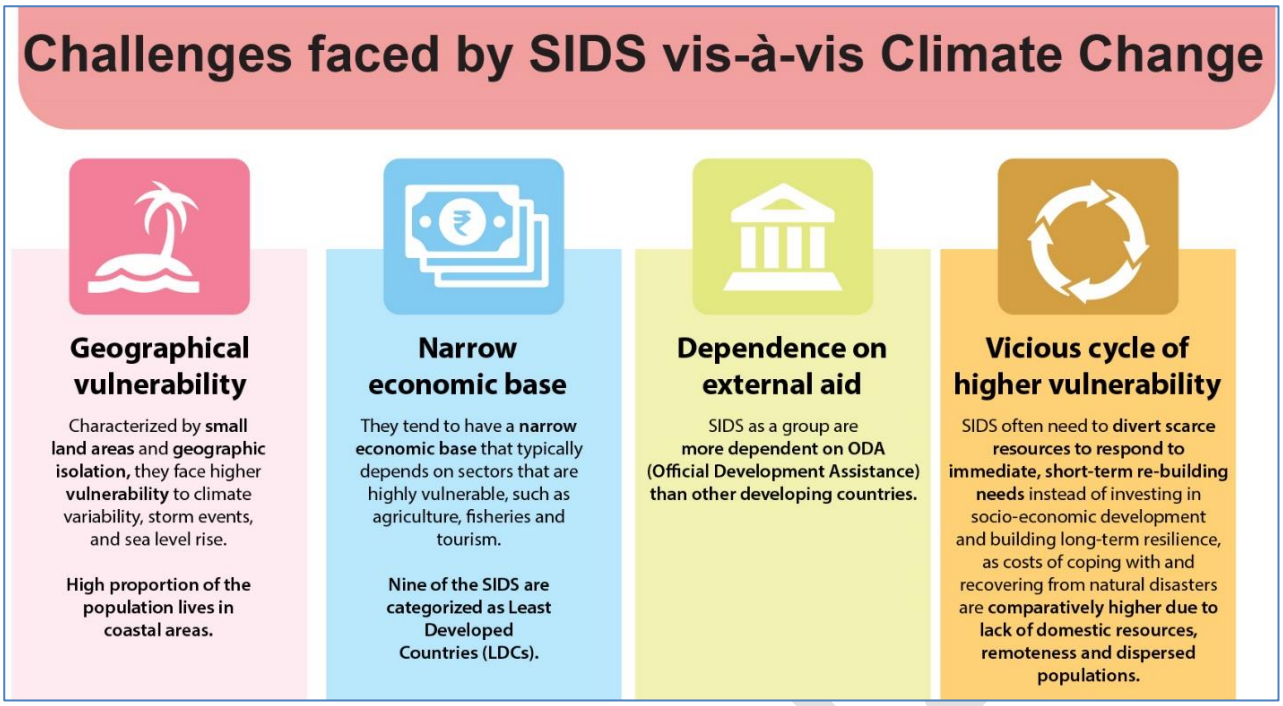
A recent OECD report has highlighted that climate finance for Small Island Developing States slumped to 2017 levels in 2019 after seeing a significant increase in 2018.

Data Bank

- SIDS combined account for close to 1% of global carbon dioxide emissions.
- SIDS nations have received **less than 5% of the total funding received as part of the climate finance in 2017.**

About SIDS and their part in climate change

- The 39 nations classified as SIDS by the UN representing **~1% of the world's population**, form a **distinct group of developing countries**.
- They are a diverse group, **differing in terms of population size and densities, geographical spread, and relative development** progress.
- **The SIDS together bear little responsibility for climate change**. Despite this, their geographical, socio-economic and climate profiles make them **particularly vulnerable to the impacts of climate change.**
- **Challenges faced by SIDS vis-à-vis Climate Change**



How can Climate Finance help in resolving these problems?

- **Making their economies resilient and greener:** by making agriculture, biodiversity and infrastructure sectors **more resilient to climate impacts,** and to **shift the energy mixes** of SIDS away from fossil fuels.
- **Strategically intervening to halt vicious cycle of vulnerability:** by providing assistance in rebuilding disaster resilient infrastructure post natural hazards.
- **Help SIDS develop better adaptation mechanisms:** both structurally and institutionally. For example, installing early warning systems for storms could prevent significant damage.
- **Addressing the larger goal of halting climate change:** Looking at the larger picture, the more finance is spent towards controlling climate change, lesser the vulnerability and damage to the overall ecosystem and especially to SIDS.

What are the challenges faced by SIDS in accessing climate finance?

- **Internal challenges:** Institutional and policy constraints, limited capacity to manage funds and few in-country systems for programming and managing funding.
- **Reliance on a limited number of donors** and there is inconsistent **fragmentation** in the way finance is delivered.
- **Most of the funding is going to mitigation** rather than adaptation. And it has been **focused on a relatively small number of sectors,** mainly "general environment protection" and "energy".
- **Global climate funds have complex requirements** for accessing finance and **limited power and voice of SIDS in international fora** affects the distribution of climate finance.
- **Eligibility criteria for concessional finance** (grants and low-interest, long-term loans) by international financial institutions and lender governments **is more inclined towards Least Developed countries,** which excludes several vulnerable SIDS**.**

How to make climate finance work better for SIDS?

- **Direct access to finance:** will allow domestic institutions to structure the disbursement schedules according to countries' needs.
- **Reforming assessment tools:** Donors, international financial institutions, multilateral agencies and the UN system should reform their assessment tools to permit concessional and grant financing especially for island nations.
- **Move away from a project approach toward a programmatic one**, allowing countries to **propose programmes and establish links with wider development purposes** to reduce transaction costs related to short term projects.
- **Share information and use regional institutions**: Partnerships with **regional agencies** to share knowledge and information at the **regional level** can also be helpful for small states as they act as **extensions of national organizations.**

- **Make climate finance reach not only vulnerable countries but also vulnerable communities.**
- **Focus on adaptation:** 'Small Island Developing States Accelerated Modalities of Action' - **SAMOA Pathway** makes linkages between **commitments focused on sustainable energy, natural resource management, an ocean based and green economy approach and partnerships**, thereby providing a **holistic view on adaptation measures** for SIDS.
- **Innovative measures**: For instance, **Debt-for-climate swaps**, a type of debt swap in which the **debtor nation**, instead of continuing to make external debt payments in a foreign currency, **makes payments in local currency to finance climate projects domestically** on agreed upon terms.

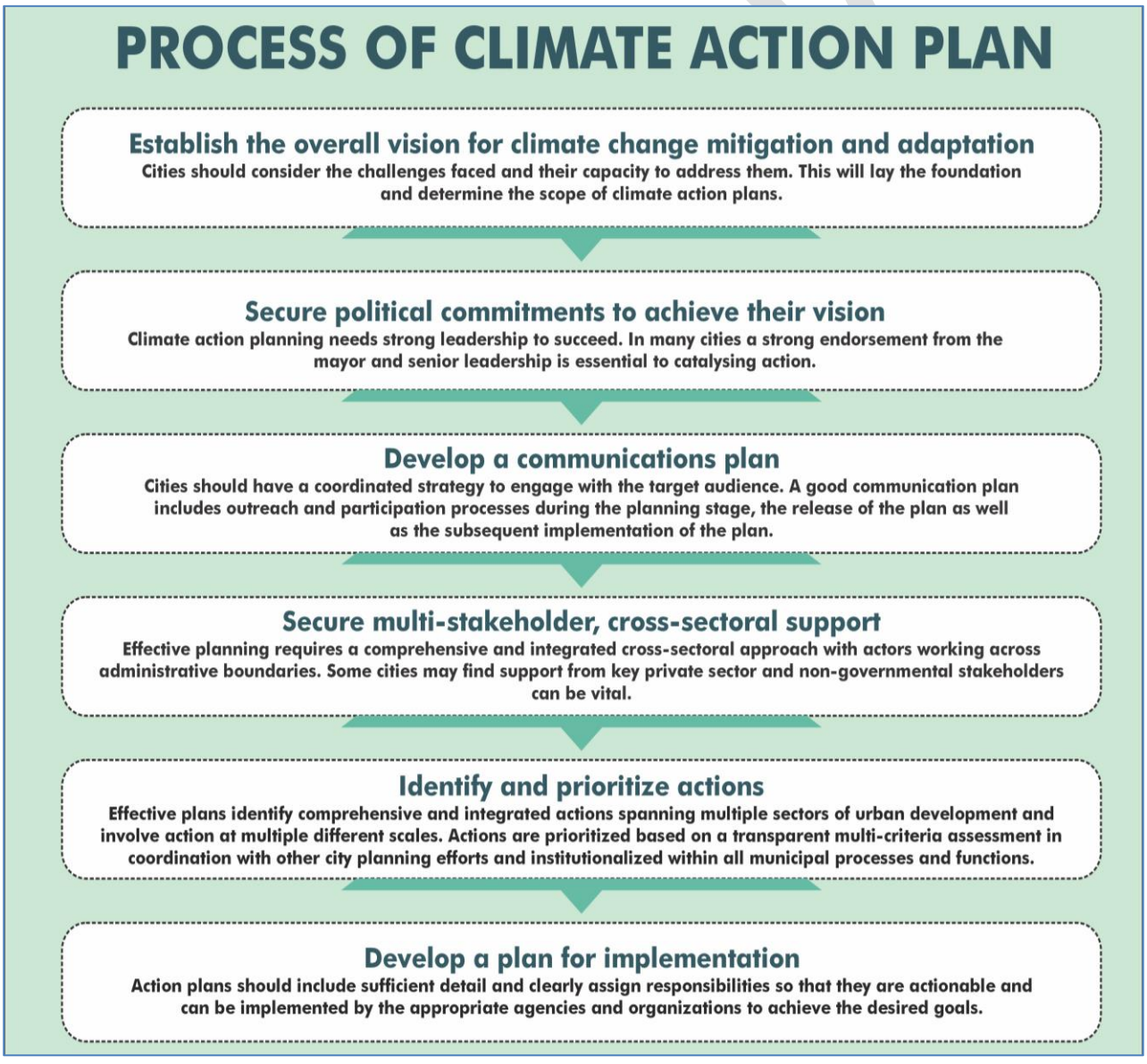
Conclusion

The **Paris Agreement** encourages all countries to establish **monitoring, reporting and verification systems** for activities to address climate change, including systems to provide information on finance. Investing in such systems could provide SIDS with **better oversight of what is being provided and for what**. Robust data would be a basis for working with development partners and funds, and for **holding them accountable for investing in the priorities** of recipient countries.

1.4. CLIMATE ACTION PLAN FOR COASTAL CITIES

Why in news?

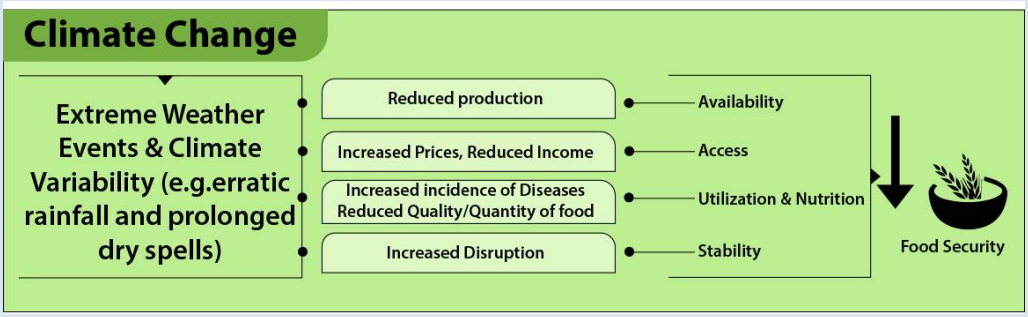
Amid warnings of climate change leading to **extreme weather events like high-intensity floods and landslides** in the city, the Brihanmumbai Municipal Corporation (BMC) is drafting a Mumbai Climate Action Plan (MCAP) in a bid to tackle climate challenges.



What is Climate Action Plan?

- A climate action plan is a detailed and strategic framework for **measuring, planning, and reducing greenhouse gas (GHG) emissions** and related climatic impacts and **provides preventative measures to address the negative outcomes of climate change**.
  - The plan demonstrates how the city will adapt and improve its resilience to climate hazards that impact the city as well as risks that may increase in the coming years.

Need of a Climate Action Plan for Coastal Cities

Impacts of climate change	Threats to coastal cities
Sea level rise and Coastal flooding	• **Hazards such as Storm surges, flooding etc.** • **Infrastructure impacted due to coastal erosion.** • **Water scarcity** due to saltwater intrusion in groundwater reserves. • **Threat to coastal ecosystems:** Sea level rise could **erode and inundate coastal ecosystems** and **eliminate wetlands.**
Extreme weather events like cyclones, heavy precipitation events, droughts, heatwaves etc.	• **Catastrophic loss of life and property damage.** • According to **India Meteorological Department (IMD), number and intensity of cyclones have increased in the Arabian Sea** since the 1980s, threatening the densely populated coastal areas. ○ Recently, Cyclone Tauktae impacted all five states (Kerala, Karnataka, Goa, Maharashtra and Gujarat), islands and territories (Lakshadweep, etc.) on the west coast.
Changes in weather patterns, precipitation events land and ocean surface temperatures	• **Biological hazards: Higher temperatures and prolonged wet conditions** lead to favorable conditions for the mosquitos, rodents and other animals that carry vector-borne diseases leading to **increased occurrence of vector-borne and water-borne diseases.** • Reduced crop nutrition and yields, fish depletion and the loss of plant and insect species leading to increased **food insecurity.** 

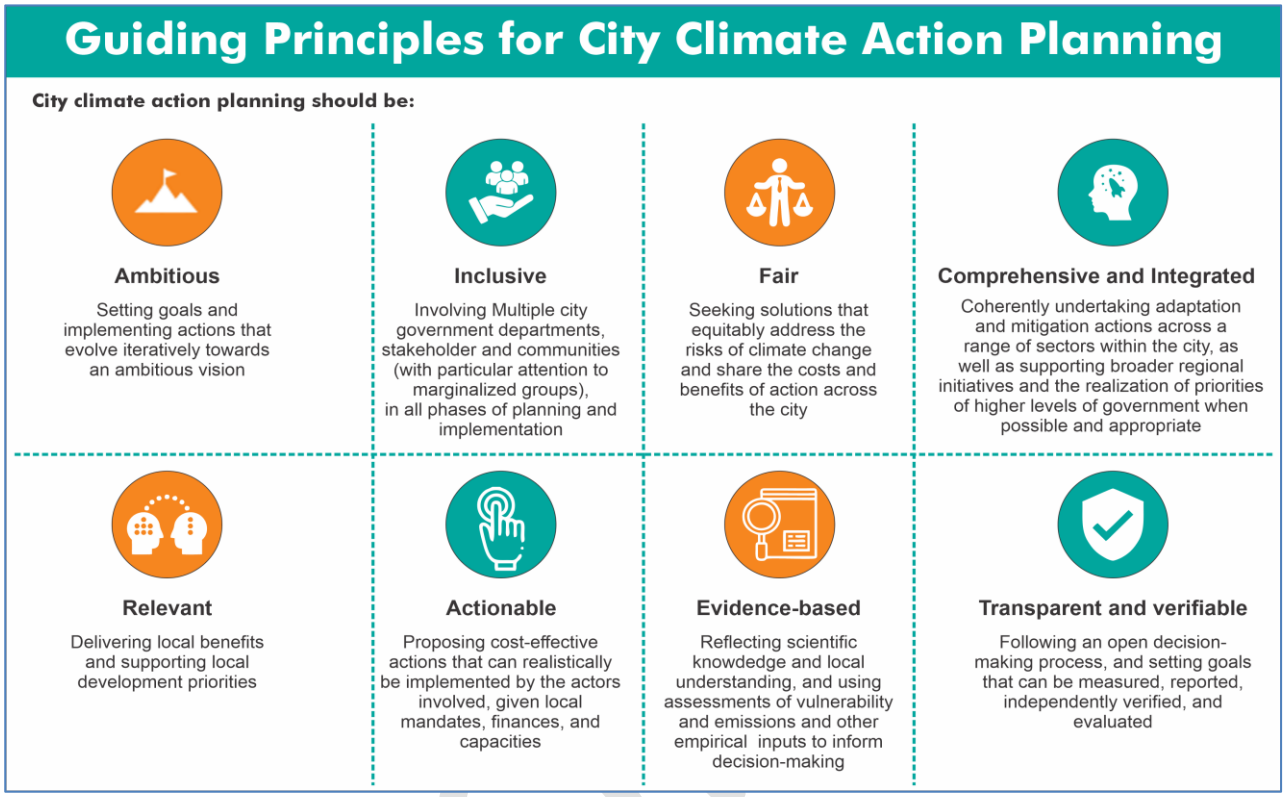
Government Initiatives/Schemes/Policies

- In 2009 the Government of India directed all state governments and union territories to prepare **State Action Plans on Climate Change (SAPCC),** consistent with the strategy outlined in the National Action Plan on Climate Change (NAPCC).
  - **Odisha Climate Change Action Plan**: Odisha is one of the first states in India to prepare a comprehensive SAPCC. The **adaptation strategy** is aimed at **reducing vulnerability and achieving resilience**.
  - **Mumbai Climate Action Plan (MCAP):** It will look at climate resilience with **mitigation and adaptation strategies**.
  - **Gujarat climate change action plan**: It aims to build a **sustainable and climate-resilient future.**
- **National Centre for Sustainable Coastal Management (NCSCM):** It was established by Ministry of Environment, Forest and Climate Change (MoEF&CC) at Chennai to **promote integrated and sustainable management of the coastal and marine areas in India** for the benefit and wellbeing of the traditional coastal and island communities.
- **National Coastal Mission (NCM):** In 2019, MoEF&CC proposes to establish NCM under NAPCC that will **address the impact of climate change on coastal and marine ecosystems,** infrastructure, and communities in coastal areas through a combination of adaptation and mitigation measures. The NCM will **include all Phases of ICZM (Integrated Coastal Zone Management) Project**.
  - ICZM is a dynamic, multidisciplinary, and iterative process to promote sustainable management of coastal zones.

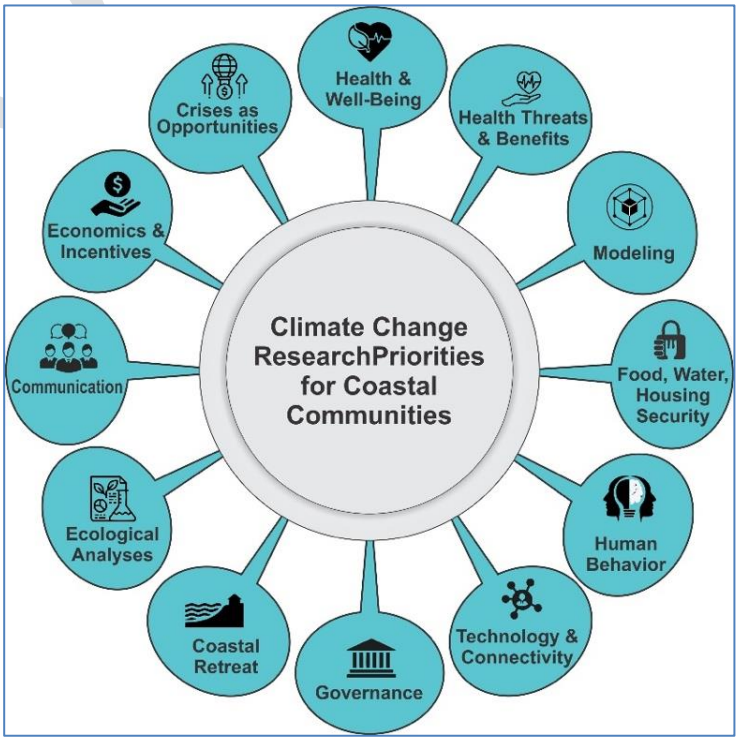
Despite these efforts, coastal cities remain highly vulnerable to the effects of climate change. This can be seen by the damage caused by the recent cyclones on the eastern coast of India.

What can be done to create an effective climate action plan for coastal cities?

- **Proper implementation and funding support:** Climate action plans for coastal city level should have clear **short and long term implementable action** and have necessary **financial, institutional and policy support.**
- **Following Guiding Principles for Coastal City Climate Action Planning aimed at mitigation,** adaptation and building local climate resilience. (refer infographic)



- **Preparing Coastal risk assessment** using coastal data along with future climate projections to inform us how we can be disaster-proof and make our coastline resilient
- **Improve access to Climate Information Services (CIS) to** improve the ability of people to make informed decisions on how to capitalise upon or prepare for future conditions, increasing their vulnerability to climate shocks and food insecurity.
- **Building capacity:** To be effective, climate change action planning requires a **comprehensive and integrated cross-sectoral approach,** with actors working across administrative boundaries. (refer infographic)
- **Following the Coastal Regulation Zone (CRZ) rules to develop and manage the coastal regions on scientific principles.**



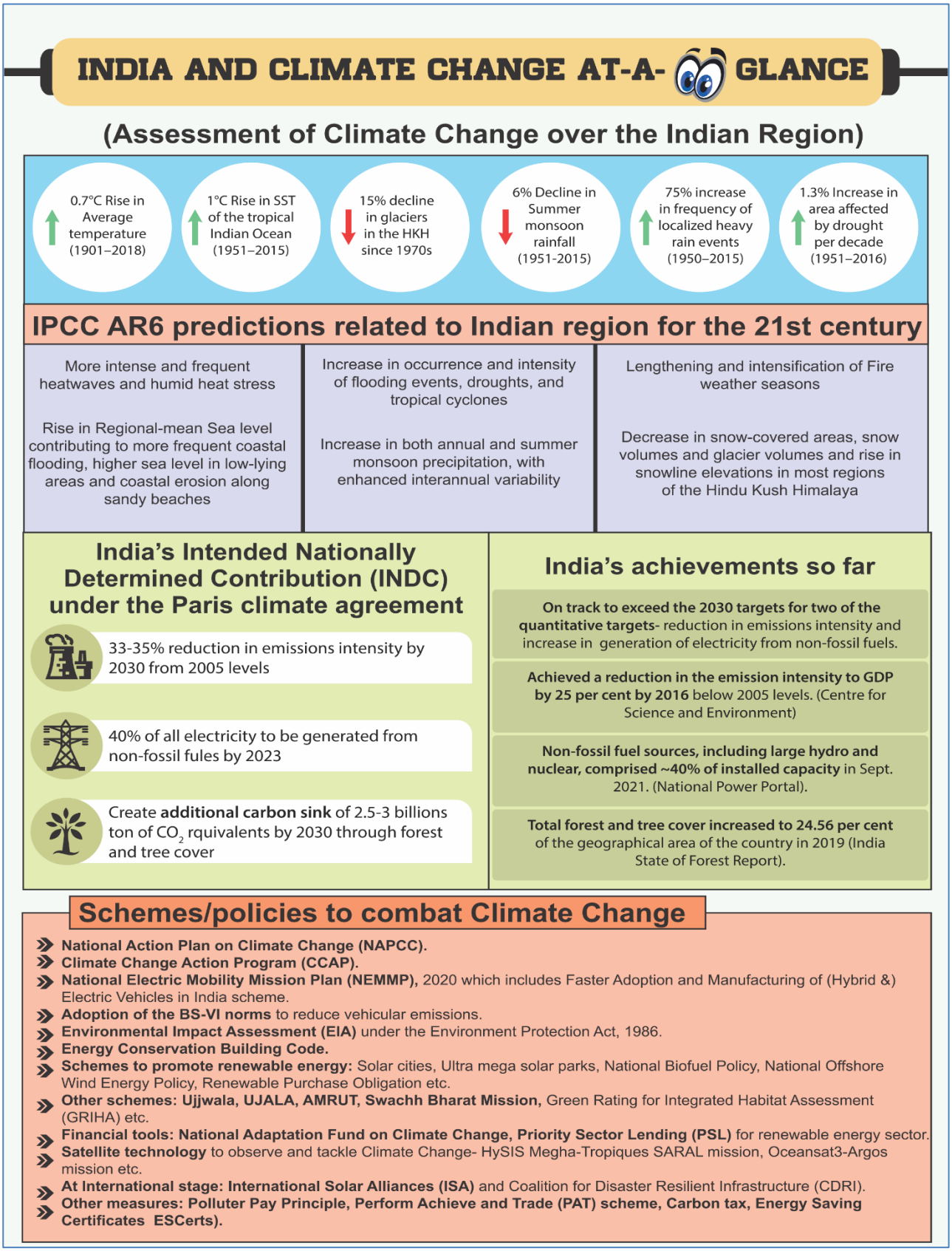
Conclusion

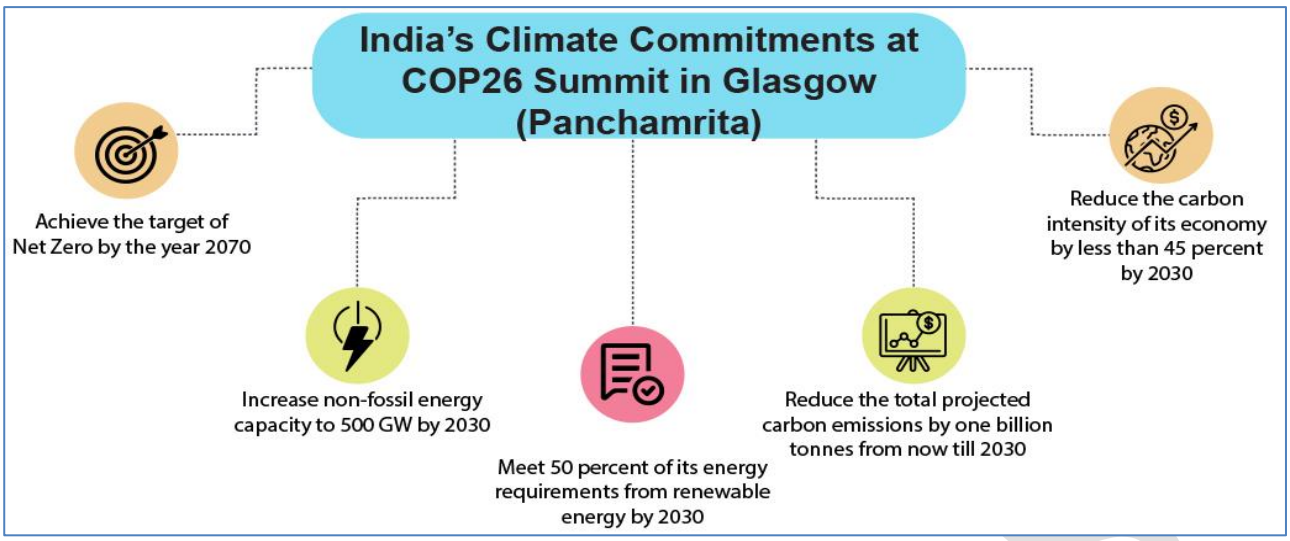
The impact of climate-change on coastal cities has strong strategic, economic, and political repercussions. There is an urgent need to **integrate climate change, developmental projects and population growth in climate adaptation and mitigation policy.**

1.5. INDIA AND CLIMATE ACTION

Why in News?

Prime Minister of India recently laid out India's climate change action plans (see infographic) at the 26th United Nations Framework Convention on Climate Change's Conference of Parties known as COP26 in Glasgow.





Prevalent challenges related to India's Climate action

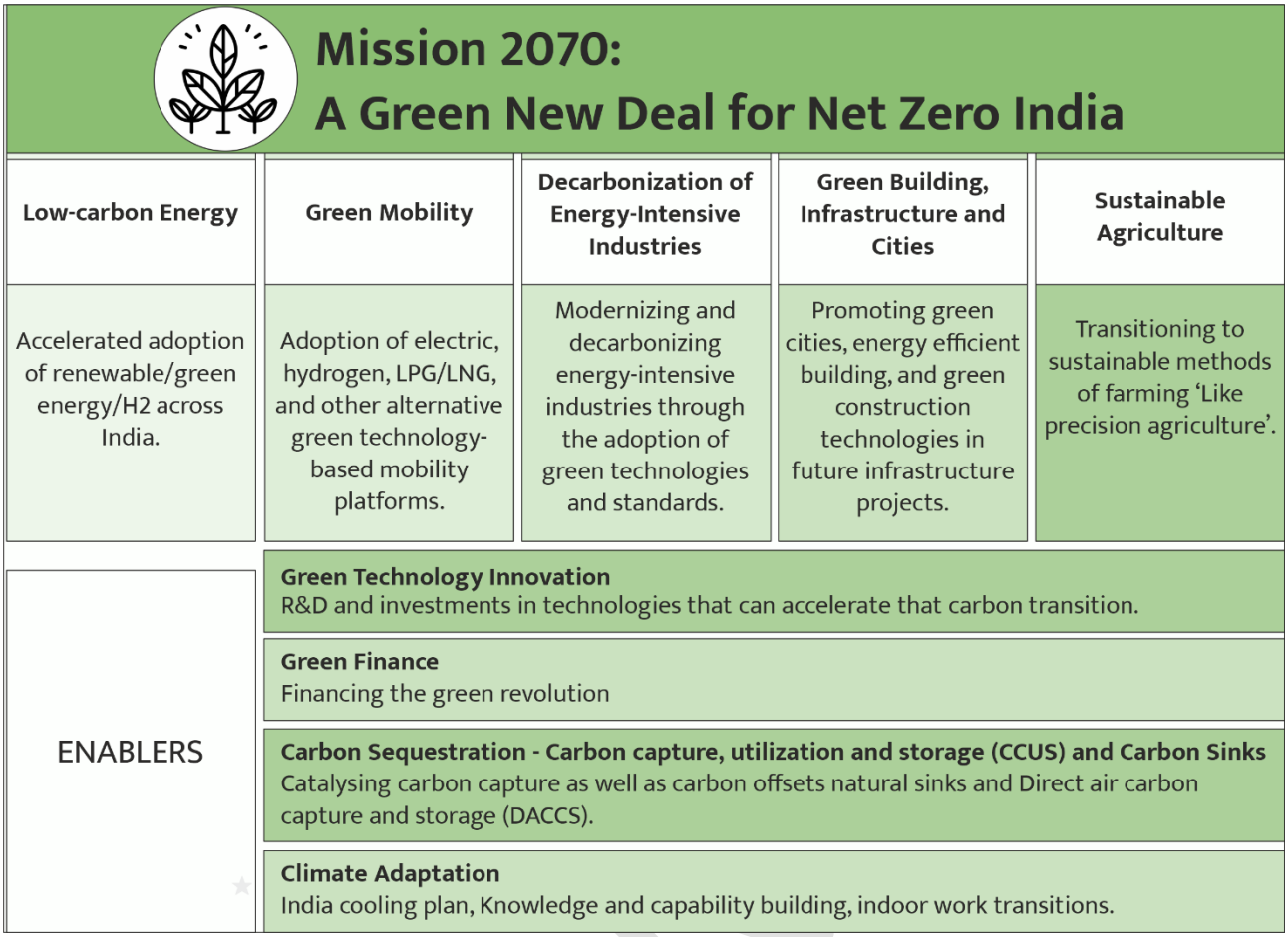
Data Bank

- India is responsible for ~7% of global emissions (Emission Gap report, 2019).
- It is the third largest (fourth largest if European Union is considered) greenhouse gas (GHG) emitter after United States of America (USA) and China.

- **Coal dependency**: Multiple coal-fired power plants already in the works are still being built and approvals are being given for new domestic mines to be opened up.
- **Balancing growth and environment:** For a country like India, committing to net zero transition could potentially have implications on growth, on the economy and on energy availability for industrialisation and urbanisation.
- **Lack of ambition in India's commitments:**
  - **Delayed timeline for Net zero**: Scientists have advised countries to go net zero latest by 2050 and move on to negative emissions to mitigate the worst effects of the climate crisis.
  - **Focus on increasing total capacity rather than total consumption** of renewable installed capacity.
  - **Absence of commitments relating to reduction in emissions from other energy-intensive sectors** like transport sector and industries like cement, iron and steel, non-metallic minerals and chemicals.
- **Rising emissions from agricultural sector:** India's significant food and fertilizer subsidies contribute to climate change leading to high GHG emissions, especially in paddy cultivation.
- **Need of investment**: India expects developed countries to provide climate finance of $1 trillion.
- **Issues in implementation of the climate missions**: like institutional, systemic and process barriers, including financial constraints, inter-ministerial coordination, lack of technical expertise and project clearance delays.

Way Forward

- **Ensuring adequate support from developed to developing countries** in the form of finance, technology and in capacity building.
- **Net negative emissions from developed nations**: In order to vacate the carbon space in 2050 for developing countries to grow, the developed countries can aim for negative emissions.
- **Phasing out coal** by retiring the inefficient coal plants and not building new ones.
- **Developing a strategy for net zero goals** (See infographic)



1.5.1. CLIMATE CHANGE LAW

Why in news?

Many countries like New Zealand, Sweden, France and the United Kingdom have already enacted Climate Change Laws, which bind these countries to achieve carbon neutrality by 2050.

Need of Climate law in India

- **Existing laws are inadequate to deal with climate change:** and do not contain provisions to specifically to reduce future climate impacts and tackle environmental/climate violations.
- **Fragmentation of climate action:** India needs a comprehensive climate action plan to monitor and deal with climate adaptation and mitigation and other environmental and socio-economic issues in an integrated manner.
    - For instance, fulfilling renewable energy goals can put critically endangered grassland and desert birds such as the Great Indian Bustard at risk, as they die on collision with wires in the desert.

Way forward

A climate law could consider two aspects:

- **Creating an institution that monitors action plans for climate change:** A 'Commission on Climate Change' with quasi-judicial powers could be set up, with the power and the authority to issue directions, and oversee implementation of plans and programmes on climate.
    - It can be assisted by a technical committee in the discharge of its functions as well as guide various private and public agencies in meeting their climate-related obligations.
- **Establishing a system of liability and accountability at short-, medium- and long-term levels** by having a legally enforceable National Climate Change Plan that goes beyond just policy guidelines.

1.5.2. RIGHT TO BURN FOSSIL FUELS

Why in news?

The Like-Minded Developing Countries — a group of developing countries which have a similar stand in the United Nations climate negotiations — has demanded that Developed countries must ensure net-zero emissions by 2030 to provide carbon space to the developing countries to burn fossil fuels like coal for their growth.

Data Bank
India's current per capita emissions are at relatively low 1.96 tons CO_2 per capita (17.6 tons CO_2 per capita for USA).

Does India need a 'right to burn' fossil fuels?

Arguments for-

- **Low share in global emissions:** India has neither historically emitted nor currently emits carbon anywhere close to what the global North has, or does, in per capita terms. Thus, it has no reason to commit to declining dependence on coal, at least in the near future.
- **Fulfilment of India's developmental imperatives** like eradication of poverty, provision of basic needs for all citizens and access to energy for all, in the context of sustainable development need space for emissions.
- **Technological and financial advancement:** Developed countries have technological and financial capacity to fulfil early targets and leave the remaining atmospheric space for the developmental rights of the developing world.

Arguments against-

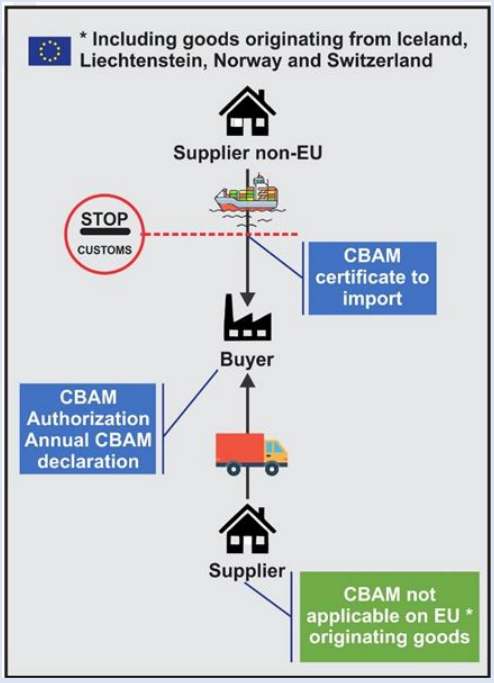
- **Urgent need to mitigate for climate impacts:** India faces harmful impacts related to sea level rise, heat stress, drought, water stress and flooding, biodiversity and natural disasters.
- **Coal is no longer reliable and cost effective:**
  - India is among the largest importers of coal in the world, and volatility in global prices threatens its energy security.
  - Recent data show that the levelised cost of electricity from renewable energy sources like solar (photovoltaic), hydro and onshore wind has been declining sharply over the last decade and is already less than fossil fuel-based electricity generation.
- **High future emissions:** India's contribution to future emissions is considerably greater, as its population is projected to continue to grow and surpass China's around 2025.
- **Green transition can increase inclusion and growth:** Investment in sectors such as renewable energy, electric mobility etc. has the potential to address the issues of employment, technology, energy poverty and self-reliance.
  - For instance, solar rooftops can provide decentralised access to clean energy to the poor and the marginalised, including in remote regions of India.
- **Injustice is not at the level of the nation-states alone:** Developing countries need to address the injustice between the rich and the poor within nations and between humans and non-human species. Poor in India will unduly bear the effect of climate change because of its tropical climate and high population density along the coastal lines.

Way Forward

- **Focus of the discussion on climate finance for developing countries should be on providing adequate resources** — both financial and technology transfer to facilitate the developing countries to transition to a low carbon growth pathway.
- **South-South collaborations** can help developing countries like India to advance technologically and financially towards a greener economy.

1.6. CONCEPTS IN BRIEF

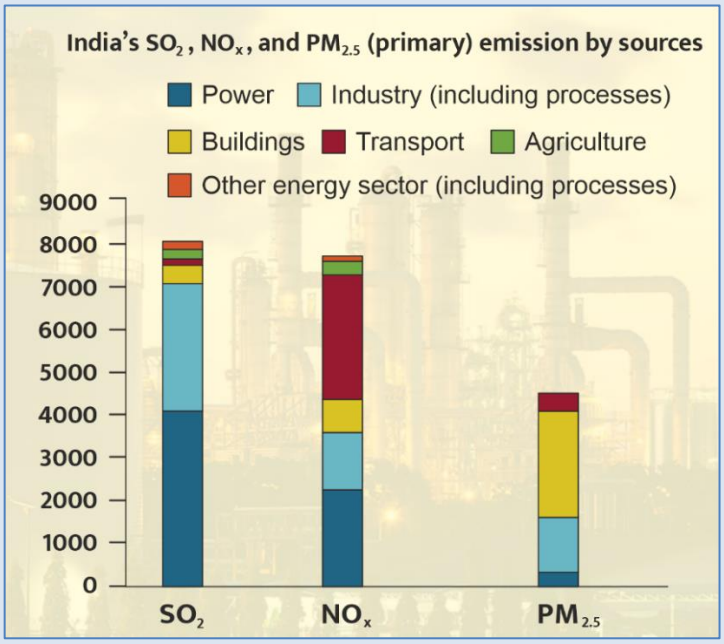
Concept	Details
Net Zero Emission	• **Net-zero**, also known as **climate neutral**, refers to a state in which the greenhouse gases going into the atmosphere are balanced by removing them out of the atmosphere. • It is different from **Gross zero, i.e.,** stopping all emissions to become climate neutral, as some sectors like agriculture can't reach gross zero even with best of efforts.

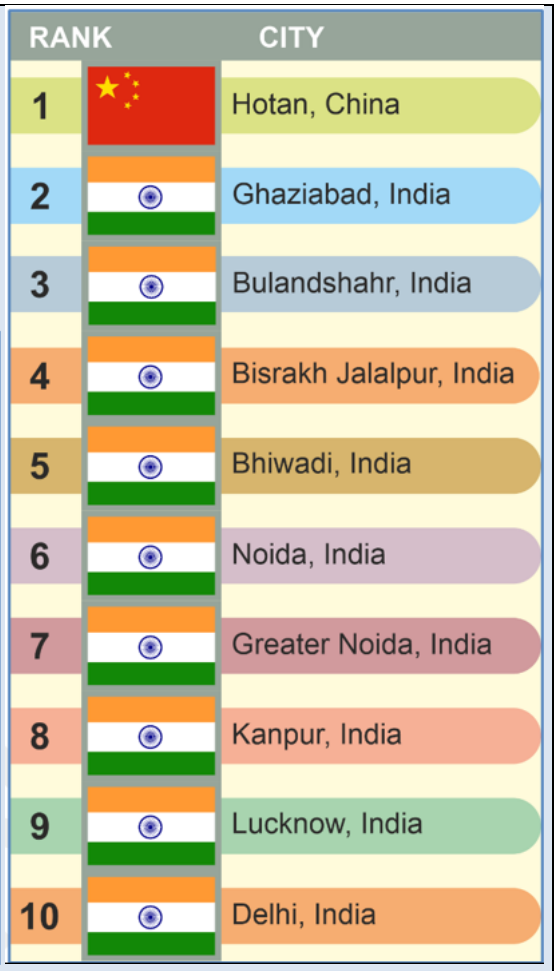
Negative Carbon emissions	• It means removing CO_2 from the atmosphere, or sequestering more CO_2 than is emitted. There are multiple ways of removing CO_2 from the atmosphere, most of which fall into three broad categories: ○ **Nature-based solutions** include afforestation, reforestation, restoration of coastal and marine habitats etc. ○ **Enhanced natural processes** include land management approaches to increase the carbon content in soil through modern farming methods or ocean fertilisation in which nutrients are added to the ocean to increase its capacity to absorb CO_2. ○ **Technology solutions** include bioenergy with carbon capture and storage and direct capture of CO_2 directly from the atmosphere.
Carbon Border Tax	• **As part of the European Union (EU) ambitious target** of reducing 55% of carbon emissions compared to 1990 levels by 2030 (Fit for 55 Initiative), it **is pushing for the world's first carbon border tax on imported goods**- Carbon Border Adjustment Mechanism (CBAM) from 2026. ○ It **seeks to address carbon leakages** i.e., companies decamp to places with cheaper pollution costs and looser climate regulations. • A **carbon border tax is a tax on carbon emissions imposed on imported goods from countries with less strict climate policies.** It aims to **create a level playing field** between imports and domestic production. • Developing countries, including India, have opposed CBAM calling it **'discriminatory' as it will ramp up prices of their goods** in Europe and **shrink demand.** ○ **Also, it goes against the UN principle** of Common but Differentiated Responsibilities and Respective Capabilities (CBDR–RC). 
Carbon footprint	• A **carbon footprint** is the total greenhouse gas (GHG) emissions caused by an individual, event, organization, service, place or product, expressed as carbon dioxide equivalent.
Short-lived climate pollutants	• They are powerful climate forcers that remain in the atmosphere for a much shorter period of time than carbon dioxide (CO_2), yet their potential to warm the atmosphere can be many times greater. • Certain short-lived climate pollutants are also dangerous air pollutants that have harmful effects for people, ecosystems and agricultural productivity. • The short-lived climate pollutants **black carbon, methane, tropospheric ozone, and hydrofluorocarbons** are the most important contributors to the man-made global greenhouse effect after carbon dioxide, responsible for up to 45% of current global warming.
Adaptation Gap	• It is defined as the **difference between actually implemented adaptation and a societal set goal,** determined largely by preferences related to tolerated climate change impacts, and reflecting resource limitations and competing priorities. ○ Adaptation is the **process of reducing countries' and communities' vulnerability to climate change** by increasing their ability to absorb impacts and remain resilient
Green, Resilient, and Inclusive Development (GRID) approach	• Green, Resilient, and Inclusive Development (GRID) approach promotes economic growth that goes hand in hand with environmental goals and social inclusion. • Pursuing the **twin goals of poverty eradication and shared prosperity with a sustainability lens**, the GRID approach addresses the risks to people, the planet, and the economy in an integrated manner that is tailored to country needs and objectives. • It sets a path that achieves lasting economic progress that is shared across the population, providing a robust recovery, and restoring momentum on the Sustainable Development Goals (SDGs).

2. AIR POLLUTION

Data bank

- 22 of the world's 30 most polluted cities are in India, with Delhi being ranked as the most polluted capital city globally ('World Air Quality Report, 2020').
- Globally, India is the top emitter of SO_2.
- India emitted 21% of global anthropogenic (human-made) SO2 emissions.
- **1·67 million deaths were attributable to air pollution in India in 2019,** accounting for 17·8% of the total deaths in the country.





Major air pollutants and their impacts

Pollutants	Environmental risks	Human health risks
Particulate Matters (PM) PM1, PM2.5, PM10	• Contributes to formation of haze as well as acid rain, which changes the pH balance of waterways and damages foliage, buildings, and monuments.	• Irritation of breathing passages • Aggravation of asthma • Irregular heartbeat
Nitrogen oxides (NO and NO_2)	• Damage to foliage • Contributes to smog formation	• Inflammation and irritation of breathing passages
Sulfur dioxide (SO_2)	• Can create secondary pollutants sulfate aerosols, particulate matter, and acid rain. ○ Acid rain formation damages buildings and monuments and can cause direct harm to trees and plants by damaging exposed tissues and, subsequently, decreasing plant growth. • Major cause of haze	• Breathing difficulties, particularly for people with asthma and heart disease • It increases the risk of stroke, heart disease, lung cancer, and premature death
Ground level ozone (O_3)	• Interferes with the ability of certain plants to respire, leading to increased susceptibility to other environmental stressors (e.g., disease, harsh weather)	• Reduced lung function • Irritation and inflammation of breathing passages
Carbon Monoxide (CO)	• Contributes to smog formation	• Exacerbates symptoms of heart disease, such as chest pain • May cause vision problems and reduce physical and mental capabilities in healthy people

Lead (Pb)	• Loss of biodiversity, decreased reproduction, neurological problems in vertebrates	• Adverse effects upon multiple bodily systems • May contribute to learning disabilities when young children are exposed • Cardiovascular effects in adults
Volatile Organic Compounds (VOCs)	• Formation of ozone and fine particulates in the atmosphere	• Eye, nose and throat irritation • Shortness of breath • Headaches, fatigue, nausea, dizziness and skin problems

2.1. AIR POLLUTION MEASUREMENT

Why in news?

The World Health Organisation (WHO) in its first-ever update since 2005 has **tightened global air pollution standards.**

Air pollution measurement in India and comparison with international standards

- **Air monitoring network and agencies involved:** Central Pollution Control Board (CPCB) initiated **National Ambient Air Quality Monitoring (NAAQM) programme in the year 1984** with 7 stations at Agra and Anpara. Subsequently the programme was renamed as **National Air Quality Monitoring Programme (NAMP).**
- **Air quality standards:** CPCB air quality standards in form of NAAQS (National Ambient Air Quality Standards) are notified for **12 parameters** (carbon monoxide (CO) nitrogen dioxide (NO_2), sulphur dioxide (SO_2), particulate matter (PM) of less than 2.5 microns size ($PM_{2.5}$), PM of less than 10 microns size (PM_{10}), Ozone (O_3), Lead (Pb), Ammonia (NH_3), Benzo(a)Pyrene (BaP), Benzene (C_6H_6), Arsenic (As), and Nickel (Ni)).

Pollutant	SO_2	NO_2	$PM_{2.5}$	PM_{10}	O_3		$CO(mg/m^3)$		Pb	NH_3
Averaging time (HR)	24	24	24	24	1	8	1	8	24	24
Standard	80	80	60	100	180	100	4	2	1	400

  - NAAQS doesn't meet the **WHO's existing standards (2005 guidelines)** and considerably differ from updated guidelines. For instance, NAAQS specify an **annual limit of 60 microgram per cubic metre for PM 10 and 100 for a 24-hour period which are 15 and 45 respectively in revised WHO guidelines.**

Why is it important to measure air pollution?

- **Assessing the level of pollutants:** Measurements helps in assessing the level of pollution **in relation to the ambient air quality standards.**
- **Devising effective strategies:** It helps in **targeting the areas with the worst air pollution**, and focusing on the **most polluting sources.**
  - It also helps in **forecasting of air quality** (i.e., tracking the behaviour of pollutants in air) and enables **evaluation of trade-offs involved** in alternative air pollution control strategies.
- **Enforcement of Standards:** It helps in determining the extent to which the **legislative standards and existing criteria are being adhered.** It also helps in identifying faulty standards and **inadequate monitoring programs.**
- **Impact assessment of policies/schemes:** Vigorous air pollution measurement can help analysts and other stakeholders to understand the impact of policy changes and make suitable changes, if required.
- **To alert people:** Air pollution measurement improves the **abilities to inform the public about the hazards** of air pollution. Thus development of new and more efficient air pollution measuring devices can help in **enhancing health and safety of the public and the environment**.
- **Scientific research:** Reducing a large set of **data to a comprehendible form** gives **better insight to the researcher** while conducting a study of some environmental phenomena.

Limitations of air pollution measurement

- **Not comprehensive:** Monitoring network does not cover majority of cities/towns in India**.**
- **Uncertainty and biases:** Involvement of various **monitoring agencies, personnel and equipment** in sampling, chemical analyses and data reporting brings uncertainty and biases to the process.

- **Possible disruptions in operations:** The functioning of monitoring stations may also get affected due to **various technical and operational aspects like long power cuts** and maintenance problems causing disruption in continuous data flow and dissemination.
- **Gap in obtaining real-time data:** Many cities **lack of real-time air quality monitoring** stations in many cities or have **manual air quality monitoring stations** which take about three days to show the result.

Road Ahead

In the past decades the monitoring infrastructure has grown leaps and bounds but is still nascent. To make sure that the measurement framework remains effective, the standards need continuous updation, data gathering techniques must be more precise, data gathering sources have to be diversified and most importantly, more awareness has to be generated regrading importance and implications of this data.

Related News:
Supreme Court (SC) questions usage of Banned firecracker

- SC lashed out at firecracker manufacturers for **violating the spirit of its 2018 judgment banning toxic ingredients like barium in fireworks**
- SC, in **2018 judgement on fire crackers banned manufacture, sale and use of joined firecrackers** (series crackers or 'laris') as they caused air, noise and solid waste problems.
  - Also, SC **banned certain chemicals in composition of firecrackers** - Barium (imparts green colour), lithium (red), arsenic, antimony (for glitters), lead or mercury and Strontium Chromate.
- However, SC allowed the **manufacture and sale of only "green"** (safe water and air sprinklers that emit less sound and light) **or "improved" crackers** (avoid the use of ash as filler material).

2.2. NEW EMISSION NORMS FOR COAL-FIRED POWER PLANTS

Why in news?

The **Ministry of Environment, Forests, and Climate Change (MoEFCC)** had **pushed the deadline** for thermal power plant (TPP) by upto three years for **complying emission norms** in the country.

Data Bank
Thermal power plants (TPPs) account for-

- more than **60%** of total industrial emissions of **particulate matter**.
- **45% of SO_2.**
- **30 percent of NOx**.
- more than 80% of mercury in the country.
- **70% of the total freshwater withdrawal** by all industries.

(Centre for Science and Environment)

Background

- In 2015, MoEFCC notified environmental norms for particulate matter, sulphur oxides, nitrogen oxides and mercury and water use for coal based TPPs.
- Initially, India had set a **2017 deadline** for thermal power plants to **install flue gas desulphurisation units that cut emissions of sulphur dioxides**. But this was postponed to varying deadlines for different regions, ending in 2022.
- The **deadline was pushed to December 2022** for all power stations in the country in view of implementation issues and challenges.

Need of new guidelines

- Coal- based power is a **resource-intensive** and **polluting industry** and contributes to air pollution.
  - Major pollutants from coal-fired power plants are **oxides of nitrogen (NOx), sulphur dioxide (SO_2) and particulate matter (PM)**.
- The emission from TPPs **causes lung diseases, acid rain and smog.**
- Till 2015, power plants in India were required to meet only the PM emission norms which was less stringent than similar norms in China, the US and Europe. There were **no national regulations for SO_2, NOx and mercury emissions** from power plants.

Flue Gas Desulphurisation (FGD)

- It is a set of technology used to **remove sulfur dioxide (SO_2) from exhaust flue gases** generated in furnaces, boilers, and other processes due to thermal processing, treatment, and combustion.
- It involves **wet scrubbing or dry scrubbing**. Wet scrubbing is most common.
- It is highly reliable, and energy and utility savings.

Key Highlights of new guidelines

- **Creation of task force**: A task force will be constituted **by the Central Pollution Control Board (CPCB)** to categorise thermal power plants (TPPs) in **three categories on the basis of their location** to comply with the emission norms within the different time limit.

- **Category A:** TPP **within 10 kilometres** of the National Capital Region (NCR) and **in cities with more than 10 lakh population** to comply with **new emission norms by the end of 2022.**
- **Category B:** In **non-attainment cities** (those cities which are not meeting National Ambient Air Quality Standards) and **those within 10 kilometres of critically polluted areas** have to meet the norms **by December 31, 2023.**
- **Category C:** Coal-fired power plants in the **rest of the areas** have to comply with the new standards by **December 31, 2024.**

- **Exemption on ground of retirement:** TPPs declared to **retire before December 31, 2025** are not required to meet the specified norms in case such plants **submit an undertaking** to the CPCB and the CEA (Central Electricity Authority) for **exemption on ground of retirement.**
- **Penalty provisions:** In case of non-compliance, a **penalty of up to 0.20 rupees per unit** will be levied for electricity generated for continuing the operations beyond the deadlines.

Issues in implementation of guidelines

- **Weak penalty regime:** Since the penalty is **generation-based,** the fine for a smaller capacity non-complying plant operating at a lesser load (generally old plants) also reduces considerably.
- **Compensation designed to favour polluters:** Instead of investing in costlier technologies such as flue-gas desulfurization, which comes at a cost of 45 lakh / MW, it would then be much easier for plants, especially in Category C, to pay a penalty as low as Rs 5 lakh / MW, thereby favouring polluters.
- **Exemption to old plants:** A new category for retiring plants has been created in the current amendment without specifying which these plants are. It **highly favours old, inefficient polluting plants** that are scheduled to retire by 2025.
- **Delay in implementation:** The new extension means about 72 percent of the coal-based capacity will now continue to pollute for another two-three years given the extension.

Way forward

It is necessary to take **strict action against the plants which will not meet the 2022 deadline**. Simultaneously, a push needs to be given to initiatives such as **Methanol Economy program** that aims at reducing greenhouse gas (GHG) emissions & converting Indian coal reserves and municipal solid waste into methanol leading to independence from import while creating new jobs by setting up Methanol Production Plants.

2.3. NEW FLY ASH UTILIZATION RULES FOR COAL AND LIGNITE BASED THERMAL POWER PLANTS

Why in News?

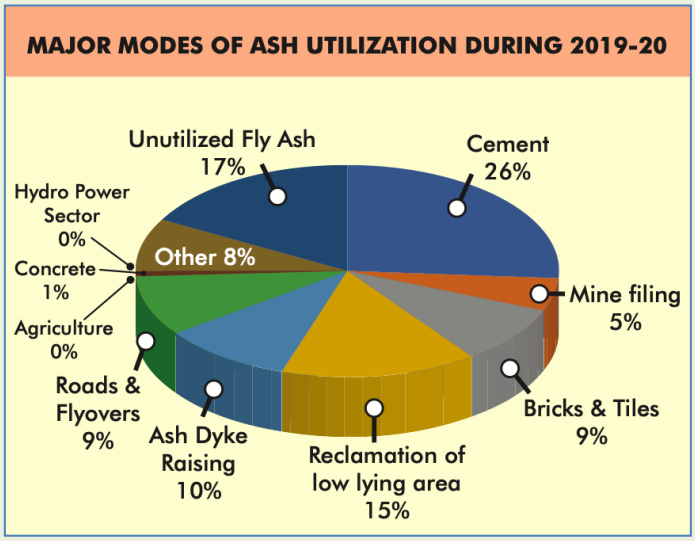
The **Ministry of Environment, Forests and Climate Change (MoEFCC)** has extended fly ash utilization deadline for thermal power plants with the introduction of **penalties for non-compliance**.

About Fly Ash

- Fly ash is a **byproduct of coal-based power generation.**
  - It is a **fine powder with substantial amounts of oxides of silica, aluminum and calcium.**
  - It also contains **traces of Arsenic, Boron, Chromium, lead etc.** which leads to air and water pollution if disposed on land.

Data Bank

- Ash content of Indian coal is as high as **30-45%** in comparison to imported coal with **10-15%.**
- **About 83% of Fly Ash in India is utilized.**



Key Highlights of the New Notification

First fly ash notification was issued in 1999 to ensure **100% fly ash utilization** in India by 2009. This was followed by a **similar notification in 2016.** The current notification aims to achieve the objective of **100% utilization in 3 to 5 years.**

- **Shorter Fly-ash utilization cycle:** Existing provisions allow TPPs to fully utilize fly ash in a four-year cycle in a staggered manner. The new policy will follow a **three-year cycle for 100% utilization of Fly-ash** with a grace period of a year if the percentage of ash utilization is between 60-80% and two years if it is below 60%.
  - In the near future, all TPPs will have to stick to average ash utilization of 100% in a 3-year cycle.
- **Legacy Fly Ash Utilization:** The progressive utilization of legacy fly ash has been extended by another 10 years.
  - Fly ash which **remains unutilized and consequently gets accumulated** is referred to as **legacy ash.**
- **Introduction of Polluter Pays Principle:** A fine of Rs 1,000 per tonne of unutilized ash has been introduced if the plant does not achieve at least 80% ash utilization annually or in three years.
- **Construction and Transportation:** The non-complying power plants will provide ash **free-of-cost** to agencies engaged in construction activities within a **300 km radius** with all transportation cost to be borne by TPPs.
- **Role of Central Pollution Control Board:** A committee under the chairmanship of CPCB chairman will examine, review and recommend eco-friendly ways on fly ash utilization. Also, **CPCB will have real-time data on ash availability.**

Issues in Implementation

- **Prolonging the legacy-ash issue:** With **1.6 billion tonnes** of legacy ash as of **March 2019,** the 10-year extension will further lead to piling up of ash.
- **Technological limitations in current TPPs:** Majority of the Coal and Lignite based TPPs do not possess dry fly ash collection and storage technology.
  - This also leads to increased risks of **unsafe disposal** and hiding of ash generated due to **increased compliance cost and penalties.**
- **Penalty amount is lesser than compliance cost:** This financially discourages compliance by TPPs as most TPPs cannot afford increasing compliance cost due to market competition.
- **Limited data provided by the TPPs:** Although the number of TPPs that are providing data has been increasing, but still is not up to the mark.

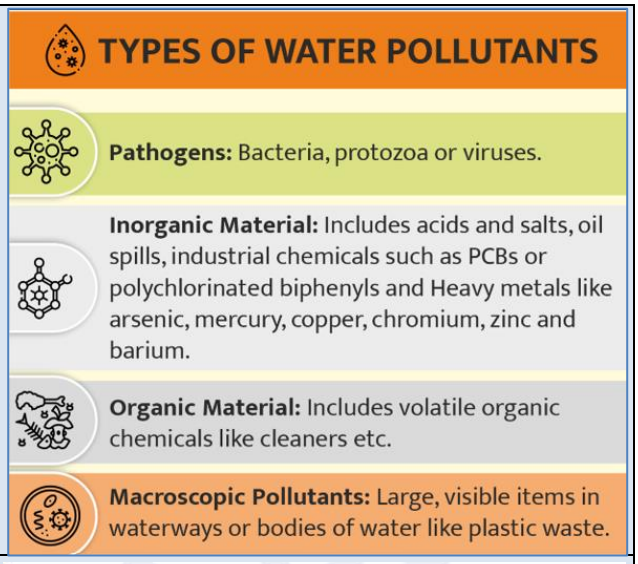
Way forward

- **Ensure compliance** through innovative monitoring like **use of drones and satellites with stronger penalty regime.**
- **Promote scientific fly ash disposal methods**, i.e., use of **Dry Fly Ash Disposal system** and **Wet Fly Ash Disposal System.**
- **Standardization with identification of prospective users** and bringing them on **ASHTRACK** (a mobile app to link fly ash users and power plant executives), helping to increase the overall utilization of fly ash.
- **Encouraging Industry-Academia Partnership** with induction of **'Fly Ash' as a subject in academic curriculum** for identifying innovative uses of Fly Ash.
- Thermal Power Stations have to **explore and promote all possible modes of fly ash utilization** at their respective thermal power station for increasing the fly ash utilization.

3. WATER AND LAND DEGRADATION

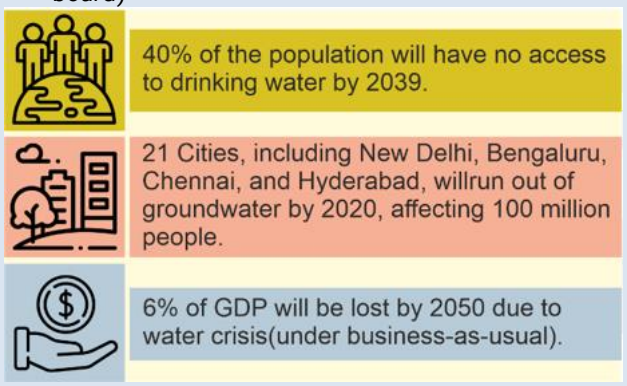
Water Pollution

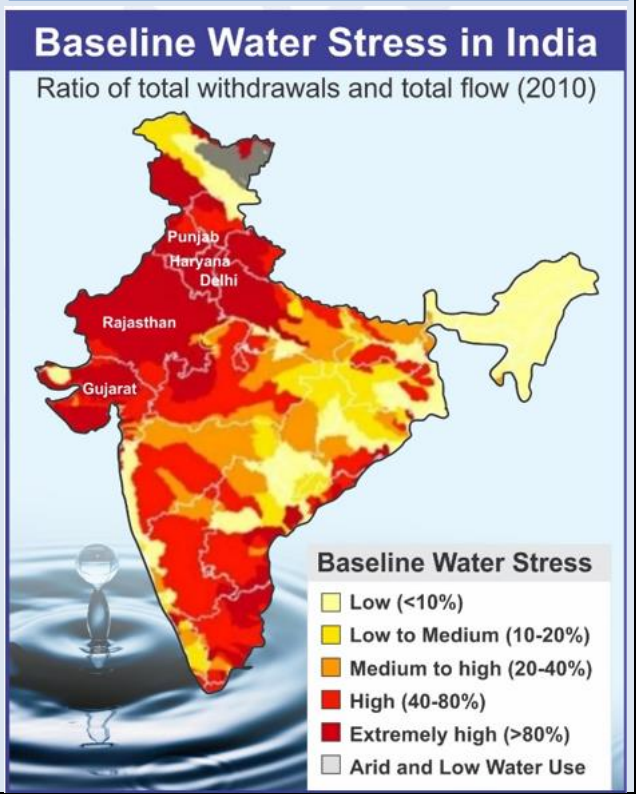
- **Around 70% of surface water in India is unfit for consumption** (NITI Aayog).
- **More than 60 per cent of sewage generated by urban India is untreated** and enters water bodies like rivers, urban water bodies etc. (NGT).
- **80% of marine pollution originates on land.**



Water Scarcity

- Groundwater level in India has **declined by 61 per cent between 2007 and 2017. (**Central ground water board)





3.1. RIVER POLLUTION

RIVER POLLUTION IN INDIA AT A GLANCE

Current status

- There were **351 polluted river stretches** in the country, with 45 of them being critically polluted (Central Pollution Control Board).
  - The CPCB considers a **BOD less than 3 mg/l as** an indicator of a healthy river.

India's Most Polluted River stretches

Order of Prioroty

1
2
3
4
5

India's most polluted stretches of rivers in 2018, indentified by control pollution control board, level of polloution decreases with priority level, with priority 1 the most polluted, priority 1,2 and 3 stretches are highlighted, while only selected priority 4 and 5 stretches in major rivers are highlighted.

Steps taken to control river pollution

- **National River Conservation Plan:** to reduce the pollution load in rivers through implementation of various pollution abatement works, thereby improving their water quality.
- **National Water Monitoring Programme (NWMP)**: Under it, CPCB monitors the water quality of both surface and ground water through a network of monitoring stations in the country.
- **Namami Gange programme for** effective abatement of pollution, conservation and rejuvenation of National River Ganga.
- In the **interim budget 2019-2020,** Government's unveiled **vision for 2030** which includes clean rivers, with safe drinking water to all Indians, sustaining and nourishing life and efficient use of water in irrigation using micro-irrigation techniques.
- To assess the efficacy of river cleaning programmes, the CPCB has been ordered by NGT to launch a **nationwide programme on biodiversity** monitoring and indexing of the rivers.

Ways to Avoid River Pollution

- Strict implementation of **recycling and reuse of wastewater** after treatment.
- Discharge from drainage to be **sufficiently treated in proportion to self-cleaning capacity of rivers.**
- **Effective Solid waste management.**
- **Suitable bioremediation measures** to not discharge untreated water directly to the river.
- **Widespread and intense awareness programme** to inform them about the serious implications of river pollution.
- **Provide sufficient water in the river for ecological flow and dilution,** by:
  - Constructing storage structures at the upstream, which can continuously release discharge for meeting dilution requirements.
  - Improving water use efficiency so that less diversion of water is needed for consumptive usage.

3.1.1. NAMAMI GANGE

Why in news?

Prime Minister recently inaugurated 6 mega development projects in Uttarakhand under the **Namami Gange Mission.**

About Namami Gange Mission

- It is an **Integrated Conservation Mission for river Ganga,** approved as 'Flagship Programme' by the Union Government in 2014 with budget outlay of Rs.20,000 Crore.
- It is being **implemented by the National Mission for Clean Ganga (NMCG),** and its state counterparts—State Programme Management Groups.
  - The **aims and objectives** of NMCG is to accomplish the mandate of National Ganga River Basin Authority (NGRBA)
    - ✓ To **ensure effective abatement of pollution and rejuvenation of the river Ganga** by adopting a river basin approach to promote inter-sectoral co-ordination for comprehensive planning and management and
    - ✓ To **maintain minimum ecological flows in the river Ganga** with the aim of ensuring water quality and environmentally sustainable development.
- **Main pillars of the mission are:**
  - River front development
  - Conservation of Aquatic life and biodiversity
  - Improvement of coverage of sewerage infrastructure in habitations on banks of Ganga.
  - River Surface cleaning for collection of floating solid waste from the surface of the Ghats and River
  - Afforestation
  - Industrial Effluent Monitoring
  - Development of Ganga Gram
    - ✓ To develop model village, that will exhibit itself as comprehensive and harmonious package of economic, historic, cultural and sanitized unit, on banks of Ganga, which is self –sustaining.
  - Creating Public Awareness

Issues faced in cleaning ganga river

- **Unsustainable development**
  - **Industrialisation:** Plastic and industrial waste, such as waste water from the leather tanneries that sit on the banks of the Ganges are one of the prime causes of pollution.
  - **Untreated sewage:** The amount of sewage entering the river exceeds the capacity of the treatment plants installed.
  - **Reduced flow of water:** due to receding Himalayan glaciers, unsustainable irrigation, damming of river etc. increases the concentration of pollution.
- **Inadequate infrastructure**
  Suboptimal performance of Sewage treatment plants (STPs) due to erratic electricity supply, high operation and maintenance costs and their inability to remove the faecal coliform bacteria from the sewage.
- **Implementation challenges**
  - **Building consensus among** competing interests and jurisdictions across various states.
  - **Bureaucratic hurdles:** Shortage of adequate number of trained manpower, red tapism, governance architecture problem, etc.
  - **Cost overruns in projects of Namami Gange**
  - **Lack of coordination** between the agencies responsible for carrying out different tasks.

Way Ahead

- **Improving STPs**:
  - **Promoting decentralised sewage treatment plants (dSTP)** at the colony level.
  - Reuse treated wastewater for irrigation and empty into natural drains.
  - **STPs need to be verified on efficiency, reliability and technology parameters** by independent agencies (tech-efficiency-reliability verification).
- **Restore base flows** through groundwater recharge, promoting water Harvesting for irrigation etc.
- **Behavioral Nudges:** to promote use of Electric crematoria as an alternative to the traditional and less efficient wood-burning pyres.
- **Effective River water quality monitoring.**
- **Holistic water management:** Many of the strategies like river-linking, riverfront development projects, access to toilets, making villages open defecation free, piped water supply in rural areas, etc. need to be integrated for long-term ecological and sustainability goals.

Conclusion

Cleaning / rejuvenation of rivers is an ongoing process. It is the responsibility of the states / UTs and local bodies to ensure required treatment of sewage and industrial effluents to the prescribed norms before discharging into water bodies, coastal waters or land to prevent and control of pollution therein. However, rivers are the lifeline of the society. Hence, every stakeholder of the society must also proactively ensure that rivers are prevented from any kind of pollution.

3.2. MARINE LITTER

Why in news?

Countries from across the oceans decided to **tackle marine plastic litter** under the ambitious global project called **'GloLitter Partnerships** Project'.

About Marine Litter

- Marine litter is any **persistent, manufactured or processed solid material discarded** into the sea or rivers or on beaches or brought indirectly to the sea with rivers, sewage, storm water or winds. It is a **form of marine pollution.**

Causes of Marine Litter

- **Land-based pollutants:** Main sources of marine plastic are **urban and storm runoff, sewer overflows, tourism and recreational use of the coasts, industrial activities** etc.
- **Consumerism and urbanisation:** Rapid urbanisation **along the world's coastlines** has seen the growth of coastal 'megacities' (cities with a population of 10 million or more).
- **Microplastics**: Under the influence of solar UV radiation, wind, currents and other natural factors, plastic fragments into small particles, termed microplastics (particles smaller than 5 mm) or nanoplastics (particles smaller than 100 nm).
- **Other factors** include:
  - **Sea based sources** like abandoned, lost or discarded fishing gear, shipping activities and ocean mining.
  - **Shortage of financial resources** and **poor practices** in managing solid wastes,
  - **Insufficient understanding** among the public of the potential consequences of its actions,
  - **Inadequate legal and enforcement** systems.

Data Bank

- At least **8 million tons of plastic end up in our oceans** every year, and make up **80% of all marine debris** from surface waters to deep-sea sediments.
  - A plastic bottle **can last up to 450 years** in the marine environment.
- The amount of **discarded plastic will outweigh the amount of fish** in our oceans by 2050 according to some estimates.

Other forms of Marine Pollution

- **Chemical pollution:** Chemical pollution is the **introduction of harmful contaminants**. Common **man-made pollutants that reach the ocean include pesticides, herbicides, fertilizers**, detergents, oil, industrial chemicals, and sewage. Crude oil **lasts for years in the ocean and is difficult to clean up**
- **Light pollution:** Light pollution **penetrates under the water**, creating a vastly different world for species near urban environments. Light **disrupts the normal cues associated with circadian rhythms.**
- **Noise pollution:** The increased presence of loud or persistent sounds from ships, sonar devices, and oil rigs **disrupts natural noises in the marine environment.** Unnatural noises **interrupt communication (whales use echolocation), disrupting migration, hunting, and reproduction patterns** for many marine animals.

Effects of Marine Litter

On marine environment	On food and health	Economic loss:

• **Death of marine species** due to ingestion, suffocation and entanglement of marine species.
• Floating plastics contribute to **the spread of invasive marine organisms and bacteria**, causing loss of biodiversity.
• Excessive nutrients (from Agri runoff) trigger **massive blooms of algae** that rob the water of oxygen, creating **dead zones.**
  ○ Dead zones are the areas which can **no longer sustain life** because they have low or zero oxygen. There are now around **500 of these dead zones** around the world.
	• Fish and other marine life ingest microplastics which in turn can **find their way into the human food chain** through biomagnification and bioaccumulation.
	  ○ Bioaccumulation is the **accumulation over time of a substance** and
		• Coastal communities are facing **increased expenditure on beach cleaning, public health and waste disposal.**
		• Plastic strewn beaches, garbage filled waters and sea devoid of marine life adversely **affects**

- Plastic litter can become **concentrated in certain areas called gyres** as a result of oceanic currents. E.g., North Pacific Gyre, known as the **Great Pacific Garbage Patch** (see fig).

especially a contaminant in a living organism.
  - Biomagnification the process by which a compound (such as a pollutant) increases **its concentration in the tissues of organisms as it travels up the food chain.**

tourism industry.
- The shipping industry is impacted by **higher costs associated** with fouled propellers, removing litter and managing waste in harbours.
- The fishing industry faces **reduced and lost catch, damaged nets and other fishing gear**, which also affects coastal aquaculture.

Global initiatives to reduce marine litter

- **London Convention/Protocol** (1972 Convention on the Prevention of Marine Pollution by Dumping Wastes and Other Matter) is **one of the first global conventions to protect the marine environment** from human activities.
  - London protocol to the convention entered **into force in 2006.**
  - It regulates the **dumping of wastes from ships**, permitting only certain types of non-harmful waste to be dumped.
- **MARPOL:** IMO's International Convention for the Prevention of Pollution from Ships (MARPOL) has regulations on **prevention of pollution by garbage, which prohibits the discharge of plastics** (including fishing gear) into the sea from ships.
- **The Global Programme of Action for the Protection of the Marine Environment from Land-based Activities (GPA): It is** a **unique intergovernmental mechanism** to counter the issue of land-based pollution.
- **GloLitter Partnerships Project** implemented by the **International Maritime Organization (IMO) and the Food and Agriculture Organization of the United Nations (FAO)**, with initial funding from the Government of Norway via the Norwegian Agency for Development Cooperation (Norad).
  - The project aims to help the maritime transport and fishing sectors move towards a **low-plastics future**.
- **GPML (**The Global Partnership on Marine Litter): GPML was launched at the **United Nations Conference on Sustainable Development (Rio+20)** in June 2012. It seeks to address the global problem of marine litter by:
  - Providing a mechanism for **cooperation and coordination**;
  - Harnessing the expertise, resources and enthusiasm of **all stakeholders.**
  - Making a significant contribution to the achievement of the **2030 Agenda**, in particular **SDG 14.1** (By 2025, prevent and significantly **reduce marine pollution of all kinds**, particularly from land-based activities, including marine debris and nutrient pollution).

3.3. GROUNDWATER EXTRACTION IN INDIA

Why in News?

The Central Ground Water Authority (CGWA) under the Jal Shakti Ministry recently issued the latest guidelines to regulate the extraction of groundwater.

Data Bank

- **India uses the most groundwater in the world** approximately 25% of the global groundwater extraction.
- Out of the total 6,881 assessment units, **17% have been categorised as 'over-exploited'**, 5% as 'critical', 14% as 'semi-critical' units and 63% as 'safe'.
  - **Majority of the over-exploited units** are concentrated in parts of **Punjab, Haryana, Delhi**, western UP, Rajasthan, Gujarat, Karnataka, Andhra Pradesh, Telangana and Tamil Nadu.
- **Ground water accounts for around 94.5%** of all the minor irrigation schemes in the country.

Background

- New groundwater guidelines were necessitated because the guidelines issued by the Centre on December 12, 2018 were struck down by the National Green Tribunal in January 2019.
  - Since then, there were no guidelines under which No Objection Certificate (NOC) for groundwater withdrawal can be issued.
- The revised guidelines are an improvement over the 2018 norms, which did not ban granting NOC to industries for extracting groundwater in over-exploited areas, did not levy environment compensation and hefty penalty for violations.
- New Guidelines have pan India applicability.

New Guidelines

- **No objection certificate (NoC):** It is mandatory for new and existing industries, group housing societies, infrastructure projects, mining projects and bulk water suppliers abstracting groundwater to get a no objection certificate (NOC) for withdrawal of groundwater.
- **Over exploited areas:** NoCs in 'over-exploited' areas will only be granted to micro, small and medium enterprises (MSME).
    - Over-exploited' areas as those where the groundwater development is more than 100%, that is, the annual groundwater consumption is more than its recharge, according to the Central Ground Water Board (CGWB).
- **Exemption from getting NoC**: The guidelines have exempted 5 categories from getting an NOC:
    - individual domestic consumers in both rural and urban areas for drinking water and domestic uses.
    - rural drinking water supply schemes;
    - Armed Forces Establishments and Central Armed Police Forces establishments in both rural and urban areas;
    - agricultural activities;
    - micro and small enterprises drawing groundwater less than 10 cubic m/day.
- **Abstraction and restoration charges:** Under the new conditions, such NOC holders will now have to pay groundwater "abstraction and restoration charges" based on the quantum of extraction unlike old provision where they had to just pay a nominal lumpsum amount.
- **Residential societies** will have to install sewage treatment plants (STPs) for getting NOCs if their groundwater requirement is more than 20 cubic m /day.
    - Under the condition, water from STPs will be utilised for toilet flushing, car washing, gardening, etc
- **Annual water audits**: It makes annual water audits compulsory for industrial users apart from mandating impact assessment for granting no-objection certificates (NOCs) for groundwater extraction.
- **Registration of Drilling Rigs:** State/UT Governments shall be responsible for registering drilling rigs operating within their jurisdiction and for maintaining the database of wells drilled by them.
- **Abstraction of Saline ground water would be encouraged:** Such industries shall be exempted from paying ground water abstraction charges.
- **Protection of Wetland Areas:** Projects falling within 500 m. from the periphery of demarcated wetland areas shall mandatorily submit a detailed proposal indicating that any ground water abstraction by the project proponent does not affect the protected wetland areas.
    - Furthermore, before seeking permission from CGWA, the projects shall take consent/approval from the appropriate Wetland Authorities to establish their projects in the area.
- **Environmental Compensation:** Extraction of groundwater for commercial use by industries, infrastructure units and mining projects without a valid NOC will be considered illegal and they will be liable to pay Environmental Compensation for groundwater extracted.
    - The minimum compensation will be at least Rs 1 lakh.
- **Penalty:** Non-compliance of NOC conditions may attract a penalty between Rs 50,000 and Rs 10 lakh.
    - Guidelines authorise district authorities to take enforcement measures like sealing of abstraction structures and prosecuting those violating the NOC conditions.
- **Time period:** The NOC issued under the new guidelines will be valid for 2-5 years depending on the entity.
- States/UTs are advised to review their free/subsidized electricity policy to farmers, bring suitable water pricing policy and may work further towards crop rotation/diversification/ other initiatives to reduce overdependence on groundwater.

Government Initiatives/Schemes/Policies

- **National Water Policy 2012** which proposes a framework for creation of a system of laws and institutions and for a plan of action with a unified national perspective.
- **National Aquifer Mapping and Management Programme:** It was initiated as a part of the Ground Water Management and Regulation scheme to delineate and characterize the aquifers to develop plans for ground water management.
- **Atal Jal Yojana**: It aims to conserve groundwater in seven states facing the biggest declines in aquifer levels mainly due to over-extraction for water-intensive crops.
    - These are Maharashtra, Haryana, Karnataka, Rajasthan, Madhya Pradesh, Uttar Pradesh and Gujarat.
- **Paani Bacho, Paise Kamao" (save water, earn money) scheme**: It was launched by Punjab State Power Corporation Limited (PSPCL) to provide direct benefit transfer for electricity to agricultural consumers. Farmers get Rs 4 as direct benefit for each unit of electricity saved.

Concerns in Guidelines

- **Exemption of the agriculture sector**.
- **Conflict between state and centre:** Water is a state subject; the guideline is expected to generate contestation at a time when the statutory power between states and the Centre is already under great strain.
- **Implementation issues:** The implementation would be difficult as it will raise conflict with single-window clearance of applications for establishing new industries.
- **Impact of mining projects:** Mining projects are counted in the regulatory bill and are required to pay a nominal groundwater abstraction fees. Negative hydrological impacts of mining are far more serious than industries and should have been cateogorised separately with detailed guidelines.
- **Not addressing depletion of groundwater**: It will not stop further depletion of groundwater as uninterrupted use of groundwater in 'critical' and 'semi-critical' areas after paying 'abstraction and restoration' charges will defeat the purpose of conservation.

Way forward

- **Incentivize:** Incentivise investors to use bulk volumes of rejected groundwater (grey water, black water) available in urban, semi-urban areas for recycling and reuse.
  - An incentive for not pumping groundwater to enhance the instrinsic value of land, improving ecological balance and overall valuation is a distinction that needs serious evaluation.
- **Increase water recycling**: Water-recycling, especially through the reclamation of waste-water, needs to be done on the front-foot.
  - While Israel recycles nearly 90% of its water, India's recycling capacity stands at just 30%. The problem is worse at the household level, where not even 5% of the water used is recycled.
- **Real time data:** The groundwater estimates need to be dumped and migrated to real time modelling.
  - The first step in this direction is a **national well census** that covers all wells adopting crowd-sourcing technology. Based on the authenticated well census, the monitoring networks recalibrate supported high-frequency data generation.
- **Capping water use**: Abuse of groundwater for irrigation can no more be pushed under the carpet and needs to be addressed upfront by defining the maximum water footprint for various crops.

3.4. URBAN WATER BODIES

Why in News?

Recent urban floods in Hyderabad have highlighted issues regarding management of water bodies in Indian cities.

About Urban water bodies

- Urban water bodies in India range from riverfronts, lakes and ponds to marshes, mangroves, backwaters, lagoons and other wetlands. E.g. - Hussainsagar and Osmansagar lakes in Hyderabad.

How anthropogenic activities have impacted Urban Watersheds?

- **Water pollution**: from **point sources**, such as waste water from a tributary drain, sewage draining, industrial effluents etc., and **non-point sources** such as urban storm water runoff, solid waste and debris, pollution from agricultural

fertilisers and chemicals etc. has **disturbed nutrient composition of urban water bodies**. This has led to algal blooms (through **eutrophication**), which makes these water bodies shallower and reduces their water carrying capacity.
    - Also, solid wastes, especially plastic waste, can **disconnect urban water bodies from inflow sources** and obstruct water flows in natural drainage systems.
- **Riverfront developments**: Developments on floodplains have adverse impacts on **riverbank stabilisation, riparian buffer and immediate floodplain ecological values**. Rivers are being narrowed far within their actual width with concrete riverbed wall embankments, impacting **river's flooding capacity**.
    - For example- the Sabarmati river channel, has been uniformly narrowed to 275 metres during the riverfront development project, when naturally average width of the channel was 382-330 metres.
- **Waste disposal:** The water bodies have been turned into landfills in several cases due to explosive increase in the urban population without corresponding expansion of infrastructure for the disposal of waste. **Guwahati's Deepor beel**, for example, is used by the municipal corporation to dump solid waste.
- **Encroachment:** through land reclamation to accommodate growing urban population can lead to loss of whole or certain portions water bodies. **Charkop Lake in Maharashtra**, Ousteri Lake in Puducherry, Deepor beel in Guwahati are well-known examples of water bodies that were encroached.
- **Illegal mining activities:** Illegal mining for building material such as sand and quartzite on the catchment and bed of the lakes/rivers can alter their beds, **force river to change course, erode banks, lead to flooding and affect groundwater recharge**.
- **Fragmentation of vegetation in the urban spaces:** due to human settlements and construction. The type and amount of vegetation, and the plant community structure, can greatly **affect the storage capacity** in any watershed as healthy vegetative cover keeps soil more permeable and allows the moisture to percolate deep into the soil for storage.
- **Low capacity of urban drainage systems:** combined with factors such as higher flows during storm water, presence of impervious surfaces etc. can lead to heavy rainfall and channel flow in urban watersheds which affect natural drainage patterns through increased soil erosion and high sedimentation in eater bodies.
- **Other impacts on functions and integrity of urban water bodies-**
    - Introduction of toxic substances that can enter the food chain and are harmful to plants, fish, and wildlife
    - Reduction of water quality
    - Clogging of sections of natural drainage channels
    - Disturbance of aquatic biodiversity

Government Initiatives/Schemes/Policies

- **Wetland (Conservation and Management) Rules 2017:** Its objective is to conserve aquatic ecosystems (lakes and wetlands), through implementation of sustainable conservation plans governed by application of uniform policy and guidelines.
- **National Plan for Conservation of Aquatic Eco-systems (NPCA):** It prohibits activities like conversion of wetland for non-wetland uses including encroachment, solid waste dumping, etc.
- **Atal Mission for Rejuvenation and Urban Transformation (AMRUT):** Its mission components include provision for rejuvenation of water bodies specifically for drinking water supply and recharging of ground water.
- **Notifying wetlands under the Ramsar Convention:** It is an inter-governmental accord signed by members countries to preserve the ecological character of their wetlands of international importance.
- **Enforcement & Monitoring Guidelines for Sand Mining:** to control the instance of illegal mining.
- **Water (Prevention and Control of Pollution) Act, 1974:** It provides several directions to control the flow of sewage and industrial effluents into water bodies.

Way Forward

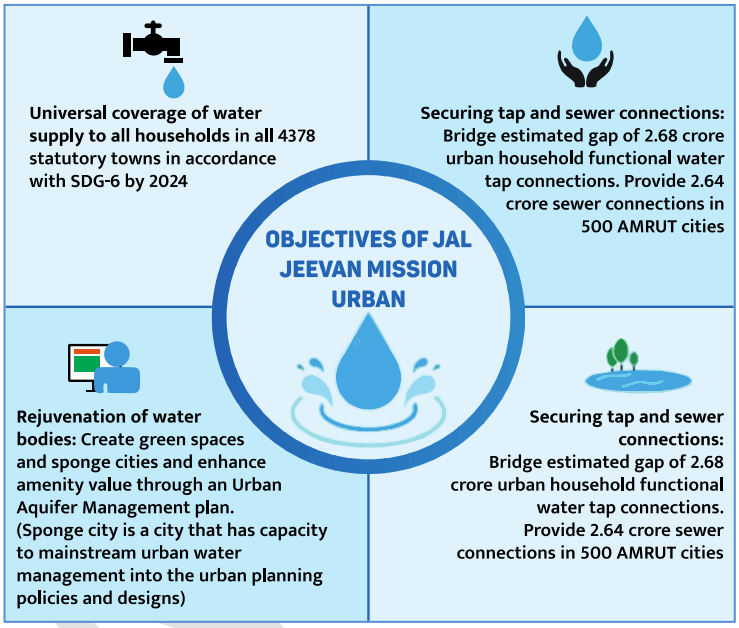
- **Revival and restoration of water bodies:** Processes such as de-weeding, desilting, aeration, bioremediation and biomanipulation can help restore the original state of these water bodies.
- **Integrated watershed development:** by developing an understanding of their inter-connectivity of urban water bodies and taking the extent and topographical conditions of catchment area, existing and proposed storm water drains and permeability of soil conditions into account.
- **Checking encroachments on urban water bodies:** Town Planning departments should regularly monitor the prohibited areas to prevent encroachments.
- **Promote groundwater recharge and pollutant attenuation**: by removing concrete flood control channels and exposing the underlying native sediment.
- **Limit, reduce and/or mitigate for impervious surfaces**: throughout the watershed by use of new engineering techniques like pervious pathways, pervious parking lots to minimize the surface runoff.

- **Stakeholder participation and capacity building:** must be used as an important instrument for better management of urban Water Bodies.
- **Ensuring planned Urbanization**: that takes into account the delineation and protection of catchment areas, drainage channels and areas of lakes, ponds, etc.
- **Other steps:** Ensuring proper disposal of solid and liquid waste, undertaking urban forestry, restricting sand mining etc.

3.5. JAL JEEVAN MISSION URBAN

Why in news?

Jal Jeevan Mission (Urban) was announced by the Ministry of Housing and Urban Affairs in Union Budget 2021-22.



Salient features of Jal Jeevan Mission (Urban)

- **Funding: 100% central funding for Union Territories, 90% for North Eastern and Hill States,** 50% for cities with less than 1 lakh population, one third for cities with 1 lakh to 10 lakh population and 25% for cities with million plus population.
- **Outcome based Funding**: Funding will be in three tranches of 20:40:40. Third instalment onwards will be released based on outcomes achieved and credible exclusion.
- **Promoting PPP Model:** Mandatory for **cities having millions plus population** to take up PPP projects worth minimum of 10% of their total project fund allocation.
- **To leverage latest global technologies** a Technology Sub-Mission for water.
- **To spread Mass Awareness,** Information, Education and Communication (IEC) campaign.
- **Pey Jal Survekshan** survey will be conducted in 10 cities to ascertain equitable distribution of water, reuse of wastewater and mapping of water bodies with respect to quantity and quality of water through a challenge process.
    - Based on the learnings, it will be **extended to all the AMRUT cities.**
    - **Focus on strengthening urban local bodies** by reducing non-revenue water to below 20%, promoting dual piping systems etc.

- ✓ Raising funds through issuance of municipal bonds. Non-revenue water is the difference between the volume of water put into a water distribution system and the volume that is billed to customers.

Need for the Mission

- **Large uncovered population**: 40.9 per cent urban households have piped water connections.
- **Water Scarcity: 6**00 million Indians face high to extreme water stress and about two lakh people die every year due to inadequate access to safe water.
- **Decline in number of waterbodies**: e.g., in 1960s Bangalore had 262 lakes and now, only 10 hold water.
- **Increasing demand**: By 2030, **country's water demand is projected to be twice the available supply.**
- **Poor water quality:** The **quality of piped drinking water in major cities in India** often failed to comply with the standards for Drinking Water as set by the **Bureau of Indian Standards.**
- **Falling ground water level**.
- **Water borne diseases**: Annually **about 37.7 million Indians are affected by waterborne diseases**.
- **Other issues** include low water use efficiency, leakages, inappropriate water tariff, less focus on recharge of local water bodies in city planning etc.
  - **In 2019, Chennai hit day zero of water** as all its main reservoirs ran dry, forcing the government to truck in drinking water. **Day zero is the day when a city's taps dry out** and people have to stand in line to collect a daily quota of water.

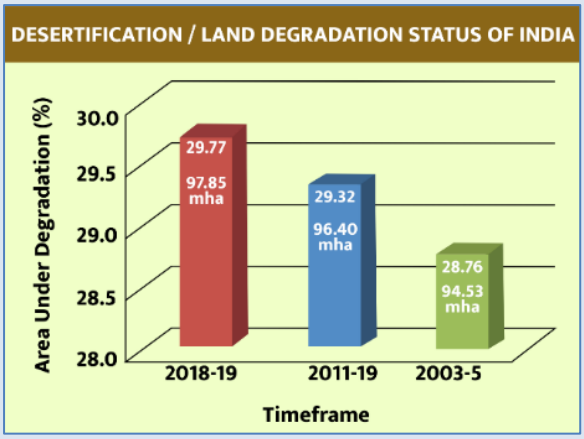
Jal Jeevan Mission (JJM) (Rural)

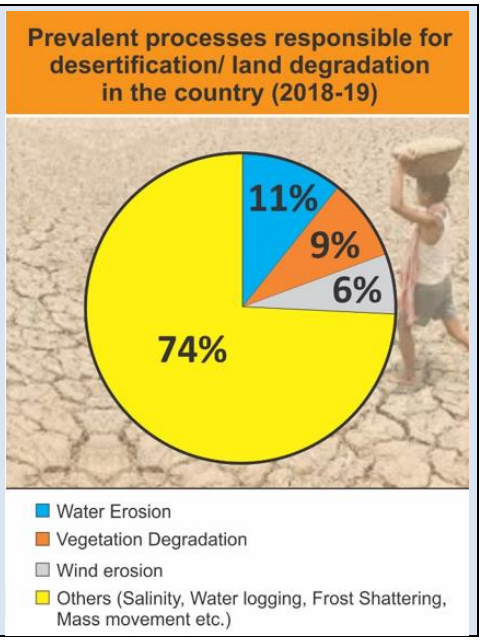
- JJM was launched in 2019, Department of Drinking Water and Sanitation under the Jal Shakti Mantralaya.
- It aims at providing supply of 55 litres of water per person per day to **every rural household** (**Har Ghar Nal Se Jal)** through Functional Household Tap Connection (FHTC) by 2024.
  - **FHTC** means a tap connection to a rural household for providing drinking water in adequate **quantity** of prescribed **quality** on **regular basis**.
  - About **3.2 crore of rural households have been provided with FTWC since the launch of the Mission**, covering around 34 per cent of the targeted households (65.5 million) in rural India.
- **Challenges/limitations of JJM (R)**
  - **Lack of convergence** with other related schemes for water management like Atal Bhujal Yojana and National Aquifer Mapping and **Management Programme.**
  - **Inadequate focus on water quality** - An assessment by the department found that as many as 56,788 rural households in 18 states have water contaminated with fluoride, arsenic, iron, salinity, nitrate and heavy metals.
  - Lack of **in-village infrastructure**, lack of capacity of local communities and poor operation and maintenance.

3.6. LAND DEGRADATION

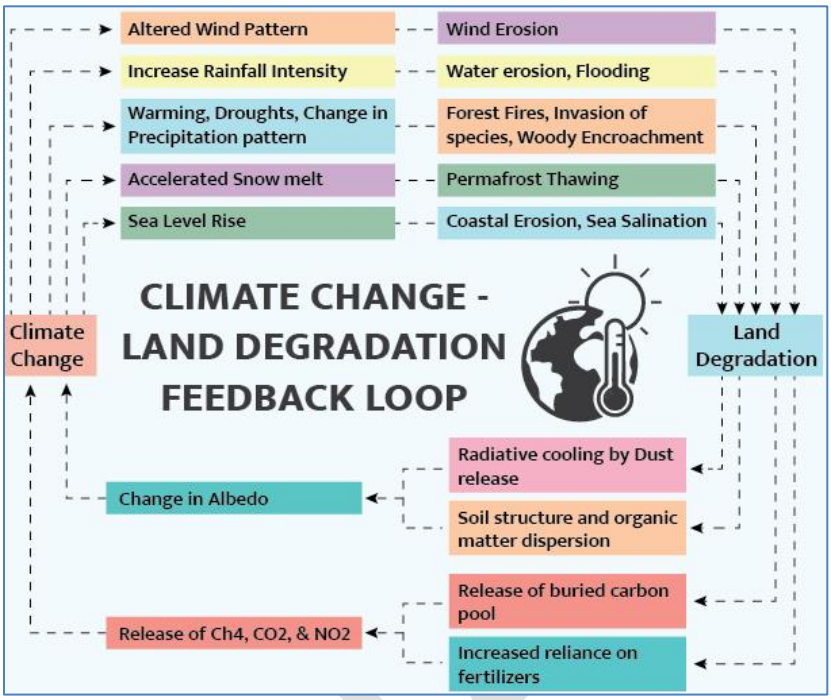
Data bank (Desertification and Land Degradation Atlas of India- ISRO)

- **Around 30**% (97.85 million ha) **of the Total Geographic Area (TGA) of the country has undergone land degradation** during 2018-19, an increase from the findings for the years 2011-13 (see figure).
- States like Jharkhand, Rajasthan, Delhi, Gujarat, and Goa have more than 50% of their area under desertification/ land degradation.



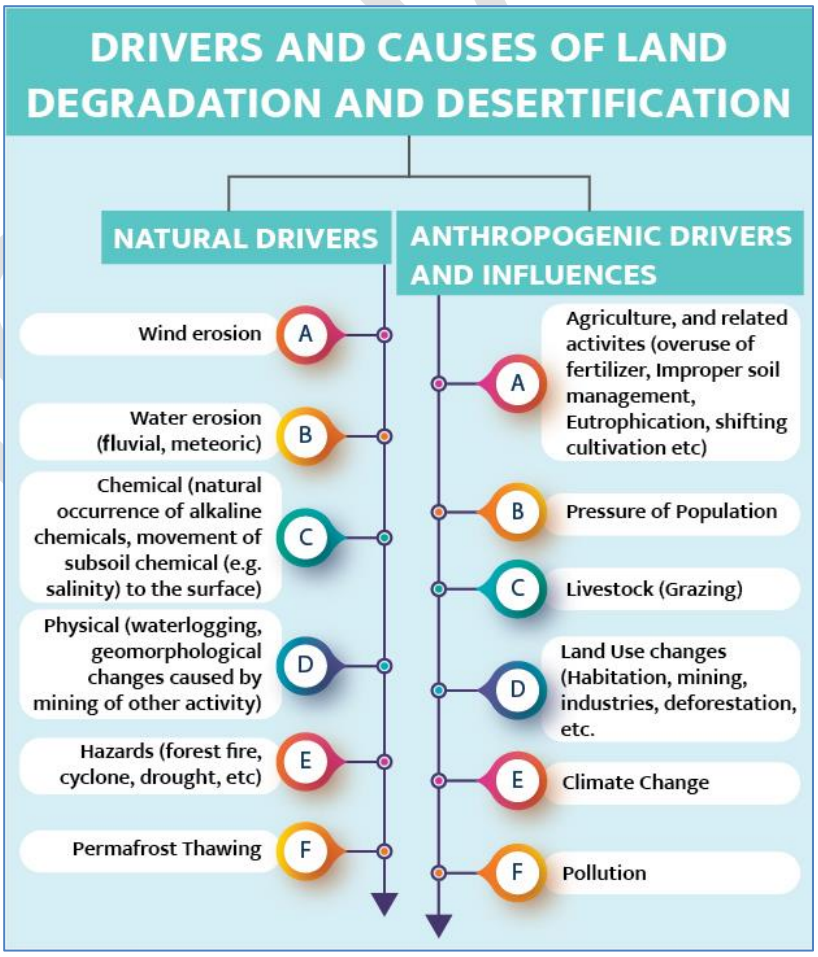


About Land degradation and Desertification



- Land degradation is **defined as a negative trend in land condition, caused by direct or indirect human-induced processes** including anthropogenic climate change, expressed as long-term reduction or loss of at least one of the following: **biological productivity, ecological integrity, or value to humans.**
  - Forest degradation is land degradation that occurs in forest land.
  - **Land degradation within dryland regions (arid, semi-arid and dry sub-humid regions) is termed as Desertification,** which turns fertile land into desert.

Impacts of Land Degradation and Desertification



- **Socio-Economic impacts:**
  - **Reduces land productivity threatening food security and livelihoods** of indigenous populations, small farmers etc.
  - **Reduces the land's ability to store water** resulting in water scarcity.
  - **Exacerbates existing societal tensions and forces migration.**
- **Impact on Human health:**
  - **Creates ground for zoonotic disease, water- and food-borne diseases and respiratory diseases.**
  - Higher threats **of malnutrition from reduced food and water supplies.**
- **Environmental impacts:**
  - **Causes extreme weather events, accelerates biodiversity loss** and disruption of ecosystem services.
  - **Contributes to Climate Change:** Land degradation is a driver of climate change through emission of greenhouse gases (GHGs) and reduced ability of land to act as a carbon sink.
    - ✓ Since climate change also exacerbates the rate and magnitude of several ongoing land degradation processes and introduces new degradation patterns, this creates a **positive feedback cycle.**

International Initiatives/Schemes/Policies

- **United Nations Convention to Combat Desertification (UNCCD):** Established in 1994, it is the sole legally binding international agreement linking environment and development to sustainable land management.
- **Global Initiative on Reducing Land Degradation:** aims to strengthen the implementation of existing frameworks **to prevent, halt, and reverse land degradation within G20 member states and globally**. It will take into account possible implications on the achievement of other SDGs.
- **Initiatives launched under the UNCCD to combat land desertification and degradation-**
  - **Land Degradation Neutrality (LDN) Target Setting Programme**: UNCCD in collaboration with multiple international partners, are supporting interested countries with their national LDN target setting process. To date, over 120 countries, **including India, have committed to setting LDN targets**.
  - **Land Degradation Neutrality Fund (LDN Fund):** Officially launched at UNCCD COP 13 in Ordos, China, it is the first-of-its-kind investment vehicle leveraging public money to raise private capital for sustainable land projects.
  - **Global Land Outlook (GLO)** is a strategic communications platform and associated publications of the UNCCD secretariat that demonstrates the central importance of land quality to human well-being.
  - **Land for Life Programme** was launched at the tenth UNCCD Conference of the Parties (COP10) in 2011 as part of the **Changwon Initiative**. The Programme seeks to address the challenges of land degradation, desertification and mitigation of drought.
- **Other initiatives:**
  - **Bonn Challenge:** Launched by the Government of Germany and IUCN in 2011, it is a global goal to bring 150 million hectares of degraded and deforested landscapes into restoration by 2020 and 350 million hectares by 2030. India has pledged to restore 21 million ha of degraded and deforested land by 2030.
  - **Global Initiative on Reducing Land Degradation**: It aims to strengthen the implementation of existing frameworks to prevent, halt, and reverse land degradation within G20 member states and globally.
  - **Reducing emissions from deforestation and forest degradation (REDD+):** It is a mechanism developed by Parties to the United Nations Framework Convention on Climate Change (UNFCCC).
    - ✓ It creates a financial value for the carbon stored in forests by offering incentives for developing countries to reduce emissions from forested lands and invest in low-carbon paths to sustainable development.

Government Initiatives/Schemes/Policies

- **India is a party to the United Nations Convention to Combat Desertification (UNCCD),** which has pledged to reach land degradation neutrality targets by 2030 as a part of the Convention's Land Degradation Neutrality Strategy.
- India promotes **sustainable land management practices in agriculture sector** through schemes such as Pradhan Mantri Fasal Bima Yojana (PMFBY), Soil Health Card Scheme, Soil Health Management Scheme, Pradhan Mantri Krishi Sinchayee Yojna (PKSY), Per Drop More Crop, etc. which are helping to reduce land degradation.
- Ministry of Environment Forests and Climate Change (MoEFCC) consolidated the intervention on **participatory forest management** through the National Forest Policy, 1988, and then through enabling guidelines in 1990 on **Joint Forest Management (JFM).**
  - JFM is a partnership involving both the forest departments and local communities in natural forest management.
- MoEFCC is implementing three major schemes for development of forest areas i.e., **National Afforestation Programme (NAP)** scheme**, National Mission for a Green India (GIM)** and **Forest Fire Prevention & Management Scheme (FFPM).**

Way forward

Following measures can help tackle the issue of land degradation:

- **Utilizing Local and indigenous knowledge for addressing land degradation:** It can help to introduce, implement, adapt and promote the use of locally appropriate responses.
- **Promoting Agroforestry:** Agroforestry needs to be made an economically viable option through policy and institutional interventions such as R&D, development and provision of quality planting material, price support instruments and mechanisms, etc.
- **Improving Agronomic practices**: Agricultural practices that can help reduce land degradation through soil erosion, pollution etc. include-
  - retention of residues and reduced tillage (or no-tillage)
  - use of locally adapted varieties
  - inter-cropping and crop rotations
  - cultivation of cover crops (green manure crops and catch crops that are grown between the main cropping seasons)
  - Integrated soil fertility management.

- **Land reclamation programmes:** They can help to reduce extreme weather conditions associated with desertification by acting as "green walls" that reduce sand and wind erosion.
    - For instance, the **Great Green Wall initiative** launched in 2007 by the African Union, supported by UNCCD, is a game-changing initiative to restore Africa's degraded landscapes and transform degraded Sahel region.
- **Sustainable forest management (SFM):** SFM aimed at providing timber, fibre, biomass and non-timber resources can provide long-term livelihood for communities, reduce the risk of forest conversion to non-forest uses (settlement, crops, etc.), and maintain land productivity, thus reducing the risks of land degradation.

Conclusion

In Banni region, in Rann of Kutch, Gujarat land restoration was done by developing grasslands, which helped in achieving land degradation neutrality. It also supports pastoral activities and livelihood by promoting animal husbandry. This illustrates how restoration of land can start a virtuous cycle of good soil health, increased land productivity, food security and improved livelihoods.

4. SUSTAINABLE DEVELOPMENT

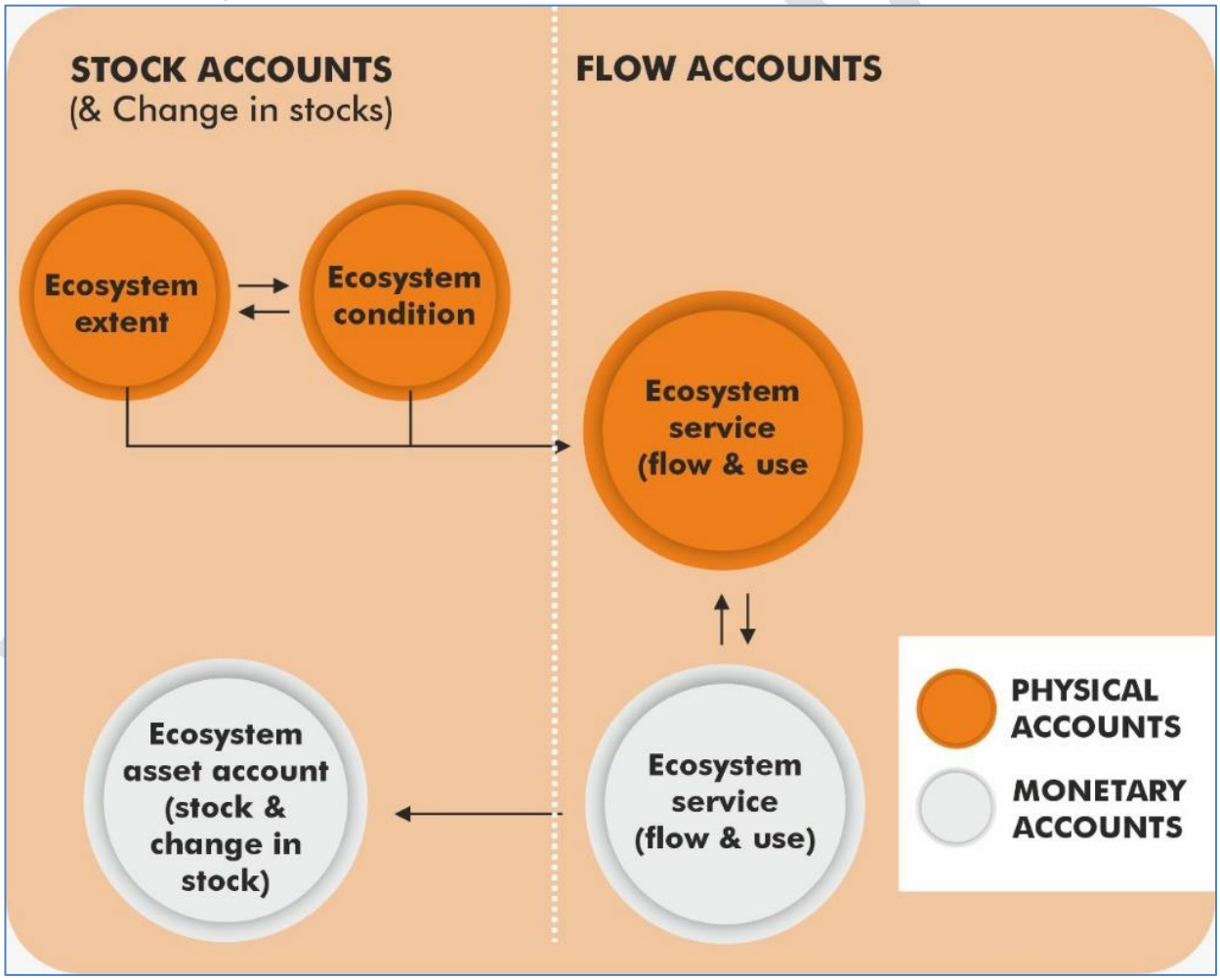
4.1. NATURAL CAPITAL ACCOUNTING

Why in News?

Recently, Natural Capital Accounting and Valuation of the Ecosystem Services (NCAVES) India Forum 2021 was organised by the Ministry of Statistics and Programme Implementation.

What is meant by Natural Capital Accounting (NCA)/Ecosystem Accounting?

- NCA is a tool that can help **measure the full extent of a country's natural capital**. It also provides a perspective on the **link between the economy, ecology and environment**.
  - Natural capital can be defined as the **world's stocks of natural assets.**
  - It includes **individual environmental assets** or resources, both biotic and abiotic (such as soil, air, water, minerals, energy, timber and fish), as well as **ecosystem assets** (e.g. forests and wetlands), **biodiversity** and **ecosystem services** (e.g. air and water filtration and purification, flood protection, carbon storage, pollination of crops and habitats for wildlife).
- NCA establishes the links between an ecosystem and the economy, which can be presented in both **physical and monetary terms**.
- NCA uses an accounting framework to provide a systematic way to measure and report on stocks and flows of natural capital.



- **System of Environmental Economic Accounting Ecosystem Accounting (SEEA EA)** has been adopted as **statistical standard by the United Nations Statistical Commission** recently.
  - It is an **integrated statistical framework for organizing biophysical data, measuring ecosystem services, tracking changes in ecosystem assets** and linking this information to economic and other human activity.

- SEEA EA is built on **five core accounts:**

Ecosystem Extent accounts	Ecosystem Condition accounts	Ecosystem Services flow accounts (physical and monetary)	Monetary Ecosystem Asset accounts	Thematic accounts
Serves as a common starting point for ecosystem accounting.	Organizes biophysical information on the condition of different ecosystem types.	Record the supply of ecosystem services by ecosystem assets and the use of those services by economic units like households, govt etc.	Record information on stocks and changes in stocks (additions and reductions) of ecosystem assets.	Organise data on themes of specific policy relevance.
Organizes information on the extent of different ecosystem types (e.g. forests, wetlands, agricultural areas, marine areas) within a country in terms of area.	Organizes data on selected ecosystem characteristics at specific points in time.		Includes accounting for ecosystem degradation and enhancement.	Examples of relevant themes include biodiversity, climate change, oceans and urban areas.
	Provide valuable information on the health of ecosystems.			

Importance of Natural Capital Accounting (NCA)

- **Overcoming Limitations of GDP**: Natural capital is essential for economic growth, employment, and, ultimately, prosperity. But Gross Domestic Product (GDP) only looks at economic performance and has a limited representation of the natural capital that underlies this income.
- **Effective management of Natural resources**: By providing a perspective on the link between the economy, ecology and environment, NCA can subsequently help to better manage natural resources that contribute to economic development.
- **Promote natural capital business model**: It is a way of doing business that recognizes the value of natural and human resources and life-supporting ecological services. NCA highlights the importance of conservation of natural capital for protecting businesses.
    - For instance, the agriculture sector needs pollinators, like bees, to grow crops and any threat to pollinator population can have escalating economic impacts on the sector.
- **Monitoring progress of global initiatives**: NCA can be applied to monitor progress on a range of critical global initiatives such as Sustainable Development Goals and the Paris Agreement to the United Nations Framework Convention on Climate Change (UNFCCC).
- **Facilitates better and informed decision-making process**: Measuring and valuing the environment leads to better decision-making for development of an economy. It helps policy makers in-
    - **Checking environmental degradation** by monitoring the status of ecosystem assets over time (both their extent and condition) which give an indication of the change in their status and quantifying long term environmental consequences and externalities of economic activity.
    - **Estimating financial needs** by evaluating how the economy responds in terms of expenditure on environmental protection.
    - **Identifying policy priorities**: The application of these accounts helps to focus the resources on the hotspots that are majorly affected and in better allocation of resources. For instance, water quality accounts can help in identifying areas that require resources for artificial ground water recharging in the immediate future.
    - **Formulating policies that have an impact on natural capital** such as agriculture and transport.

- **Poverty reduction**: NCA provides systematic information about the assets that poor people and low-income countries depend on for income, livelihoods, health, security and resilience.
- **Developing future strategies**: Developing a set of statistics on biodiversity hotspots and flora and fauna species accounts can help in setting up **Post-2020 Global Biodiversity Framework for the Convention on Biological Diversity**.
- **Climate change mitigation**: In the face of climate change and variability, the various indicators of the human footprint on land, such as the use of land, needs to be assessed on a regular basis for scientific and effective land use planning, management and ecological restoration.
- **Generates awareness about environmental preservation**: Accounting for ecosystem services can help create public awareness about environmental values.
    - For instance, the preservation of the environment is one of the main drivers of **nature based tourism**. Accounting its economic value helps promote **sustainable tourism development** which takes into account current and future economic, social and environmental impacts, while addressing the needs of visitors, the industry, the host communities and most importantly, the environment.

About Project Natural Capital Accounting and Valuation of Ecosystem Services (NCAVES)

- In 2017, the United Nations Statistics Division (UNSD), the United Nations Environment Programme (UNEP), the Secretariat of the Convention on Biological Diversity (CBD) and the European Union (EU) launched the NCAVES Project.
- This project is funded by the EU through its Partnership Instrument and aims to assist the **five participating partner countries**, namely Brazil, China, **India,** Mexico and South Africa, to advance the knowledge agenda on environmental-economic accounting, and in particular **ecosystem accounting**.
- In India, the NCAVES project is being implemented by the **MoSPI** in close collaboration with the Ministry of Environment, Forest and Climate Change (MoEF&CC) and the National Remote Sensing Centre (NRSC).
- Achievements of MoSPI under the project include-
    - India is one of 90 countries that have successfully adopted the ecosystem accounting system including the new framework for **SEEA EA.**
    - **Publication of "EnviStats India",** on an annual basis since 2018, which is a compilation of the Environment Accounts as per the **UN-SEEA framework.**
    - **Development of the India-EVL Tool** which is essentially a look-up tool giving a snapshot of the values of various ecosystem services in the different States of the country.
- Recently, MoSPI also released **'Ecosystem Accounts for India - Report of the NCAVES Project'**, which provides an overview of work undertaken in India as part of the NCAVES project

Challenges of Environmental accounting

- **Cost involvement:** Environmental accounting and reporting will require extra manpower and cost. Many enterprises, unless otherwise compelled, may not be willing to incur such costs. Thus, incurring additional cost may be considered as problems in introducing EA.
- **Lack of skilled manpower:** Educated people, skilled workers are vital for the efficient and effective implementation of natural accounting. Lack of skilled workforce is an obstacle for the environment.
- **Lack of consciousness about environmental accounting:** Manufacturing organisation does not record correctly on the different account of environmental accounting. Many institutions intentionally avoid separate environmental accounts.
- **Lack of coordination** with different stakeholders related to environmental issues affect proper implementation.

Conclusion

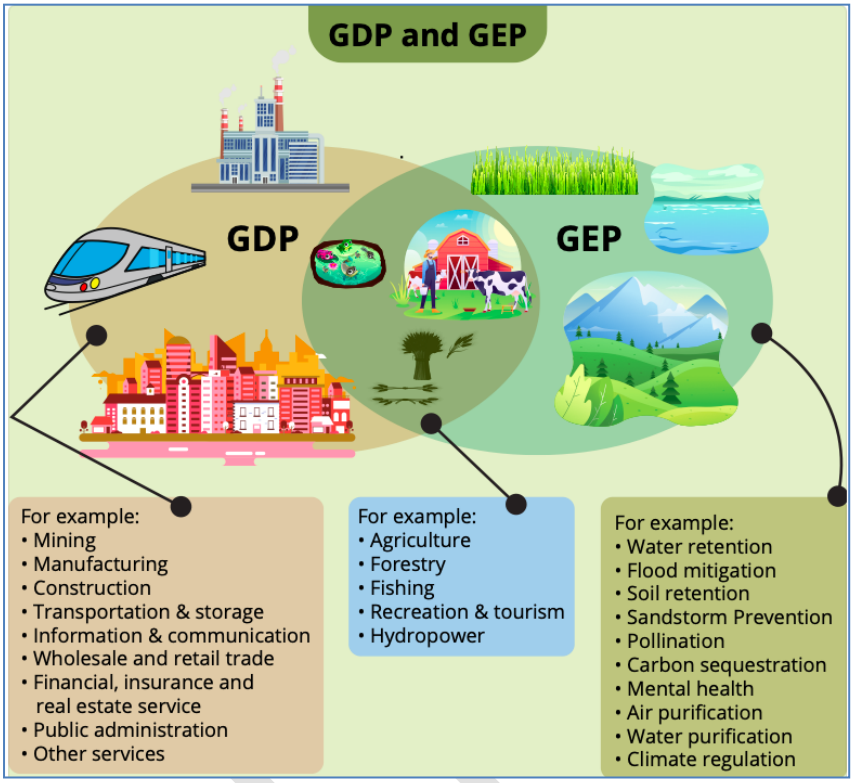
India has shown that it does not take decades to break down information silos and that SEEA can be implemented in a short period of time. It highlights India's commitment on mitigating the effects of climate change.

4.2. GROSS ENVIRONMENT PRODUCT

Why in news?

On World Environment Day (June 5), **Uttarakhand became the first state** in India **to take into account Gross Environment Product (GEP)** while calculating its Gross Domestic Product (GDP).

What is GEP?



- It is the **total value of final ecosystem services supplied to human well-being in a region annually** and can be **measured in terms of biophysical value and monetary value.**
- It indicates the **overall health of the environment** as GEP measures prime indicators such as forest cover, soil erosion, air quality and dissolved oxygen in river water.
- **Unlike Green GDP** which is obtained after deducting the damage to the environment from the total production of the state, **GEP will assess the improvement in the environment components in a year.** Further it will tell **how much work the state has done in reducing the loss of the ecosystem** in environmental protection and resource use.

Need for GEP

- **Economic growth alone cannot represent true economic development:** and may lower human well-being if it is accompanied by growing inequity and environmental degradation.
  - Resource depletion during industrial growth impacts rural growth disproportionately as the rural economy depends on such natural resources only. GEP thus **forms a balanced development approach where ecology is given equal space.**
  - Accounting GEP into GDP will give a **true measure of the nation's growth towards sustainable development.**
- **Shortcomings of traditional systems:** The Traditional System of National Accounts (SNA) like **GDP/GNP neither accounts for the value of natural resources and ecosystem services** nor **the value of environmental/resource degradation** taking place during the developmental process.
  - **Ecosystem Services** are **"benefits people derive from ecosystems"** like **provisioning services** (food, wood etc.) and **regulating services** (water purification, carbon sequestration etc.)
- **Framing adequate policies:** GEP helps in **understanding the impact of anthropological pressure on our ecosystem** and natural resources. This will enable us to make policies that will balance ecology and economy.

Issues in capturing GEP into GDP

- **Knowledge gap:** There is **lack of data and an existent challenge to assign a monetary value** to ecosystem services. **Assigning monetary value to ecosystem services is possible only to a limited extent.**
  - For example, the **pipal tree** in India is revered as a holy tree and religious ceremonies are conducted under its shade. Here **economic valuation of the tree cannot encompass the complexity and the ecological, socio-cultural and institutional heterogeneity** of a particular area.
- **Policy gap:** There is **lack of recognition of ecosystem services** in economic decision-making, development planning and resource allocation. Value of ecosystem services is either ignored or inadequately understood.
- **Institutional failure: Insufficient 'Compensation for ecosystem services' (CES)** provided by the government to stakeholders.

- CES involves **recognising and compensating people who manage the land that contribute to the long-term security of ecosystem functions.** It is a new financial resource for funding conservation measures to ensure a vital ecosystem. Prominent CES mechanism is **'Payments for Ecosystem Services' (PES).**

Way forward

- **Incorporate environmental assets accounts:** This approach **collects data on various types of natural capitals** like forests, groundwater etc. and **convert them into monetary terms.**
- **Biophysical and spatio-temporal dynamics** of the region needs to be kept in mind while quantifying and valuing ecosystem services
- **Develop frameworks to incorporate impacts of climate change** on ecosystem services.
- **Develop alternative or complementary non-market methods to evaluate ecosystem services** with focus on intangible assets, skills and knowledge and cultural values.
- Factors like **social disparities** should be accounted for in evaluating ecosystem services.

Conclusion

GEP can become an **environmental indicator that measures the value of natural resources along with improvements done in the ecosystem to truly assess national wellbeing.** If Uttarakhand successfully implements GEP, pressure will be on other states to do the same.

Other global standards /initiatives

- **System of Environmental and Economic Accounts (SEEA)**: guidebook developed by the United Nations to provide **standards for incorporating natural capital and environmental quality into national accounting systems.**
- **China** (since 2004) **has been undertaking studies to estimate the cost of various types of environmental damage which offsets its economic growth**. China's investment in pollution control and renewable energy has been growing rapidly since then.
- The **Happy Planet Index (HPI) created by the British New Economics Foundation (NEF) measures national welfare in the context of environmental sustainability.**
- **Bhutan's Gross National Happiness (GNH) has environmental preservation as one of the four policy objectives.**
- **Sweden** (since 2003) **has brought in various environmental indicators** (like air emissions , waste etc.) as part of the government policy of achieving sustainable development

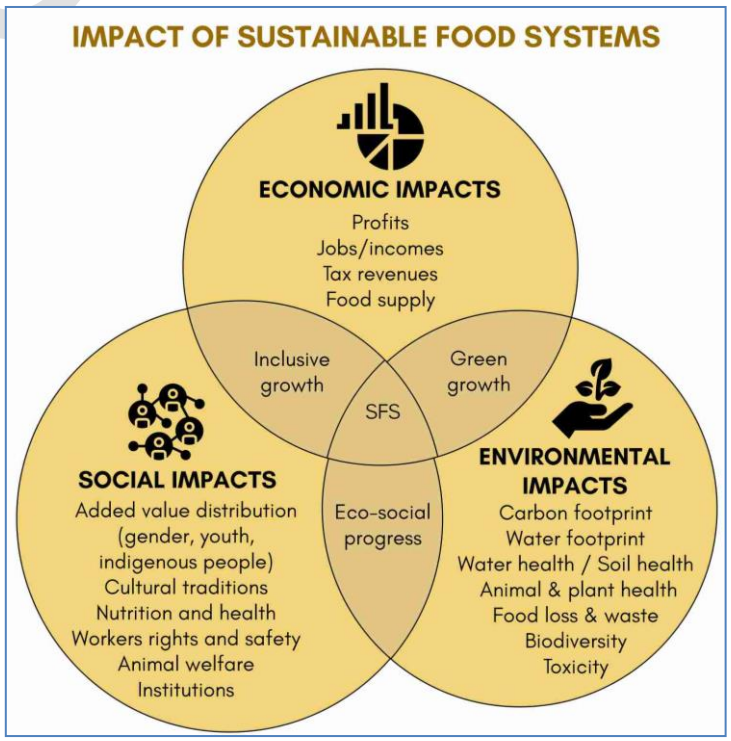
4.3. SUSTAINABLE FOOD SYSTEMS

Why in news?

India held the **first National Dialogue on agri-food systems (at Delhi)** for exploring national pathways towards creating sustainable and equitable food systems.

About Sustainable Food Systems

- Food systems encompass the **entire range of actors and their interlinked value-adding activities** involved in the production, aggregation, processing, distribution, consumption and disposal of food products that originate from agriculture, forestry or fisheries.
  - It also involves **economic, societal and natural environments** in which they are **embedded.**
- Food system is **composed of sub-systems** (e.g., farming system, waste management system, input supply system, etc.) and interacts with other key systems (e.g., energy system, trade system, health system, etc.)



- A **structural change in the food system can originate from a change in another system**; for example, a policy promoting more biofuels will have a significant impact on the food system.
- A **sustainable food system (SFS)** is **a food system that delivers food security and nutrition for all in such a way that:**
  - It is **profitable throughout** (economic sustainability)
  - It has **broad-based benefits for society** (social sustainability)
  - It has a **positive or neutral impact on the environment** (environmental sustainability)
  - **Need of future generations** are not compromised.

Challenges for Sustainable Food Systems in India

- **High wastage:** due to lack of Cold storage units, poor road connectivity, low value addition, lack of post-harvest technologies etc. leading to high wastage.
- **Scarcity of Land**: Scarcity of land combined with poverty and inability to take risks, lack of access to credit and inputs and poor market access, severely limit the sustainability of food and agriculture systems.
- **Low productivity of agriculture:** Capital formation in the agriculture sector is low in comparison with other sectors.
- **Green House Gas Emissions from agriculture:** Majority of agricultural GHG emissions occur at the **primary production stage** and are generated through the production and use of agricultural inputs - water, fertilisers, and pesticides.
- **Stubble Burning:** Burning of crop residue causes damage to **micro-organisms present in the upper** layer of the soil as well as **its organic quality.** It also contributes to **environmental pollution.**
- **Low water use efficiency:** The **overall irrigation project efficiency** in **developed countries is 50 – 60%** as compared to **only 38% in India**.
- **Outdated legacy incentives and policy support**
  - Subsidies on irrigation water and power have led to **overexploitation of groundwater**.
  - **Fertiliser subsidies, particularly urea**, have led to **imbalanced application of nutrients** in the crop cycle, besides **degrading the soil**.
  - **Policy biased in favour of rice and wheat,** at the opportunity cost of many nutritious and climate-resilient crops.

Government Initiatives/Schemes/Policies

- **National Mission for Sustainable Agriculture (NMSA)** aims at making agriculture more productive, sustainable, remunerative and climate resilient.
  - It was included as **one of the 8 missions under National Action Plan on Climate Change** in 2008 and operationalized from 2014-15.
- **Pradhan Mantri Krishi Sinchayi Yojana (PMKSY)** aims to Introduce sustainable water conservation practices, among others.
- **Paramparagat Krishi Vikas Yojana** which aims promotion of commercial organic production through certified organic farming.
- **Pradhan Mantri Kisan SAMPADA Yojana (Scheme for Agro-Marine Processing and Development of Agro-Processing Clusters)** for creation of modern infrastructure with efficient supply chain management from farm gate to retail outlet.

Way forward

- **Sustainable farming practices:** A crop management system that promotes the **use of organic manures, bio-fertilizers and bio-pesticides** and judicious use of agrochemicals.
- **Effective implementation of land use policy measures:** Revisiting the legislation on the **ceiling on land holdings, tenancy** etc. from the perspective of livelihood and sustainable food and nutrition security is necessary.
- **Adoption of modern irrigation methods:** Promotion of **water efficient technologies** such as sprinkler and drip irrigation can increase the efficiency of surface water use in agriculture.
- **Crop diversification:** To tackle the **twin challenges of climate change and malnutrition**, diversifying existing cropping systems to more nutritious and environment-friendly crops is need of the hour.
- **Adoption of technology: E**.g., Turbo Happy Seeder (THS) machine can uproot the stubble and also sow seeds in the area cleared. The **stubble can then be used as mulch** for the field.
- **Research and Innovation:** It will play a key role in achieving the goal of sustainable and nutritious food systems by development of suitable crop varieties with desired traits like yield, climate-resilience and nutritional qualities**.**
- **Consumer Behaviour:** For crop diversification to succeed, **healthy and diversified diets need to be incorporated and promoted in the menu of Indian consumer**. Post-COVID-19, this positive trend for healthier foods is expected to further rise.

4.3.1. WATER CHALLENGES IN AGRICULTURE

Why in news?

Recently, Food and Agriculture Organization of the United Nations (FAO) has released the report **State of Food and Agriculture, 2020** with the theme 'overcoming water challenges in agriculture'.

What has made Indian Agriculture practices water inefficient?

- **Water intensive crops:** The most important crops of India like rice, wheat and sugarcane, are the most water consuming crops. .
- **Unintended consequences of government policies that changed the cropping pattern for worse:** This resulted in withdrawal of more ground water for sustaining and enhancing the production. For example
  - **Green revolution led to marginalization of water efficient crops** (millets, oilseeds and pulses) and promotion of water intensive wheat and rice.
  - **Rice and sugarcane are more suitable for eastern states** (they receive better rainfall and are also endowed with perennial rivers). However, Punjab produces more rice and Maharashtra produces more Sugarcane than eastern states.

Data Bank
- **Agricultural irrigation accounts for 90% of India's freshwater withdrawals** (global average being 70%).
- **India's annual agricultural water withdrawal is the highest in the world** followed by China and the United States.

- **Degradation of soil in Green revolution belt reduced the water productivity:** Excessive use of fertilizers and chemicals has degraded the soils in these areas thereby reducing its friability and water holding capacity (WHC). This resulted in increased demand of water for cultivation. For example, Punjab requires 2-3 times more water than Bihar and West Bengal to produce a kilogram of rice.
- **Traditional irrigation practices:** Majority of the farmers practice flood irrigation method which has only 50% water use efficiency.
- **Poor conservation of water:** According to the Central Water Commission, India requires at most 3,000 billion cubic meters of water annually and receives 4,000 billion cubic meters of rain. However, India captures only 8% of its annual rainfall (the lowest in the world). Additionally, about 80% of the water that reaches households, leaves as waste and pollutes our water bodies and environment.

What is being done by the government to overcome water challenges in Agriculture

- **Pradhan Mantri Krishi Sinchayee Yojana (PMKSY):** It is an overreaching scheme of Ministry of agriculture cooperation and farmers welfare with vision to ensure access to some means of protective irrigation to all agricultural farms in the country (Har Khet ko Pani). **Two of its components ensure high water use efficiency of irrigation projects.**
  - **Per Drop More Crop (PMKSY- PDMC)** focusing on micro irrigation systems (sprinkler, drip, pivots, rain-guns etc.) that promote precision farming by making water available in a targeted manner to the root zone of crops.
  - **Watershed Development Component of PMKSY (WDC-PMKSY):** This component pertains to effective management of runoff water and improved soil & moisture conservation activities such as ridge area treatment, drainage line treatment, rain water harvesting, in - situ moisture conservation and other allied activities on watershed basis.
- **Micro irrigation fund:** Micro Irrigation Fund corpus of Rs. 5000 crore has been created with National Bank of Agricultural and Rural Development (NABARD) to supplement the PMKSY-PDMC. It aims to extend loans to state governments to undertake special and innovative projects in micro irrigation.
- **Jal Shakti Abhiyaan a campaign for water conservation and water security** was launched by the Ministry of Jal Shakti. The campaign is driven by citizen participation and has 5 important water conservation interventions:
  - Rainwater harvesting;
  - Renovation of traditional and other water bodies/tanks;
  - Reuse bore well recharge structures;
  - Watershed development;
  - Intensive afforestation.
- **Crop diversification/Promotion of millets:** Millets consists of Jowar, Bajra, Ragi and minor millets together termed as **nutri-cereals** (due to presence of high amount of micronutrients). These are climate

smart crops (resistant to climate change) are highly resistant to water scarcity. Therefore, following efforts are made for their promotion (enhancing cultivation and consumption)

- Ministry of Agriculture & Farmers' Welfare is running **a Rs 600-crore scheme to increase the area, production and yield of nutri-cereals.**
- **Minimum support price (MSP) on millets was hiked** this year.
- Agricultural and Processed Food Products Export Development Authority (APEDA) is preparing a perspective Action **Plan for increasing export of Millet and Millet Products for a period five years** (2021-2026).

How governments' efforts for overcoming water challenges could be made more effective?

- **Climate sensitive agricultural policies:** Price reforms and doing away with unsustainable subsidy is need of the hour for resolving the water crisis caused by the agriculture.
- **The spread of drip and sprinkler irrigation systems should be increased rapidly** with state support.
- **Promotion of new agronomic practices:** like sub-surface irrigation, raised bead planting ridge-furrow method of sowing, and precision farming, Zero budger natural farming, conservation farming etc. They have the potential to enhance water-use efficiency in agriculture.

Conclusion

The need to "produce more with less" is underscored by the fact that 90% of freshwater consumption in India is cornered by the agriculture sector. With the growing population demand for fresh water would also rise. Therefore, holistic and integrated approach should be devised for efficient conservation and utilization of water more so by agriculture.

4.3.2. ENVIRONMENTAL IMPACT OF AGRICULTURAL SUBSIDIES

Why in news?

Recent incidents of burning paddy stubble in Punjab, Haryana and Western Uttar Pradesh have raised concerns about Agriculture's contribution to pollution and role played by regime of agricultural subsidies in it.

Types of Agricultural Subsidies in India

Different kinds of agricultural subsidies provided to farmers in India are as follows:

- **Input Subsidies:** These are subsidies granted through distribution of inputs at prices that are less than the standard market price for these inputs. Several varieties of subsidies in this category are-
  - **Fertilizer Subsidy:** Urea and Phosphatic and Potassic (P&K) fertilizers are made available to farmers at subsidized prices through fertilizer manufacturers/importers.
  - **Irrigation Subsidy:** Subsidies to the farmers which the government bears on account of providing proper irrigation facilities through provision of **subsidized private irrigation equipment** such as pump sets or **public goods** (such as canals, dams etc.).
  - **Power Subsidy:** The government charges low rates for the electricity supplied to the farmers, which is primarily used by the farmers for irrigation purposes.
  - **Seed Subsidies:** High yielding seeds can be provided by the government at low prices.
  - **Credit Subsidy:** It includes interest subvention schemes for farmer loans and other costs such as write-offs bad loans.
- **Price Subsidy:** It includes mechanisms such as Minimum support prices (MSPs) at which the government procures food-grains from farmers at a higher price than its market price.
- **Infrastructural Subsidy:** Government allowing use of public goods such as roads, storage facilities, power, information about the market, transportation to the ports, etc. at lower prices to farmers.
- **Export Subsidies:** Subsides provided to encourage exports of specific agricultural products.

Environmental impacts of Agricultural subsidies in India	
Pollution from fertilizer industry (falls in "red category" of polluting sectors as per Central Pollution Control Board of India)	> **Wastewater** → Groundwater and surface water pollution > **Fuel oil/coal-based captive power plants** → high carbon emissions and air pollution.
Overuse of fertilizer in Agricultural fields	**On soil** > Stagnating or even declining soil productivity > Widespread deficiency of secondary and micronutrients > Soil alkalinity and salinity
	Others > Loss of Nitrogen to the environment → **Photochemical smog** and **ground-level ozone.** > Nutrient Runoff → **eutrophication** of water bodies.
Extensive paddy cultivation	> Intermittent flooding in rice farms → **high methane and nitrous oxide emissions**, both GHGs. > Disposal of paddy stubble through burning → **Air pollution.**
Wastage of resources	> Disposal of Excess stocks of food grains procured by Food Corporation of India (FCI) → **high methane emissions and wastage of precious resources like water.**
Other impacts	> **Depletion of groundwater** due to subsidized cost of energy and equipment. > **Intensification and extensification of Agricultural Production** leading to issues like Encroachment on fragile ecosystems and deforestation, water pollution, land degradation, and biodiversity loss.

Way Forward

- **Sustainable policies:** Policy frameworks for subsidies related to agricultural activity need take into account **local environmental conditions** and socioeconomic contexts and focus on **sustainable use of resources.**
- **Rationalization of fertilizer subsidies:** Instead of massive subsidisation of urea to the tune of almost 75 per cent of its cost, it would be better to give farmers input subsidy in cash on per hectare basis, or something on the lines of the nutrient based subsidy programme.
- **Fertilizer sector in India needs appropriate investments in technologies** for pollution control, such as NO_x control in stack, ammonia emissions curtailment, and advanced water treatment.
- **Promoting crop diversification:** and other practices such as multi cropping can help reduce impacts of intensive agricultural practices and encourage cultivation of climate suitable and less water intensive crops.
- **Shifting from input subsidies to investment subsidies:** For instance, investments can be made for the conversion of paddy areas to orchards with drip irrigation, vegetable, pulses and oilseeds, that consume much less water, much less power and fertilisers and don't create stubble to burn.
- **Rationalizing power subsidies:** Public investments in electricity subsidies can be diverted to innovation and infrastructural development in micro irrigation techniques and helping farmers become capable in using such techniques.
- **Adopting Nutrient Management Techniques:** Farmers need to be trained to improve nutrient management practices by applying nutrients (fertilizer and manure) in the right amount, at the right time of year and with the right methods.
- **Regulation of groundwater extraction:** There is an urgent need to limit groundwater extraction, which can be done by placing upper limits on extraction, promoting water harvesting techniques and ensuring last mile connection of farmlands to water sources such as canals and rivers.

4.3.3. PESTICIDES MANAGEMENT BILL, 2020

Why in news?

Recently, the experts warned about some provisions in the **Pesticides Management Bill, 2020 which will hurt farmers' livelihood.**

About the bill

- The Pesticide Management Bill, 2020 was introduced in Rajya Sabha by the **Ministry of Agriculture and Farmers Welfare in March 2020.**
- It **seeks to regulate the manufacture, import, sale, storage, distribution, use, and disposal of pesticides,** in order to ensure the availability of safe pesticides and minimise the risk to humans, animals, and environment.

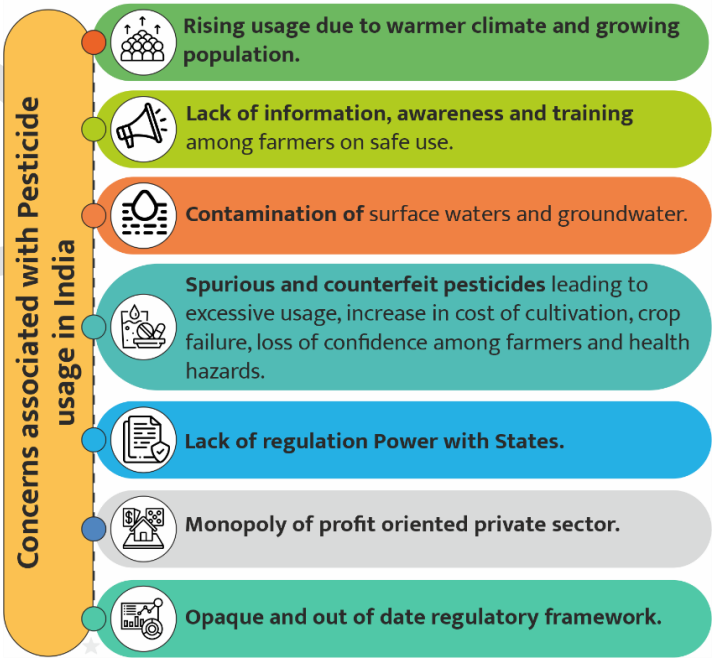
Production and usage of pesticides in India

- India is the **fourth-largest producer of pesticides** in the world, with the market segmentation tilted mainly towards insecticides..
- **Insecticides, fungicides and herbicides are used in India,** with insecticides forming the highest share.
- The main use of pesticides in India is for cotton crops, followed by paddy and wheat.
- As of 2019, a total of 292 pesticides are registered in India.
- **Total pesticide consumption is the highest in Maharashtra,** followed by Uttar Pradesh, Punjab and Haryana.
  - Per hectare consumption of pesticides is the highest in Punjab.

- It seeks to **replace the Insecticides Act, 1968** which currently governs the registration, manufacturing, export, sale and use of pesticides in India.
- The reason for introducing PMB was the **inadequacy of the 50-year-old Insecticides Act, 1968** to meet the needs of multi-dimensional management and administration of pesticides.
  - Also, agriculture in India is largely dependent on chemicals, including pesticides and their overuse and misuse has a **huge impact on the health of humans, animals, bio-diversity and the environment.**

Key Features of the Bill

- **Defines Pest & Pesticide:**
  - **Pest** is any species of animal, plant, or pathogenic agent that is unwanted, or injurious to plants, humans, animals, and the environment.
  - **Pesticide** is any substance of chemical or biological origin intended for preventing or destroying any pest in agriculture, industry, public health, pest control operations, or for ordinary use. It also promotes organic pesticides.
- **Constitution of Central Pesticides Board:** to **advise the central and state governments on scientific and technical matters** arising under the Act. It will also advise the central government in formulating standards and best practices for
  - recall and disposal of pesticides
  - working conditions and training of workers
  - pesticide manufacturers, laboratories, and pest control operators
- **Other Provisions related to –**
  - Registration of pesticides
  - Procedure for obtaining licence to manufacture, distribute, stock pesticides
  - Regulating prices if necessary
  - Prohibition on certain pesticides
  - Offences and penalties



Intended Benefits of the Bill

- It proposes to **promote the production and distribution of safe and effective pesticides** and **to reduce crop losses** due to the use of spurious and substandard products.
- It **assesses the potential effects of these products** on the health of people and the environment.
- Advertisements for pesticides will also be **regulated to prevent misleading claims.**
- **Manufacturers who violate the law will be subject to a heavy penalty** in addition to an imprisonment of up to five years.
- The penalties collected will form a central fund that will **provide compensation for farmers facing losses due to illegal, low-quality or spurious chemicals.**

Key Issues/Concerns

- **Export of pesticides**: PMB 2020 does not allow the export of pesticides that are banned in India even if those are approved for use in other countries.
  - In PMB 2020, there is **no requirement for the registration of a technical grade pesticide** before importing any of its formulations in India.
- **Encouraging the import of formulations:** Bill seeks to encourage the import of formulations, ultimately damaging the crop, health of farmers, and the environment**.**
- **Prescription:** Under PMB, farmers will have to obtain the prescription before they can buy certain pesticides, which will pose a huge obstacle in the timely procurement of pesticides.
- **Power of licensing & registration:** too much power in hands of bureaucracy.

Way Forward

- **Focus on minimal use of pesticides:** Minimizing the use of pesticides, recognizing the fact that pesticide use is not sustainable. Promoting pesticides will take India away from sustainable agriculture practices and agro-ecology.
- **Pesticide promotion must not be allowed:** Like pharmaceutical drugs, pesticides due to their hazardous nature, must not be allowed to be promoted.
- **Farmers must be made aware of judicious usage:** Pesticides are hazardous chemicals with causing acute as well as chronic toxic effects. They must be sold and used cautiously under supervision like drugs.
- Successful **alternative agro-ecological methods of pest management** without using any chemical pesticide can be used. Such methods must be mainstreamed and promoted among farmers.
- Experts have called for **wider consultations on the Bill** and for it to be placed before a **Select Committee.**

4.3.4. ORGANIC FARMING

Why in news?

About 14,491 hectare area in Andaman and Nicobar has been certified as organic under the Large Area Certification (LAC) Scheme of the PGS-India (Participatory Guarantee System) certification programme (the first large contiguous territory to be certified).

Data Bank

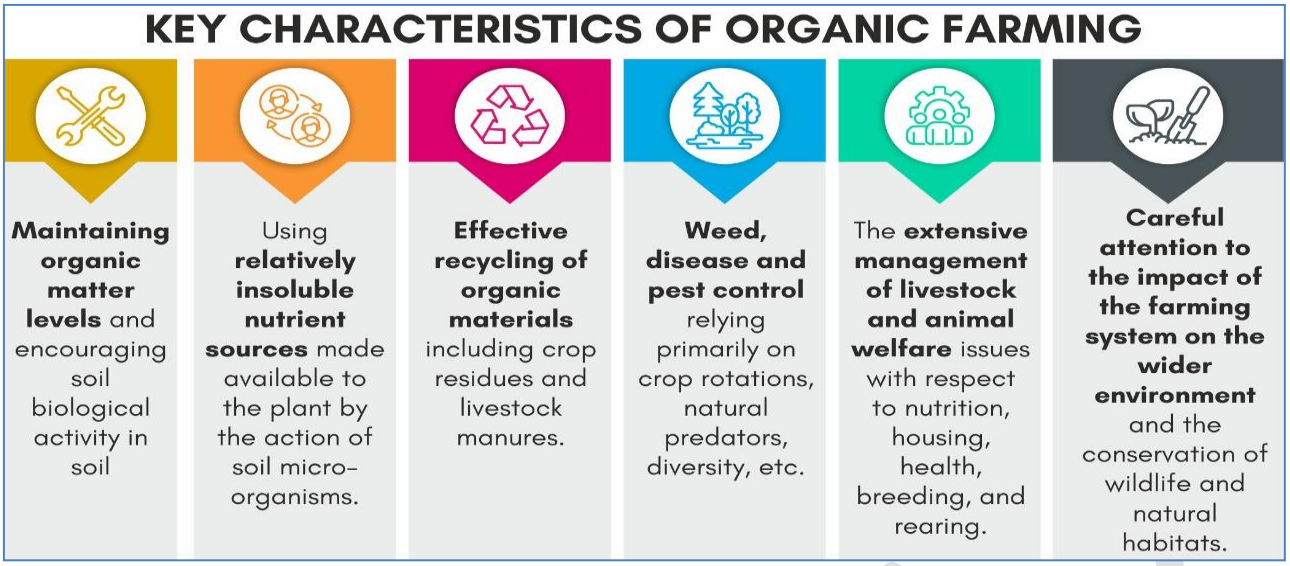
- **Only 2% of the net sown area in the country is under Organic cultivation.**
- India's rank 8th in terms of World's Organic Agricultural land and 1st in terms of total number of producers as per 2020 data.
- Sikkim became the first State in the world to become fully organic in 2016.

About LAC

- It is a unique quick certification programme to harness the potential areas of Organic farming in India.
- It was launched by the Department of Agriculture and Farmers Welfare under its flagship scheme of **Paramparagat Krishi Vikas Yojana (PKVY).**
- Under LAC, **each village in the area is considered as one cluster or group** and simple documentations are maintained village-wise.
- All farmers with their farmland and livestock need to adhere to the standard requirements and on being verified get certified en-mass without the need to go under conversion period.
- **Certification is renewed on annual basis** through annual verification by a process of p**eer appraisals as per the process of PGS-India**.

About Organic farming

- As per **Food and Agriculture Organisation** "Organic agriculture is a unique production management system which promotes and enhances agro-ecosystem health, including biodiversity, biological cycles and soil biological activity, and this is accomplished by using on-farm agronomic, biological and mechanical methods in exclusion of all synthetic off-farm inputs".
- Organic products are grown under a system of agriculture without the use of chemical fertilizers and pesticides with an environmentally and socially responsible approach.



Benefits

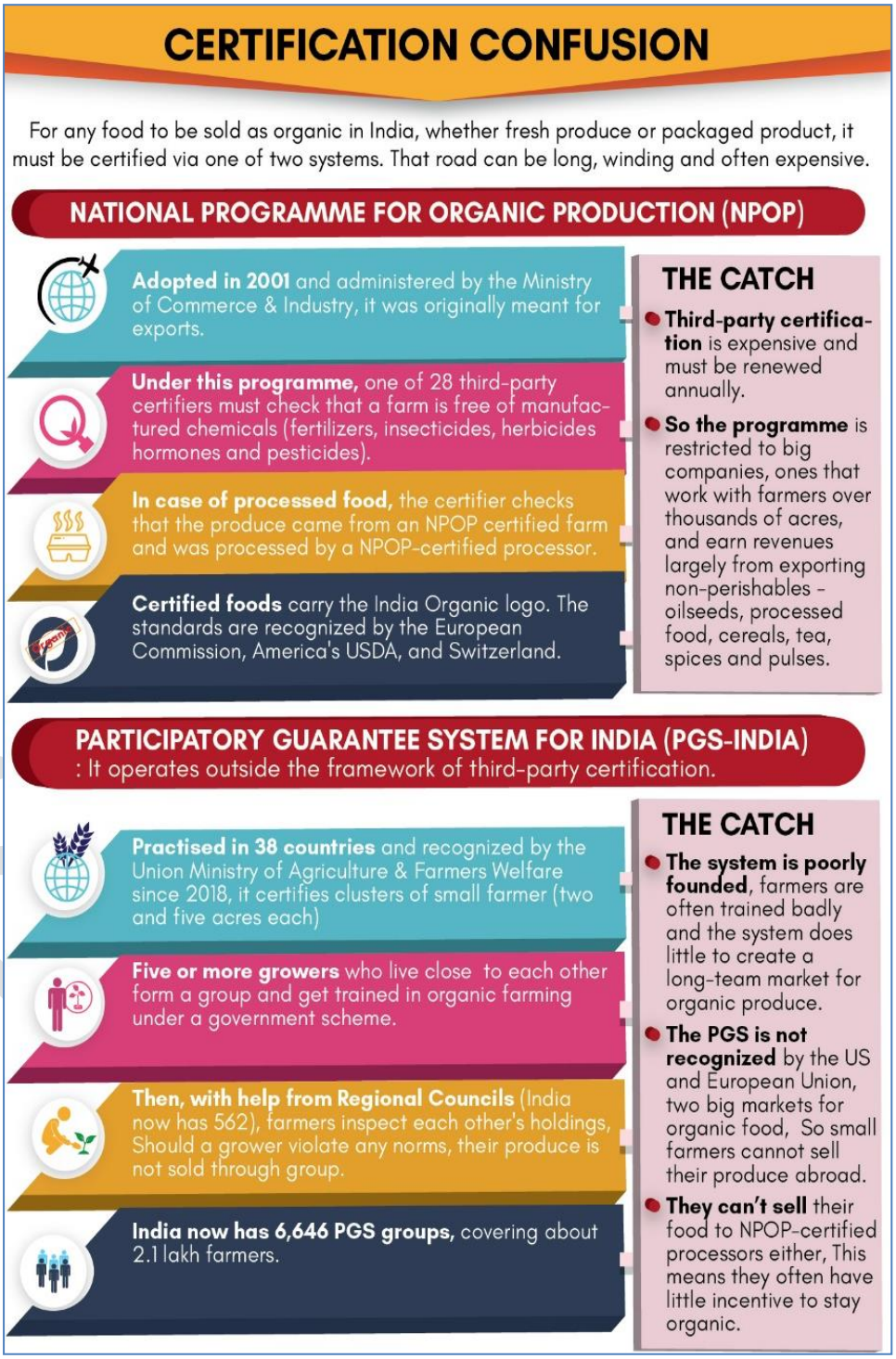
- **Healthy Foods:** Many studies reveal that organic food is higher in certain key areas such as total antioxidant capacity, total polyphenols, etc which are nutritionally significant.
  - Studies have also shown that dairy products from organically raised animals are healthier than conventionally produced dairy products.
- **Ecological benefits:**
  - **Improvement in Soil Quality:** It sustains healthy soils by maintaining and building a fertile living soil through the application of organic matter inputs like green manures and by implementing low soil disturbance tillage.
  - **Reduced Pollution:** Due to healthier soil and absence of harmful pesticide and fertilizer, organic farming reduces water and air pollutants.
  - **Low Incidence of Pests:** It has been observed that if the soil is healthy, the pest problem is negligible as compared to soil where agrochemicals are used or where there is low organic matter in the soil.
- **Efficient use of resources:**
  - **Improved water management:** Improving water infiltration and retention capacity through high levels of organic matter reduce the amount of water needed for irrigation.
  - **Lower Energy Use:** Many popular crops such as corn require nitrogen rich soil which is a high energy use. Organic farming achieves the nitrogen rich soil, instead, by using composted manure and the use of cover crops.
- **Economic benefits:**
  - **Increased income:** In the long run the input cost decreases significantly and the yield of organic crops improves which provides income security to the farmers.
  - **Employment Opportunities:** According to many studies, organic farming requires more labour input than the conventional farming system. Thus, it will provide employment opportunities especially for countries like India.
  - **Eco-tourism:** Organic farms have turned into major attraction in terms of Eco-tourism in countries like Italy.

Government Initiatives/Schemes/Policies

- **Paramparagat Krishi Vikas Yojana (PKVY):** It is a part of National Mission of Sustainable Agriculture (NMSA).
  - Under the scheme, Organic farming is promoted through adoption of organic villages by cluster approach and Participatory Guarantee System (PGS) certification.
- **Mission Organic Value Chain Development for North East Region (MOVCD):** It is a Central Sector Scheme which aims to develop certified organic production in a value chain mode to link growers with consumers and to support the development of the entire value chain.
- **Soil Health Card:** The scheme aims to improve Soil Health by providing nutrients information to the farmers.
- **Agri-export Policy 2018:** It focuses on marketing and promotion of organic agriculture products foods to aid organic farming in India.
- **Zero Budget Natural Farming:** Government is actively promoting Zero budget natural farming. It is a method of chemical-free agriculture drawing from traditional Indian practices.

Challenges faced by Organic sector in India

- **Reluctancy of the Farmers:** Due to high initial cost and potential impact on immediate income, most of the farmers are reluctant to undertake organic farming.
  - Also, in many cases the farmers experience some loss in yields on discarding synthetic inputs on conversion of their farming method from conventional to organic.
- **Disparity of Supply and Demand:** The major demand of perishable items comes from metros where there are no farmlands to produce organic fruits and vegetables.
- **Lack of support for inputs:** The government provide subsidies for chemical fertilisers and pesticides but there is no such provision for organic inputs. Also, organic seeds and inputs are highly regulated and governed by government policies.
- **Confused Certification Framework:** There is a lack of unique, well known and third party certified policy or framework for selling organic food products in India, which creates trust issues among the customers. (see infographic)
- **The High Price of Organic Produce:** The final prices of organic produce are mostly higher than conventional products which impact the organic produce market in India.
- **Lack of Quality Standards for Biomanures:** There are no fixed standards and quality parameters for biofertilizers and bio manures.



Way Forward

- **Awareness campaigns:** There is a need of holistic and community-driven approach, similar to the "Swachh Bharat" for "Swachh Food" needs to be undertaken.
  - A vigorous campaign to highlight the benefits of organic farming against the conventional system is essential to increase the awareness of the farmers and consumers.
- **Smart transport and dedicated channels of supply** can help bridge the demand- supply gap.

- **Policy initiatives for organic input management:** The government should implement a separate policy framework for organic farming which covers seeds production and input supplies.
- **Transparent regulatory framework for compliance of organic standards** to develop trust among customers.
    - **FSSAI's Jaivik Bharat logo** for Organic Food that enables consumers to distinguish organic food products from other non-organic products is a step in the right direction.

4.3.5. MILLETS: CLIMATE-RESILIENT GRAINS

Why in news

United Nations General Assembly unanimously approved the resolution sponsored by India to declare **2023 as the International Year of Millets.**

More on news

- In 2018, India had proposed to celebrate 2023 **as International Year of Millets** at Food and Agriculture Organization.
- Significance of declaring **International Year of Millets.**
    - Help in **raising awareness and direct policy action** to **nutritional and health benefits** of millets consumption and their **suitability for cultivation under adverse and changing climatic conditions.**
    - Draw focus for **enhanced investments in research and development** and **extension services** related to millets.

About Millets

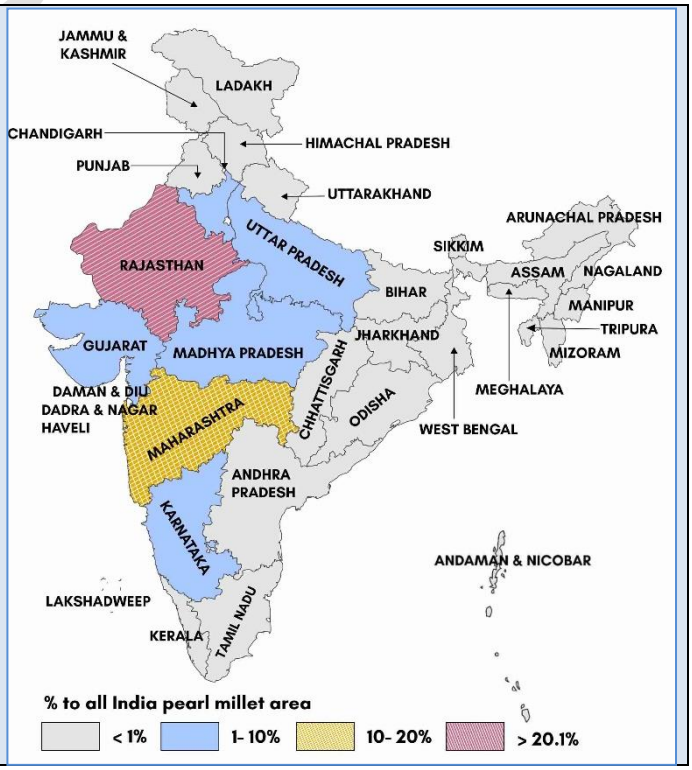
- Millets are a group of **small-seeded grasses**, widely **grown as cereal crops or grains** for human food and as fodder.
- They are classified into **Major Millets and Minor Millets based on their grain size.**

Major millets	Minor millets	Psuedo millets
Sorgum (jowar), pearl millet (bajra), finger millet(ragi).	**foxtail, little, kodo, proso and barnyard millet**	**Amaranth (Rajgira) and Buckwheat (Kuttu).** These are **not part of the botanical family to which 'true' grains belong**; however, they are **nutritionally similar** and used in similar ways to 'true' grains.

- **Major Millets grow in Kharif season** (July to October): Pearl millet/bajra, finger millet/ragi (cereals), and jowar are kharif crops.

Data Bank

- India is the **largest producer of millets** in the world with a **41.0% global market share.**
- During 2017-18, the **maximum area under millets was in Rajasthan,** followed by Maharashtra and Karnataka.
- **Area under millet declined by about 60%** from 1965-66 to 2016-17.



Benefits of Millets production

Health benefits	Ecological benefits	Economic security
• **Fighting malnutrition: Rich in** rich in fibre, minerals, vitamins **and have more nutrient content.** • **Gluten-free**: advantageous for people suffering from diabetes. • **Anti-carcinogenic foods and anti-hypertensive** and help prevent obesity and heart diseases • Reduce **inflammation and improves digestion.**	• **Can sequester carbon from the atmosphere** while **paddy fields emit methane.** • **Less water intensive.** • **Hardy, drought-tolerant, and heat-resistant crops** that generally **do not succumb to pests and diseases.** • Can **grow in areas with less than 350 mm of rainfall.** • Can **grow on low fertility soil** and help to reclaim soils.	• Millets are called **'Famine reserves'** as they have a short growing season of 65 days and can keep well for two years or beyond. • **Low investment** needed for production as they do not require chemical fertilisers etc. • **High demand for export.**

Challenges to millet production

- **Disproportionate focus on rice and wheat:** As a fall out of green revolution the focus tilted towards the two staple but less nutritious crops.
- **Lack of awareness:** There is a **lack of considerable knowledge of the value of millets** among traditional communities. **Earlier recognized as 'coarse grains'**, they are looked down upon as part of a poor person's diet.
- **Changes in dietary habits:** Between the mid-1960s and 2010, an urban Indian's wheat consumption almost doubled. At the same time average annual per capita consumption of sorghum and millets, reduced. **Lack of ready-to-eat millet-based products** has also led to decline in consumption.
- **Post-harvest treatment of millet**: Millets need **more processing than other crops,** but the machines for these have not reached the farmer yet.
- **Low productivity: Most of the millets are grown in** arid and semi-arid regions which are rainfall dependent.
- **Monoculture of ragi:** Within millets, focus is on ragi **as it is economically viable, increases soil fertility and can be intercropped.** This results in less focus on another millets and risks agro-biodiversity.
- **Lower or near absence of production support**, in terms of input supply and subsidy (seed and nutrients), irrigation support, and marketing support, and lack of modern technology when compared to the support enjoyed by other crops.

Government Initiatives/Schemes/Policies

- **Initiative for Nutritional Security through Intensive Millet Promotion (INSIMP)** was launched in 2011-12 to promote millets as "nutri-cereals' and enhance India's nutritional security. It is a part of **Rashtriya Krishi Vikas Yojana.**
- **Integrated Cereals Development Programmes in Coarse Cereals** under Macro Management of Agriculture scheme to increase the overall productivity under specific crop-based systems.
- Government allowed **inclusion of "Nutri-Cereals" in the Public Distribution System (PDS) and mid-day meal scheme.**
- Government is also continuously increasing **the minimum support price (MSP) of millets** (bajra, jowar, and ragi) substantially so as to incentivise farmers to grow millets especially in drought prone areas.
- Government has **declared 2018 as National Year of Millets.**

Way forward

- The **use of millets in commercial/packaged food** will encourage farmers to grow millets and will open new opportunities and revitalize the farmers.
- The inclusion of millet-based foods in **international, national and state-level feeding programs** will help to overcome the existing nutrient deficiencies of protein, calcium and iron in developing countries.
- As per NITI Aayog, there needs to be a strong **integration of the schemes for millet promotion with other schemes such as introduction of locally produced millets with ICDS (integrated child development scheme) and PDS.** E.g., Odisha has introduced local millets into ICDS.
- There are **millet hotspots like Mandla and Dindori in Madhya Pradesh**, Malkangiri in Odisha, the Garhwal Himlayas and Kolli hills in Tamil Nadu. These locations should be **promoted for diverse-centric agriculture.**
- Millets are less favorable from taste (sensory value). **This can be overcome by mixing millet flours with other flours** of high acceptability and preparing composite foods.

4.3.6. AQUAPONICS

Why in news?

Recently, a pilot Aquaponics facility developed by Centre for Development of Advanced Computing (C-DAC), Mohali was inaugurated.

About Aquaponics

- Aquaponics is a **combination of aquaculture,** which is growing fish and other aquatic animals, **and hydroponics** (see box).
- Aquaponics uses these two in a symbiotic combination. **Fish waste from the aquaculture portion of the system is broken down by bacteria** (microbes or nitrifying bacteria) into dissolved nutrients (e.g. nitrogen and phosphorus compounds) that plants utilize to grow in a hydroponic unit.
- This **nutrient removal improves water quality for the fish and also decreases overall water consumption** by limiting the amount released as effluent.

Benefits of Aquaponics

- Aquaponics is a recirculating food production system that **uses less than 10% of the water normally required** for fish farming and plant production.
  - It is therefore **suitable for small-scale/domestic consumption** as well as commercial fresh food production, particularly in communities where water is scarce.
- In aquaponics, there is **no toxic run-off from either hydroponics or aquaculture.**
- This methods is **ideal if the available land is not fertile or suitable for cultivation**
- It is an **excellent way of producing protein rich foods** such as fish and vegetables in both impoverished areas (to support food security), as well as in areas where there is a high demand for good quality produce.
- Using this methods one can **set up vertical farms on grow towers.**
- **Need for inputs is low** once the system has been set-up, just some simple systems' maintenance along with fish, fish feed, seeds (or seedlings) and water to replenish the unit.

Limitations of Aquaponics

- Aquaponics **combines the risks of both aquaculture and hydroponics,** and thus expert assessment and consultation is essential.
- Commercial aquaponics is **not appropriate in all locations** and Large-scale systems require careful consideration before financial investment.
- Aquaponic systems are characterized by a broader range of microflora than conventional hydroponic systems therefore **pest and disease management need further improvement.**
- The most challenging aspect of managing an aquaponics operation is to **develop a realistic, accurate, and workable marketing plan**. Raising fish indoors is two to three times more expensive than raising fish in open ponds.

Conclusion

In the future, the agriculture sector will need to produce more with less. Aquaponics **has the potential to support economic development and enhance food security** and nutrition through efficient resource use, and it will become one additional way of addressing the global challenge of food supply in a sustainable way.

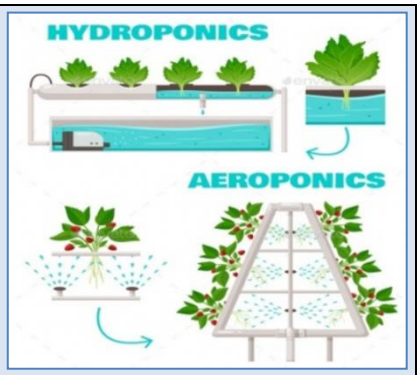
Related Concepts

Hydroponics

- Hydroponics is the **cultivation of plants without using soil.** In the absence of soil, water provides nutrients, hydration, and oxygen to plant life.
- This system fosters **rapid growth, stronger yields, and superior quality.**
- When a plant is grown in soil, its roots are perpetually searching for the necessary nutrition to support the plant. If a plant's root system is exposed directly to water and nutrition, the **plant does not have to exert any energy in sustaining itself.**

Aeroponic

- In Aeroponic**plants are grown in a controlled air environment** and are not placed on a substrate or in water.



- The **exposed roots are periodically sprayed with nutrient solutions** for the plants to grow.

Vertical Farming

- By Vertical Farming, food crops can be cultivated easily by planting in vertically stacked layers in order to save space and use minimal energy and water for irrigation.

4.4. ISLAND DEVELOPMENTAL STRATEGY

Why in news?

Recently, some developmental changes were opposed in the islands of Lakshadweep and Andaman& Nicobar.

More on news

- Recently Lakshadweep administration introduced three legislations, which are:
- There has been considerable opposition to these legislations. The reasons cited for this opposition include **poor precedence of the two-child policy, need for a strong legislation like Prevention of Anti-social activities** and on the broader level on grounds of lack of sustainability and interference.
- In similar connotation, **India's turtle researchers have been opposing NITI Aayog's development plans for Little Andaman and Great Nicobar Islands.** They say the islands' rich **biodiversity will be greatly affected** if the plans reach fruition.
- These events bring into focus the issues with the current island development policies.

What are the issues with this current paradigm of developmental strategies?

- **Overlooking culture and traditions of the ethnic communities:** For example, despite of the fact that more than 90 percent of Lakshadweep's population is Muslim, the regulation prohibits buying, selling, transportation or storing beef or beef products in any form which is widely consumed.
- **Unsustainable Approach**: Disturbing the human-nature relationship may destabilize the coral reefs of Lakshadweep or Mangrove cover in Andaman and Nicobar Islands which are nurtured and maintained by the life and culture of the homogeneous community that live on the islands.
- **Disaster vulnerability:** For example, the Andaman & Nicobar Islands are in a seismically highly active zone. The NITI Aayog's strategy of island development does not auger well with this vulnerability.
- **Lack of inclusiveness in development:** The inhabitants of the island have their own priorities, lifestyle and needs. In accordance with that, they have developed traditional wisdom with regard to existence on these islands. Current development strategies discount this traditional wisdom in their overall strategy.

Regulation	What it does?
The Lakshadweep Animal Preservation Regulation, 2021	It prohibits slaughtering or causing any animal to be slaughtered without a certificate issued by the authorities.
The Lakshadweep Panchayat Regulation, 2021	It makes any person with **more than two children** ineligible to contest panchayat elections or continue as a member.
The Lakshadweep Development Authority Regulation 2021	It **allows the government to evict, alter and/or occupy any land owned by any common man** in the island for development purposes.
The Lakshadweep Prevention of Anti-Social Activities Regulation	It provides for the administrator to order the **detention of a person for a period of up to one year** if the offender's actions adversely affect the maintenance of public order.

These issues highlight an underlying trade-off between the national importance of these islands and developmental needs and priorities of the local populace.

What are Stakeholder's expectations from Island's Developmental Strategy?

Stakeholders	Expectations from Developmental Policy
Island Community	• Economic Opportunities • State-of-the-art Infrastructure • Adequate air, sea and web connectivity
The Government of India	• Security of the islands • Sustainable development • Union Territories to be model of economic development for establishing a New India by 2022 • Achievements of objectives as envisaged for sectors under four sections namely Drivers, Infrastructure, Inclusion and Governance

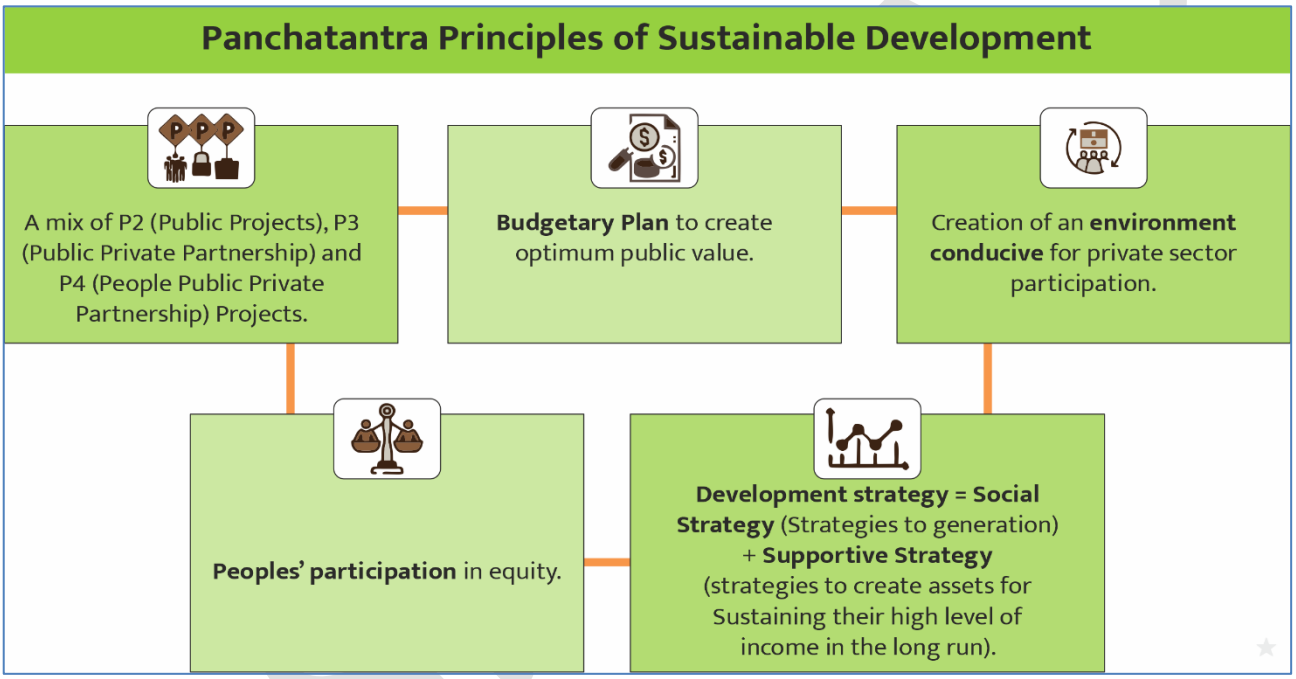
Tourist (domestic and foreign)	• Assured delivery of high-quality tourist services • Infrastructure that caters to the tourists' expectations • Digital connectivity • Disaster preparedness and rescue services
Civil Society	• Environmental Sustainability • Satisfactory Human development Index (HDI)

What developmental strategy can be adopted to satisfy all stakeholders?

In order to balance the developmental needs of all the stakeholders, **'Panchatantra Principles of Sustainable Development'** as suggested **by NITI Aayog** can be adopted. These principles are:

Conclusion

An ideal Island development strategy must include **Infrastructural needs** as well as **Geostrategic role** of the island. Both **Lakshadweep and Andaman and Nicobar Islands** act as a significant theatre for country's force projection and a deterrent to China's increasing influence in the **Indian Ocean, Indo-Pacific region** and **India's extended neighbourhood.** But at the same time, it is the habitat of people and their **local priorities should receive their due weight.**



4.5. WASTE MANAGEMENT

4.5.1. SINGLE USE PLASTICS

Why in news?

Recently, the **Ministry of Environment, Forest, and Climate Change (MoEF&CC)** has notified the **Plastic Waste Management Amendment Rules, 2021,** which **prohibits identified single use plastic items** which have low utility and high littering potential by 2022.

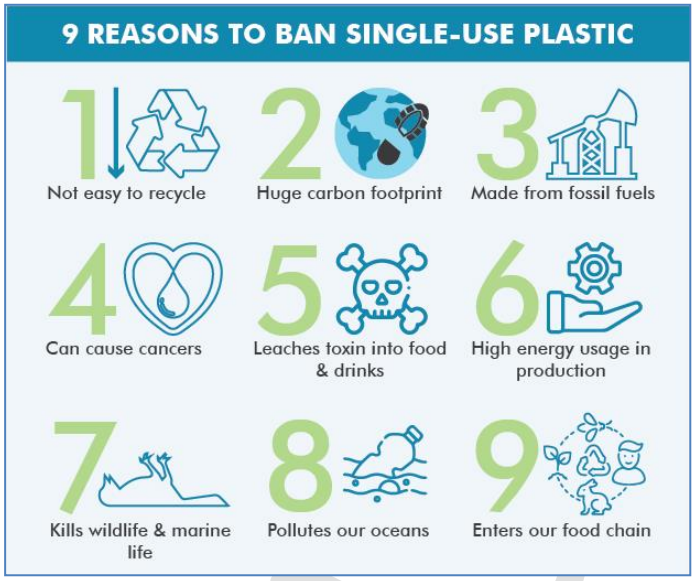
Data Bank

- India generates approximately **9.46 million tonnes (MT) of plastic waste per year.** (Central Pollution Control Board)
- Of this, **nearly 60% is collected and recycled** while the **remaining 40%** of the plastic waste remains **uncollected and littered in the environment.**
- Over **300 million tons of plastic are produced every year,** half of which is used to design **single-use items** such as shopping bags, cups etc. (IUCN)

What are Single-use plastics (SUP) and why are they a threat?

- India has defined SUP as **"a plastic commodity intended to be used once for the same purpose before being disposed of or recycled"** in its Plastic Waste Management Amendment Rules, 2021.
  - These include plastic bags, straws, coffee stirrers, soda and water bottles and most food packaging.
  - The assessment of SUP was conducted by comparing **two pillars** — the **utility index of a particular type of SUP** and the **environmental impact of the same.**

- The **product that scores low on utility and high on environmental impact** should be considered for immediate phase out.



Key Provisions of Plastic Waste Management (PWM) Amendment Rules, 2021

The new rules will **replace the existing Plastic Waste Management Rule, 2016** (PWM Rules, 2016) that was amended in 2018.

- **Prohibition: Manufacture, import, stocking, distribution, sale and use of single-use plastic,** including polystyrene and expanded polystyrene, commodities shall be **prohibited with effect from 1st July 2022.**
  - The ban will **not apply to commodities made of compostable plastic**.
- **Thickness of plastic**: With effect from **30th September 2021, thickness of plastic carry bags has been increased** from 50 microns to 75 microns and to 120 microns with effect from the 31st December, 2022.
- **Extended Producer Responsibility (EPR):** Plastic packaging waste not covered under present notification shall be collected and managed in an environmentally sustainable way through **EPR of the producer, importer and brand owner (PIBO)** as per PWM Rules, 2016.
  - For effective implementation of EPR Guidelines, **they have been given legal force** through PWM Amendment Rules, 2021.
  - EPR is a policy approach in which producers take responsibility for management of the disposal of products they produce once those products are designated as no longer useful by consumers.
- **Implementing agency:** Along with state pollution bodies, **Central Pollution Control Board (CPCB)** will monitor the ban, identify violations, and impose penalties already prescribed under the Environmental Protection Act, 1986.
- **Task Force:** States and UTs had constituted the **special task force for elimination of SUP and effective implementation of the PWM Rules, 2016.**
  - Environment Ministry has also set up a **national-level task force** for making coordinated efforts in this direction.
  - State /UT Governments and concerned Central Ministries/Departments have also been requested to **develop a comprehensive action plan for elimination of SUP** and its implementation in a time bound manner.

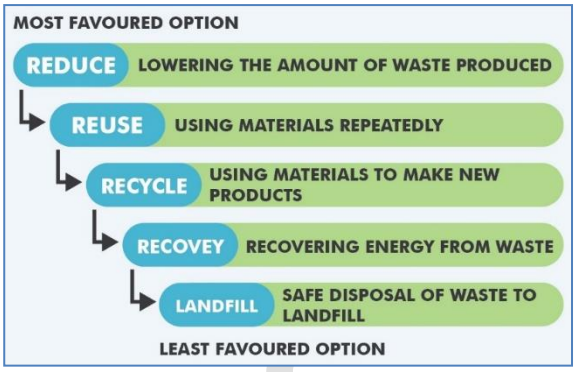
Government Initiatives/Schemes/Policies

- **India Plastic Challenge – Hackathon 2021**: It has been organized for students of higher educational institutions and startups recognised under the Startup India Initiative to **encourage innovation in the development of alternatives to SUPs as well as digital solutions** to plastic waste management.
- **India Plastic Pact (IPP):** India becomes first Asian country to launch IPP with the aim to tackle plastic pollution in the country, bringing together businesses from across the Indian plastics value chain to move towards a circular plastics system that aims to keep the material in the economy, and out of the environment.
- **Un-Plastic Collective (UPC):** It is a voluntary initiative launched by the UN-Environment Program-India, Confederation of Indian Industry and WWF-India to drive corporate action toward solutions on plastic leakage.
- **GloLitter Partnerships Project**: It was launched by the International Maritime Organization (IMO) and the Food and Agriculture Organization of the United Nations (FAO) to assists developing countries to **prevent and reduce marine plastic litter from the maritime transport and fisheries sectors** and identifies opportunities for the reduction of plastic uses in both fisheries and maritime transport sectors.

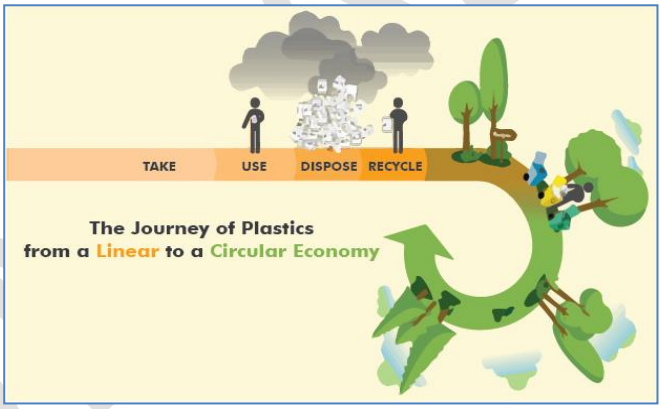
Challenges associated with Plastic Waste Management in India

- **Easy availability**: Plastic carry-bags pose a special problem. Although they are strong, lightweight and useful and can be saved, cleaned and reused many times, this is mostly not done because they are **available very cheap** and are, therefore, not valued (often shops give plastic carry bags for free). They become, effectively, single-use plastics.
- **Large consumption:** will make transitioning in a short period difficult.

- **Opposition by plastic indsutry:** The All India Plastic Manufacturers' Association (AIPMA), has requested the government to push the deadline for phasing out SUP products by a period of one year to 2023 owing to economic distress faced by manufacturing units due to the COVID-19 pandemic.
- **Lack of adequate infrastructure and technology:** for segregation, collection and disposal of plastic waste in a cost- and resource-efficient way.
- **Challenges in bringing** behavioral change among the users as along with economies of the suppliers.
- **Unprofitability of recycling enterprises** due to lack of assured quantity of segregated waste, technological know-how, legal compliance etc.



- **Lack of R&D investments limit technological innovation**: For instance, recycling of Multi Layered Packaging (MLPs) is expensive as separating various layers of this packaging is difficult owing to adhesive nature of various layers, while single use plastics are a low value input for plastic recyclers to produce quality outputs.
- **Enhanced complexities due to COVID:** Our improved, hyper-hygienic way of life in the fear of transmission has conveniently shifted our behavioral patterns like increased demand for plastic-packaged food and groceries, and the use of disposable utensils.



Way Forward

- **4Rs (Reduce, Rejuvenate, Reuse, and Recycle):** The focus should be on using 4Rs principle to conserve the environment from plastic waste disposal. (refer infographic).
- **Monetising the waste:** One way to ensure better collection of plastic waste is to ensure that the 'junk' has a value attached that is 'redeemable' in the immediate future.
- **Infrastructure**: The key to efficient waste management is to **ensure proper segregation of waste at source** and to ensure that the waste goes through different streams of recycling and resource recovery through proper infrastructure and access to technology. There is a need for **collective efforts** from the Union/state governments and municipalities in developing and using the infrastructure.
- **Adopting affordable and viable alternatives**: There is need to promote alternatives like cotton, khadi bags and biodegradable plastics.
    - Raise awareness among people to minimise their use of plastics.
- **Regulation supporting incentive structure to make biodegradable alternatives affordable** for large-scale adoption and use.
- **Strengthening the waste management practices** i.e. segregated collection and processing waste through material recovery facilities in cities.
    - Material Recovery Facilities (dry waste collection centres) have been set up by Bangalore Municipalities where recyclable plastic waste can be sold at pre- decided rates.

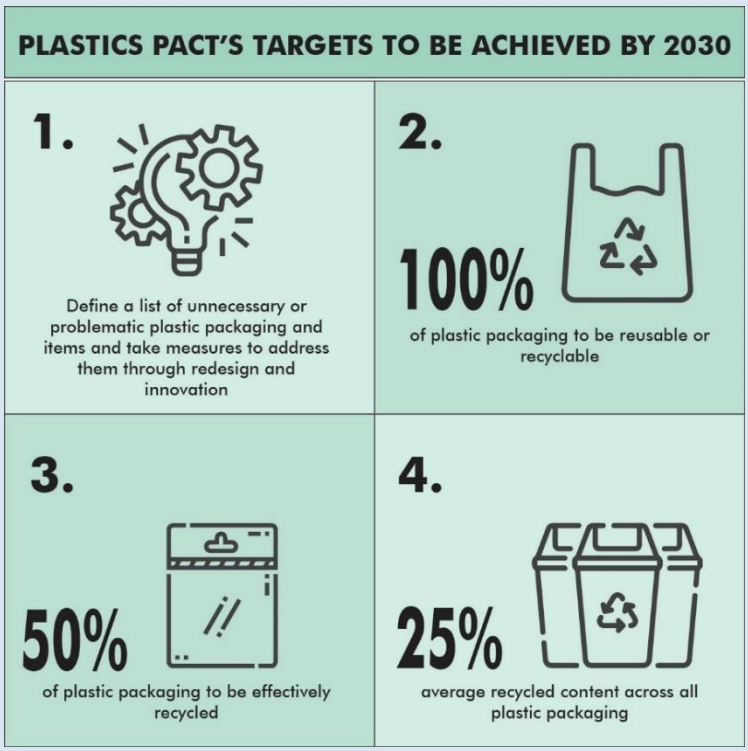
- **Upcycling the plastic waste:** Using non-recyclable plastics to make roads or recover energy from them, using them as alternate fuels to replace fossil fuel.
- **Design benchmark to be developed by the Bureau of Indian Standards** for quality control and creating a market for products produced from the recycled feedstock.
- **Strongly application EPR policies** in consensus with state urban development bodies

Related Concept: Circular Plastic Economy

- India has become the first Asian country to develop a **plastics pact** for building a circular system for plastics.
- **Circular Economy** focuses on resource efficiency and recovery and is **restorative and regenerative by design**. This means materials constantly flow around a 'closed loop' system, rather than being used once and then discarded.
    - In the case of plastic, this means simultaneously keeping the value of plastics in the economy, without leakage into the natural environment.

About India Plastics Pact

- The India Plastics Pact (IPP) has launched as a **collaboration between WWF India and the Confederation of Indian Industry (CII).**
- The initiative brings together all stakeholder across the whole value chain to set **time-bound target-based commitments** to transform the current linear plastics system into a circular plastics economy.



4.5.2. BIOMEDICAL WASTE

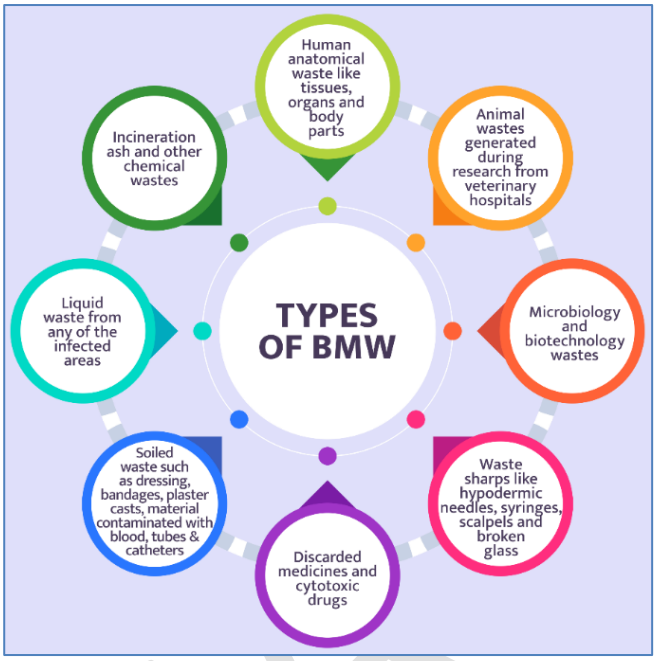
Why in news?

The report titled, "State of India's Environment 2021," released by the Centre for Science and Environment, said **2,03,000 kg of COVID-19 biomedical waste was produced daily in May** this year.

About Biomedical Waste (BMW)

- Biomedical waste means any **waste generated during diagnosis, treatment or immunization** of human beings or animals.
- **Sources** of BMW are:

Primary source	Other sources
Hospitals, nursing homes, veterinary hospitals, clinics, dispensaries, blood.	Households, Industries, education institutes and research centers.



Effects of BMW

Health risks	Environmental impact

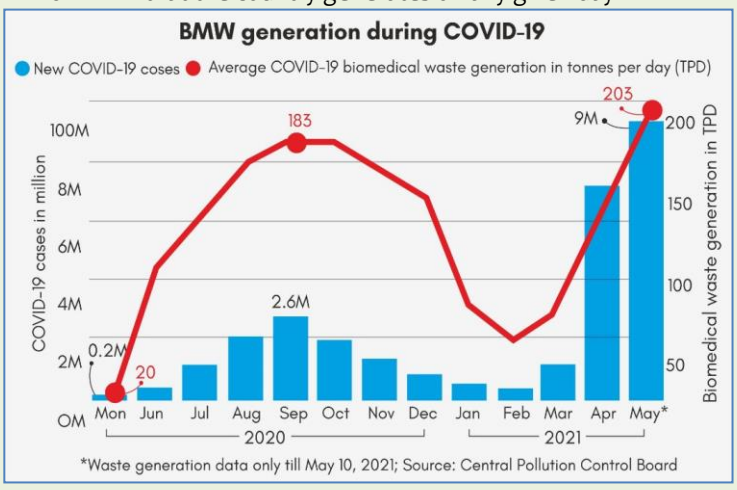
• BMW contains potentially harmful microorganisms that can **infect hospital patients, health workers and the general public.**
• Adverse health outcomes associated with BMW waste include:
  ○ Potential infections caused by exposure to BMW.
  ○ **Rise of drug resistant microorganisms.**
  ○ Sharps-inflicted injuries and **radiation burns**.
  ○ **Toxic exposure** to pharmaceutical products, in particular, antibiotics and cytotoxic drugs and to substances such as **mercury or dioxins**, during the handling or incineration of health care wastes;
  ○ **Chemical burns** arising in the context of disinfection, sterilization or waste treatment activities;
  ○ **Thermal injuries** occurring in conjunction with open burning and the operation of medical waste incinerators;
	• Treatment and disposal of healthcare waste may pose health risks indirectly through the **release of pathogens and toxic pollutants into the environment.**
	  ○ Pathogens present in the waste can **enter and remain in the air** for a long period in the form of spores or as pathogens. Inadequate incineration or the incineration of unsuitable materials results in the **release of pollutants into the air and generation of ash residue.**
	  ○ The liquid waste generated when let into sewers can also lead to **water pollution** if not treated properly. BMW can also lead to **contamination of ground water** if landfills are not properly constructed.
	  ○ **Soil pollution** is caused due to infectious waste, discarded medicines, chemicals used in treatment.
	  ○ Heavy metals such as cadmium, lead, mercury etc. which are present in the waste may get absorbed by plants and **can then enter the food chain.**

Challenges with BMW management and how COVID-19 has exacerbated it

- **Most states and Union Territories generate more biomedical waste than they can handle.**
- **Non-uniform distribution of treatment facilities** among states.
- **Disproportionate increase in BMW due to pandemic.**
- **Difficulties in monitoring the flow of COVID-19 waste due to its innumerable sources** that vary from individual households to isolation centres and makeshift quarantine camps.

Data Bank

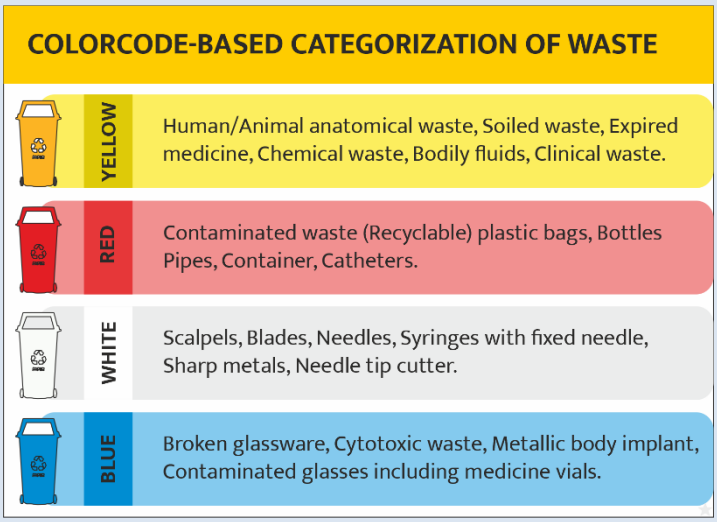
- Since the pandemic's first wave, India has generated **126 tonnes of COVID-19 waste a day** which is about **20 per cent of the 614 tonnes of BMW** that the country generates on any given day.



- **Lack of reporting by generators and Common biomedical waste treatment facilities** on the government mobile application, COVID-19 BMW app.
- **Poor segregation in home quarantine centres** due to **poor awareness and lack of communication.**
- **Increase in wastage due to vaccination drive:** Every jab generates a **waste syringe,** and every 10 or 20 vaccinations, depending on the vaccine type, generate **one waste glass vial.**

Biomedical Waste Management (BMWM) rules in India

- In July 1998, first BMWM rules were notified by Government of India which were modified multiple times (latest in 2016).
- **Salient features of Biomedical Waste Management Rules, 2016 (**issued in exercise of the powers conferred by **Environment (Protection) Act, 1986**) are:
  - The scope of the rules has been expanded to include **various health camps** such as vaccination camps, blood donation camps, and surgical camps.
  - Biomedical waste has been classified into **four categories based on color code-type** of waste and treatment options (see fig).
  - **Pre-treatment of the laboratory waste,** microbiological waste, blood samples and blood bags through disinfection or sterilization on-site.
  - **Provide training** to all health care workers and immunise all health workers regularly;
  - Establish a **Bar-Code System** for bags or containers containing bio-medical waste for disposal;
  - The new rules prescribe **more stringent standards** for incinerator to reduce the emission of pollutants in environment;
  - No occupier shall establish on-site treatment and disposal facility, **if a service of common bio-medical waste treatment facility is available at a distance of seventy-five kilometer.**
  - Operator of a common bio-medical waste treatment and disposal facility to ensure the **timely collection** of bio-medical waste from the Health Care facilities (HCFs) and assist the HCFs in conduct of training.



CPCB Guidelines for BMWM during pandemic

- CPCB issued separate guidelines for **'Handling, Treatment & Disposal of bio-medical waste generated during Treatment/Diagnosis/Quarantine of COVID-19 patients'** which gives guidance on management of COVID-19 related BMW including used masks and gloves.
  - As per Guidelines, used PPEs like face shields, goggles, used masks, head cover etc. generated from **COVID-19 isolation wards at Healthcare Facilities** shall be **segregated and sent to Common Facilities for disposal** as per BMWM Rules (2016).
  - However, used PPEs like masks and gloves generated in **Common Households, Commercial Establishments, Institutions, etc.**, are required to store **separately for minimum 72 hours for disposal** along with solid waste after cutting or shredding. Such shredded used masks from household can be collected as **dry solid waste by Urban Local Bodies (ULBs).**
- CPCB has issued **directions under section 5 of Environment (Protection) Act** to all State Pollution Control Boards (SPCBs)/ Pollution Control Committees (PCCs) to **ensure compliance** to guidelines.

Way Forward

- Key elements in **improving BMW management** are:
  - Building a **comprehensive system,** addressing responsibilities, resource allocation, handling, and disposal.
  - **Raising awareness** of the risks and of safe practices;
  - Selecting **safe and environmentally friendly** management options, to protect people from hazards when collecting, handling, storing, transporting, treating, or disposing of waste.
  - Government support for **universal, long-term improvement,** although immediate action can be taken locally.
- **Minimization/Recycling of BMW:** The reduction of waste generation must be encouraged by the following practices:

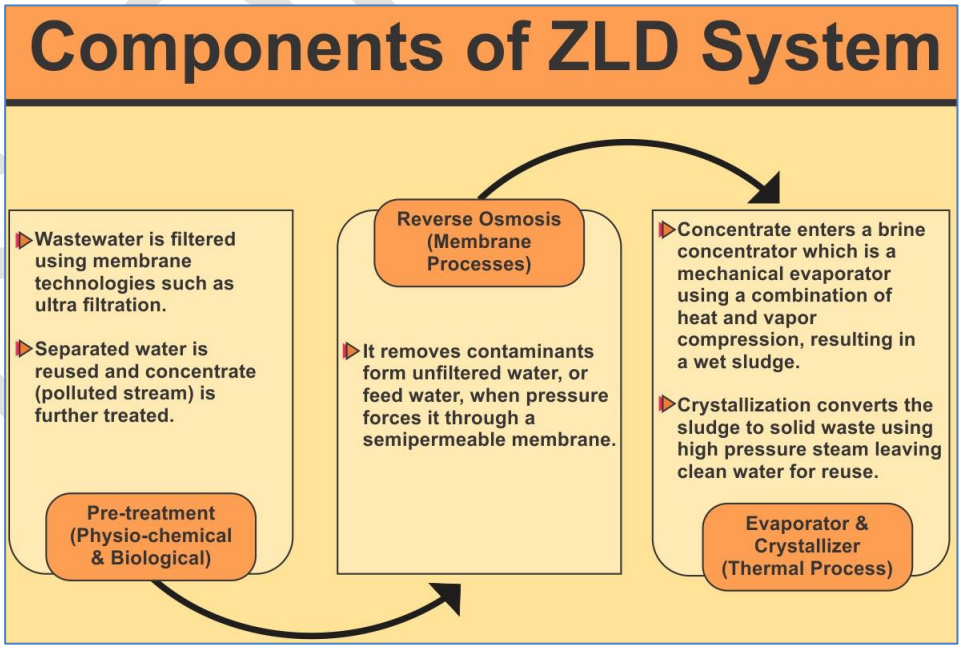
Reducing the amount of waste at source	• Choosing products that generate **less waste.** • Choosing suppliers who **take back empty containers** for refilling (cleaning products). • Choosing equipment that **can be reused.**
Purchasing policy geared to minimizing risks	• Opting for the **least toxic** products. • Purchase of **mercury-free** equipment.
Product recycling	• Recycling of **batteries, paper, glass, metals, and plastic.** • **Recycling of the silver** used in photographic processing.
Stock management	• Centralized purchasing. • Chemical and pharmaceutical stock management **aiming to avoid a build-up of expired or unused items:** "first-in—first out" stock management, expiry date monitoring. • Choice of suppliers according to **how promptly they deliver small quantities.**

BMW related international agreements and Conventions

- **Basel Convention on Hazardous Waste** to protect human health and the environment against the adverse effects resulting from the generation, management, and disposal of **hazardous wastes.**
  - As per WHO, of the total amount of waste generated by health-care activities, **about 85% is general, non-hazardous waste** comparable to domestic waste and remaining **15% is considered hazardous** material that may be **infectious, chemical or radioactive.**
- **Stockholm Convention on Persistent Organic Pollutants (POPs)** to protect human health and the environment from POPs (dioxins and furans). Toxic chemicals are formed by medical waste incinerators and other combustion processes.
- **Minamata Convention on Mercury** to protect human health and the environment from the adverse effects of mercury. It includes the **phasing out of certain medical equipment** in health-care services, including **mercury-containing medical items** such as thermometers and blood pressure device.
- **Blue book:** WHO handbook on **safe management of wastes from health-care activities.** Its second edition published in 2014 includes topics such as health-care waste management in emergencies, emerging pandemics, drug-resistant bacteria, and climate changes.

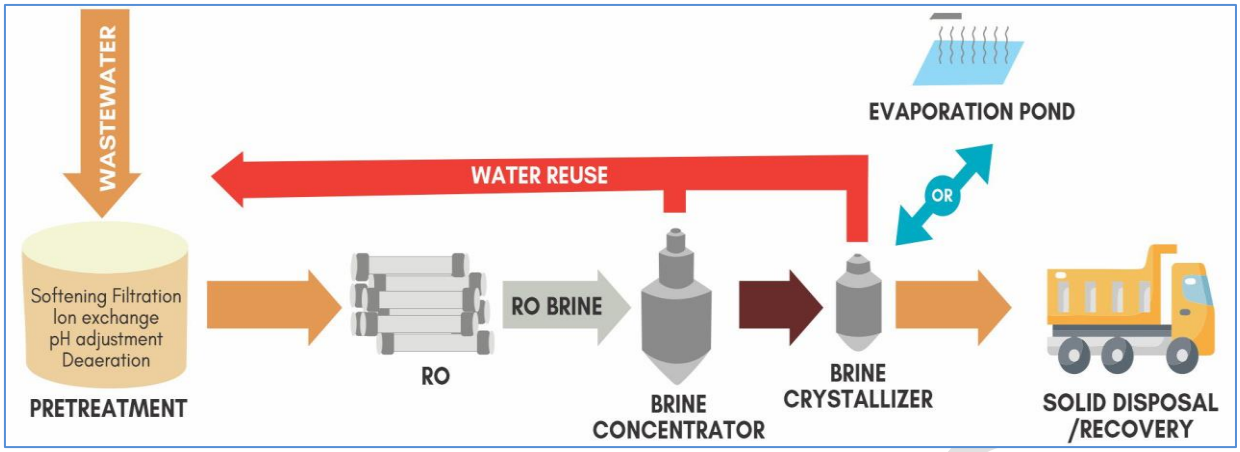
4.5.3. ZERO LIQUID DISCHARGE (ZLD)

The Centre is examining various options of moving forward on the country's ZLD policy trying to make a balance between the environmental protection and industrial development.



About ZLD

- ZLD is a **water treatment process** to recirculate all the water back to the process with zero liquid waste.
- A ZLD system involves a range of advanced **wastewater treatment technologies for treating water up to the level that can be reused inside the same Company.**



- **ZLD helps industries by**
  - **Protecting the public health:** By eliminating the need of discharging wastewater into ecosystem (nearby water bodies or on land, by enabling efficient recycling of wastewater streams).
  - **Reducing the water stress:** ZLD reduces the water demand from the Industry thereby contributing reduction in water stress also.
  - **Ensure production cost efficiency by recovering valuable products** from waste streams, such as, caustic soda, sodium sulphate, potassium Sulphate, gypsum and other heavy metals.

Challenges in adopting ZLD system for effluent management:

- **ZLD generates hazardous solid wastes** creating disposal challenges.
- Evaporators in ZLD system **consume a large amount of energy** thus increasing the carbon footprint. Also implementing ZLD increases the production costs 25%-30%.
- **Certain industries like semiconductors cannot reuse 'treated' wastewater** as they need ultra clean water.

Thus, it could be seen that ZLD system comes with certain environmental and economic cost. **Therefore, following alternatives can also be considered for sustainable management of industrial effluent discharge.**

- **Minimal liquid discharge (MLD):** MLD refers to water treatment processes where 70-95% of water is recovered (almost 100% water recovery in ZLD). The installation and maintenance cost of MLD system is far less than that of ZLD system. Thus MLD could be a better alternative to ZLD.
- **Deep-well injection:** Deep well injection is a liquid waste disposal technology. This alternative uses injection wells to place treated or untreated liquid waste into geologic formations that have no potential to allow migration of contaminants into potential potable water aquifers. Deep-well injection is easier and also less expensive than ZLD.
- **User specific norms:** ZLD is not suitable for industries that need ultra clean water (like semiconductors). These industries should be exempted from the obligation of 'reuse' of treated wastewater. However, even they must be mandated to treat their effluents before disposing them.
- **Discharge the effluents after primary and secondary treatment into the sea:** Releasing High TDS water in sea is a safe disposable method. So, industries that are near coastal areas should be allowed this method.
- **Hybrid of ZLD and Common Effluent Treatment Plants (CETPs):** CETPs are treatment systems specifically designed for collective treatment of effluent generated from small-scale industrial facilities in an industrial cluster. ZLD Systems could also be integrated with the CETP to make the effluent treatment and reuse of the wastewater cost efficient for small scale industries also.

Conclusion

Failing to address wastewater as a social and environmental problem would nullify other efforts towards achieving 2030 Agenda for Sustainable Development. Similarly, too strict effluent discharge norm would hamper the economic growth. Hence, an integrated approach is needed to address the challenges of industrial development, deteriorating water quality, and rising water stress in a holistic manner.

5. RENEWABLE ENERGY AND ALTERNATIVE ENERGY RESOURCES

RENEWABLE ENERGY AT- A- GLANCE

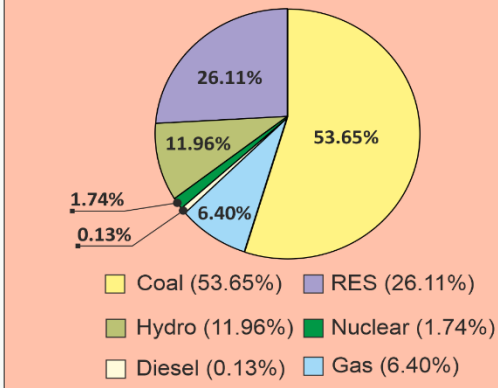
TARGETS

- 50% of energy requirements will be met from renewable energy by 2030.
- 500 GW of non-fossil energy capacity to be installed by 2030.
- 227 GW of renewable energy capacity to be installed by the year 2022.

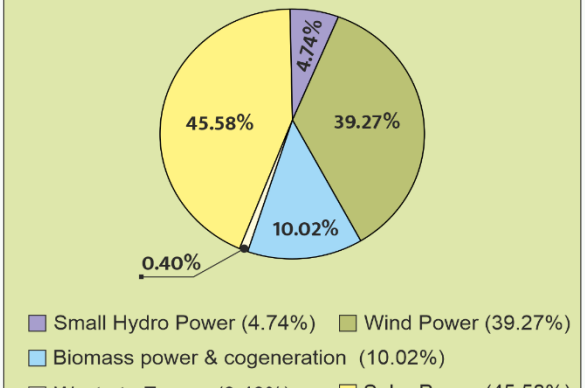
CURRENT SITUATION

- India stands at 4th position in the world in terms of installed RE capacity 5th in Solar and 4th in Wind energy capacity.

Installed Capacity Categorywise (Sep-2021)



Installed Capacity of Renewable Energy Sources (Sept 2021)



RENEWABLE ENERGY AT- A- GLANCE

CHALLENGES

Solar energy (Grid connected and Off-grid)	Wind energy (Onshore and Offshore)	Small Hydro energy	Waste to energy	Bio Energy (Bagasse & Non-Bagasse)	Other: Ocean Energy, Hydrogen Energy, Geothermal
» Unsustainably Low tariffs » Dependence on imports for components	» Impact on local birds & wildlife » Profitable only for large scale projects » Topographic and geological limitations	» Sedimentation » Displacement » Environmental concerns » Disrupted Supply due to low flows	» Poor quality of municipal waste » Weak supply chain » Environmental and health impacts	» Non-availability and high procurement cost of biomass	» Scarcity of cost-competitive and scalable projects

» Intermittent supply.
» Lack of power storage at an affordable cost.

- » Land acquisition issues
- » High initial cost of installation
- » Low investment in R&D related to RE leading to technological backwardness
- » Shortage of skilled labour
- » Difficulties in Grid integration
- » Lack of information and awareness about benefits and need of RE

SCHEMES/POLICIES

- » National Solar Mission
- » PM KUSUM
- » Atal Jyoti Yojana (AJAY)
- » Grid Connected Solar Rooftop Scheme
- » National Programme on High Efficiency Solar PV (Photo Voltic) Modules
- » Solar Parks and Ultra Mega Solar Power Projects
- » Suryamitra Skill Development Programme
- » National offshore wind energy policy
- » Small Hydro Power Programme
- » Programme on Energy from Urban, Industrial and Agricultural Wastes/ Residues
- » Scheme to Support Promotion Of Biomass Based Cogeneration In Sugar Mills And Other Industries In The Country
- » Biogas based Power Generation (Off-grid) and Thermal Application Programme
- » National Biogas and Organic Manure Programme (NNBOMP)

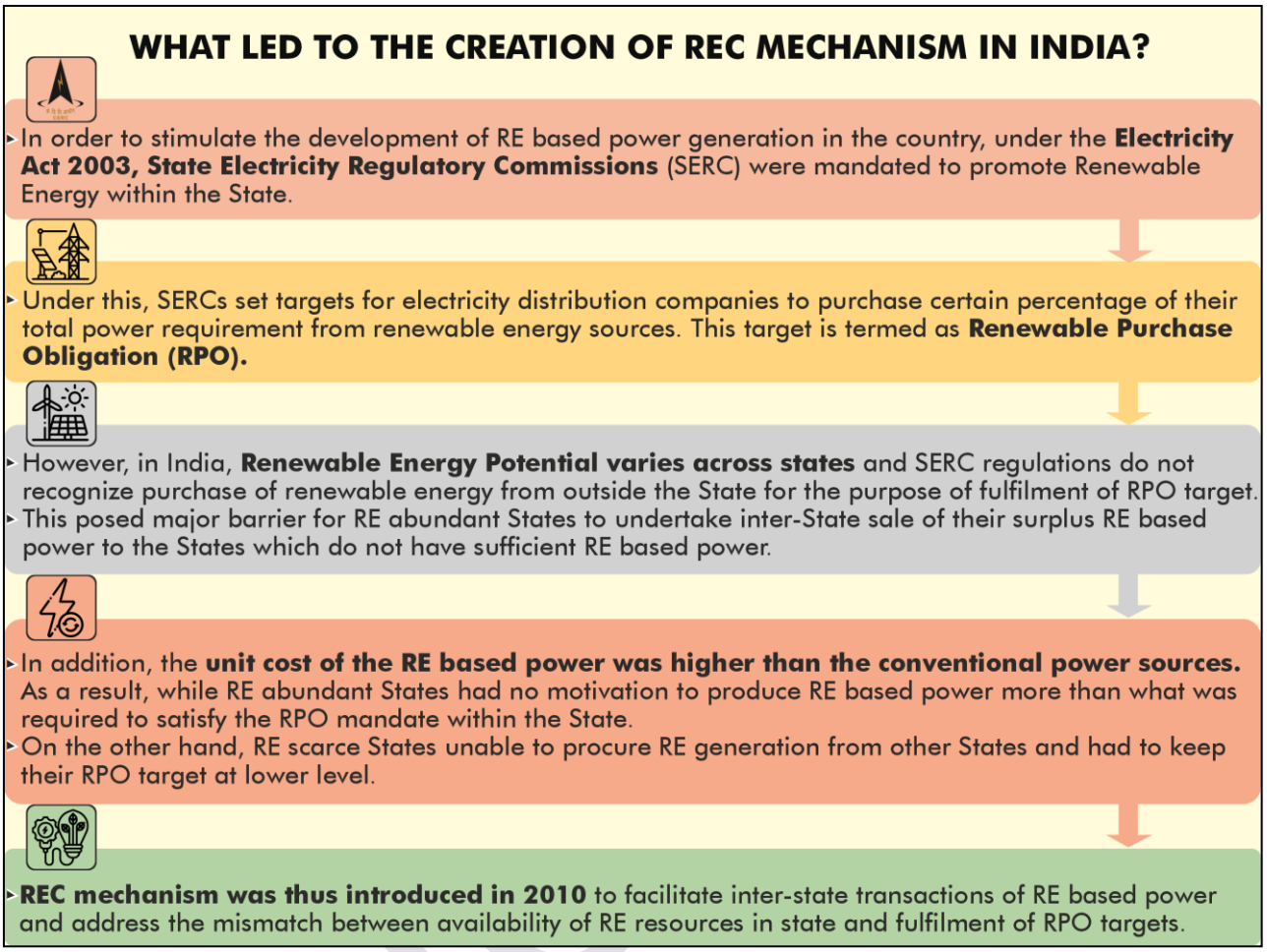
WAY FORWARD

- » **Higher allocation for clean energy from governments**, via subsidies and other measures.
- » **Revise tariff structures** to make renewable energy profitable and promote private investment.
- » **Invest in R&D** in renewable energy Technologies.
- » **Develop suitable grid infrastructure**.
- » **Explore Hybrid renewable energy systems** to tackle fluctuations.
- » **Conduct awareness generation programmes**.
- » **Appropriate training and skills development** among Indian workforces.
- » **Push for technology transfers** from Developed nations for elements such as battery and storage systems under international frameworks.
- » **Promote innovation and entrepreneurship** in new and upcoming renewable technologies.

5.1. RENEWABLE ENERGY CERTIFICATE (REC)

Why in news?

Ministry of Power redesigned Renewable Energy Certificate (REC) Mechanism to boost green economy.



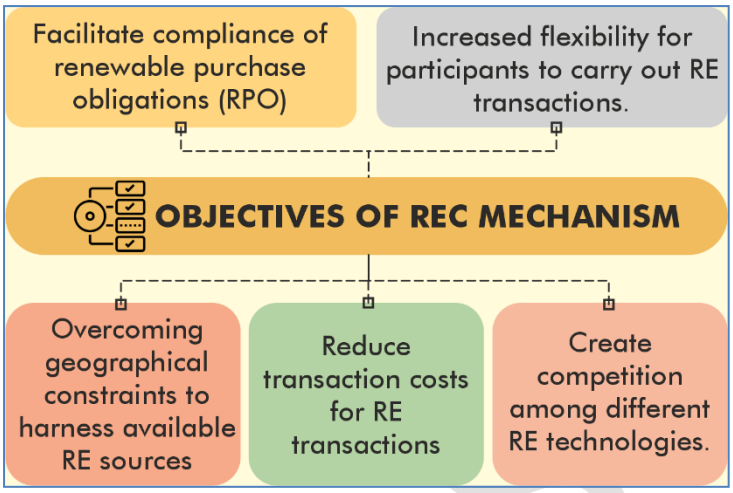
About Renewable Energy Certificates (REC)

- Renewable Energy Certificate (REC) also called as **Renewable Energy Credit,** is a **market based instrument** where the owner of the REC can legally claim to have purchased renewable energy.
- **One Renewable Energy Certificate (REC) is treated as equivalent to 1 MWh.** In other words, it represents the environmental benefits associated with one Megawatt-hour of electricity generated from a renewable energy resource.
- There are **two categories of RECs**, viz.,
  - **Solar RECs:** issued to eligible entities for generation of electricity based on solar as renewable energy source
  - **Non-solar RECs:** issued to eligible entities for generation of electricity based on renewable energy sources other than solar.
- RECs are traded in power exchange within the **forbearance price and floor price determined by Central Electricity Regulatory Commission (CERC)** from time to time.
- **National Load Despatch Centre (NLDC)** is responsible for registration of Renewable Energy Generation Facilities, issuance of Renewable Energy Certificates etc.
- **The distribution companies, Open Access consumer, Captive Power Plants (CPPs)** are eligible of purchasing the REC.

Need to redesign REC mechanism

- **To align with the emerging changes in the power scenario:**
  - Maturity of technologies like solar PV etc., due to technology advancement, economies of scale and market competitiveness has resulted in a **declining trend of prices of solar and wind energy** unlike in the inception stage.

- **Renewable Energy Management centres** (REMCs) have been commissioned for better forecasting and scheduling.
- **Power exchanges are in place for an alternate mechanism to sell and buy RE power** through various products viz Day Ahed Market (DAM), Term Ahead Market (TAM), Green Term Ahead Market (GTAM), Real Time Market (RTM) etc., in addition to REC mechanism.



- **To promote new and high cost RE technologies** like Off-shore wind, Pumped Storage Hydro power Station, Hydrogen, etc. so as to maintain the future energy security.
- **To deal with challenges associated with REC market:**
  - **Excess supply over demand resulted in REC prices remaining close to the floor price.**
  - **Low compliance of RPO among states.**

CHANGES INTRODUCED IN THE REVAMPED REC MECHANISM ARE:

- **Validity of the REC is now perpetual** till it is sold. (Presently the validity of an REC is 3 years).
- **Removal of the floor and forbearance (maximum) prices** of REC.
- **Monitoring and surveillance mechanism** to ensure that there is no hoarding of RECs.
- **REC will be issued to the eligible RE generators for the period of the power purchase agreement (PPA).** (Existing RE projects eligible for REC would continue to get RECs for 25 years).
- **Technology multiplier** for promotion of new and high priced RE technologies.
- **RECs can be issued to obligated entities beyond their RPO targets.**
- **No REC to be issued to the beneficiary of subsidies**/concessions or waiver of any other charges.
- **Allowing traders and bilateral transactions in REC mechanism.**

Conclusion

The energy mix in India is rapidly changing from fossil fuel dominance to increasing non-fossil fuel share. With an impetus on promoting RE, Pan-India market-based REC Mechanism was introduced and has achieved success in a very short span of time.

The current REC framework therefore needs to be revised periodically to meet the ever growing demand of RE market and meet the climate change obligations.

5.2. HYDROGEN BASED ENERGY

Why in news?

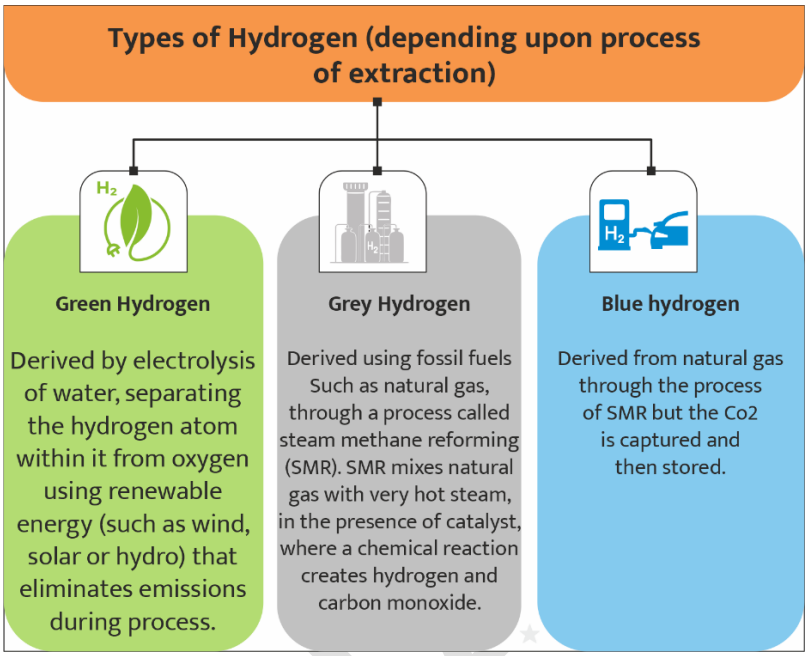
Indian firms such as NTPC Ltd, Indian Oil Corporation, Acme Solar and Greenko are looking at hydrogen as a new business opportunity for extracting energy.

Data Bank
Hydrogen has the highest energy per mass of any fuel, almost three times more than diesel or gasoline

About Hydrogen as fuel

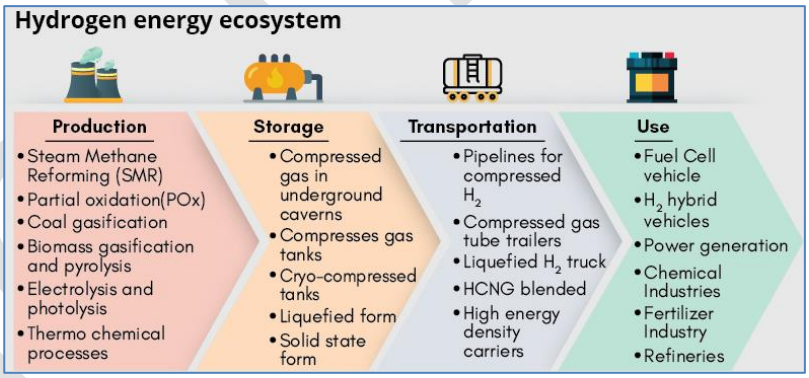
- Hydrogen (H_2) is an **alternative fuel** that can be produced from diverse domestic resources.
  - It is abundant in our environment and it's stored **in water (H_2O), hydrocarbons (such as methane, CH_4), and other organic matter.**
  - Hydrogen is an **energy carrier that can be used to store, move, and deliver energy** produced from other sources.
  - Hydrogen with its **abundance, high energy density, better combustion characteristics**, non-polluting nature etc. has vast advantages over the conventional fuels.

- Hydrogen economy will be a **cornerstone of the future energy system** which can substitute the conventional fuels.
- Most of Hydrogen is presently being produced from fossil fuels — 76% from natural gas and around 23% from coal, with the remaining from electrolysis of water.
    - In India, **hydrogen is being commercially produced in the fertilizer industry, petroleum refining and chemical industries** and also as a by-product in chlor-alkali industries.
    - Cleaner methods of hydrogen production chiefly constitute **electrolysis, via chemical or photoelectrochemical routes.**

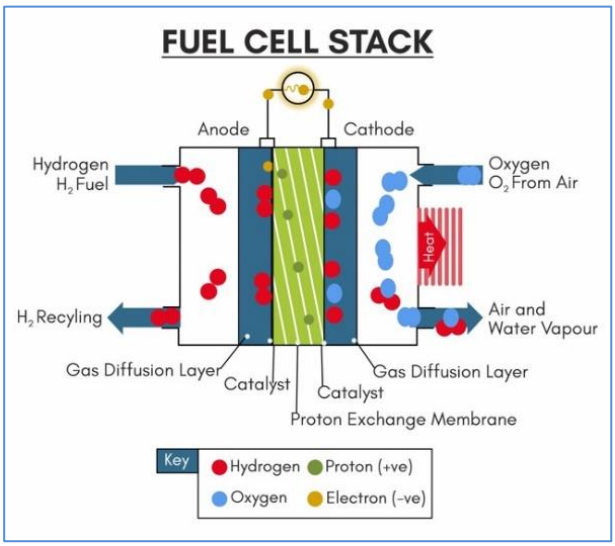


Application of hydrogen:

- **Fuel cell:** Hydrogen fuel cell systems are used for generating electricity, in vehicular applications (Fuel cell cars, buses, etc.) and portable devices (Laptops, phones, etc.)
    - A **fuel cell is a device that generates electricity by a chemical reaction.** An electrolyte (membrane) carries electrically charged particles from one electrode to the other (anode and cathode), as well uses catalysts to speed up the reactions and produce electricity at the electrodes.
    - **Only water vapour and heat** are emissions from fuel cell.



- **Direct fuel in internal combustion (IC) engine vehicles:** Hydrogen is used as an energy carrier directly in IC engines and turbines in place of fossil fuels or as blended mixture with fossil fuels.
    - **Eg. H-CNG,** the is hydrogen enriched compressed natural gas upto 30%, with better power output, 4% more fuel economy and 70% more reduction in carbon monoxide emissions than CNG.
- **Chemical industries, Fertilizer industries, refineries:** Hydrogen is used as a raw material in the fertilizer, chemical and petroleum refining industries as it is a fundamental building block for the manufacture of ammonia.



Advantages of hydrogen-based energy:

- **Reduced imports.**
- **Non-polluting & decarbonising:** Leaves only water vapour and heat as emissions.
- **Abundance:** Can be produced locally from numerous sources like methane, gasoline, biomass, coal or water.
- **High efficiency and High energy density.**

Challenges in growth of Hydrogen based economy

- **Energy intensive production:** E.g. green hydrogen requires a massive expansion of renewable generation to power the electrolysis plants that split water into hydrogen and oxygen.
- **Emissions in Grey Hydrogen:** Natural gas reforming process (methane reforming) to produce grey hydrogen requires a fossil-fuel and emits carbon monoxide and carbon dioxide.
- **Storage:** Hydrogen requires compression to 700 times atmospheric pressure, refrigeration to -253 degree Celsius. It can embrittle metal and is more explosive.
- **Additional costs:** Transmission & Distribution (T&D) costs and cost of production are high.
- **Code of standard:** Requires of code and standards to get a sort of consistency and encourage deployment.

Government Initiatives/Schemes/Policies

- **National Hydrogen Energy Board:** It was set up in 2003 to prepare, implement and monitor the National Hydrogen Energy Road Map and the National Hydrogen Energy and Fuel Cell Programme.
- **National Hydrogen Energy Roadmap**: It was laid in the year 2006 to provide a blueprint for hydrogen energy development in the country.
- **High level steering committee:** It was constituted under the chairmanship of Dr. K. Kasturirangan for Hydrogen and Fuel cells, committee prepared comprehensive reports on different themes like hydrogen production, storage, utilization, transport, safety and standards.
- **Mission Innovation:** It is global initiative to accelerate global clean energy innovation, which include innovation challenge on renewable and clean hydrogen and India is participating in this challenge.
- Renewable Energy Limited (REL), a 100% subsidiary of National Thermal Power Corporation (**NTPC**), **signed an MoU with the UT of Ladakh**, to set up the **country's first green Hydrogen Mobility project** by plying hydrogen buses and setting up solar plant and green hydrogen generation unit in Leh.
- To tap the opportunities in India's **hydrogen economy and supply chain**, a number of industries have come together to commercialize hydrogen technologies under **India H_2 Alliance (IH_2A).**

Way forward

- **Development of code of standards** will help in dealing with Hydrogen vehicles in particular and help in progress of Hydrogen economy in a smoother way.
- **Advanced research and technology developments** are necessary to improve the efficiency of fuel cells, tolerant to impurities, use of non-precious metals as catalyst etc.
- **Need to develop safe and cost-effective solid-state storage methods** using development of carbon nanostructures to achieve the desired storage goals.
- **Major R&D programmes should be introduced** linking with applications which may have market acceptance. For this, large number of demonstrative projects should be supported by Department of Science & Technology in production, storage and application areas in addition to usual development projects.
- **Generation of hydrogen from renewable sources** should be encouraged and Government should explore policies for subsiding hydrogen price generated from renewable.

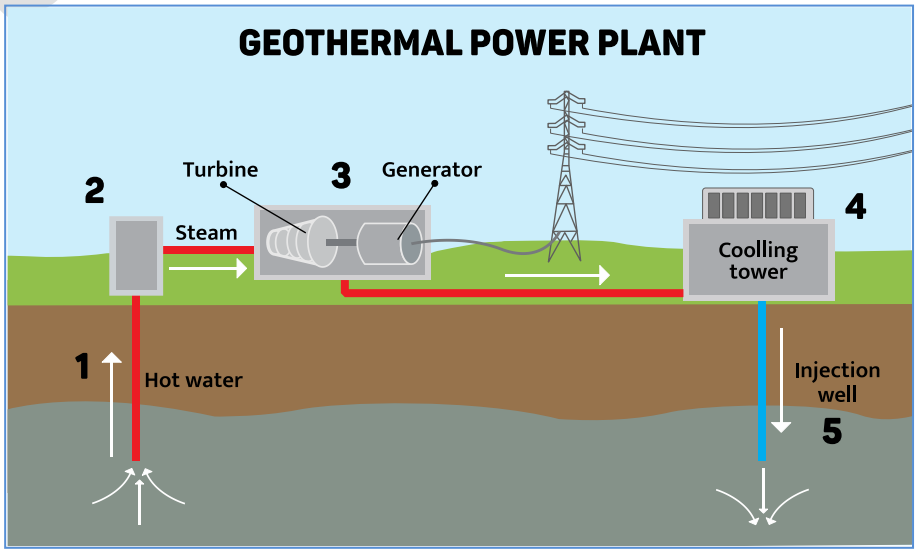
5.3. GEOTHERMAL ENERGY

Why in News?

An agreement for establishing **India's first-ever geothermal field development project** in Leh has been signed.

What is Geothermal Energy?

- Geothermal energy is the thermal energy generated and **stored inside the Earth's crust.** Geothermal power is the electricity generated from the heat source within the earth's crust.



- This geothermal **energy originates from the geological processes** during formation of the planet, radioactive decay of minerals, and from solar energy absorbed at the surface.
- Geothermal energy is converted into electricity in following ways.

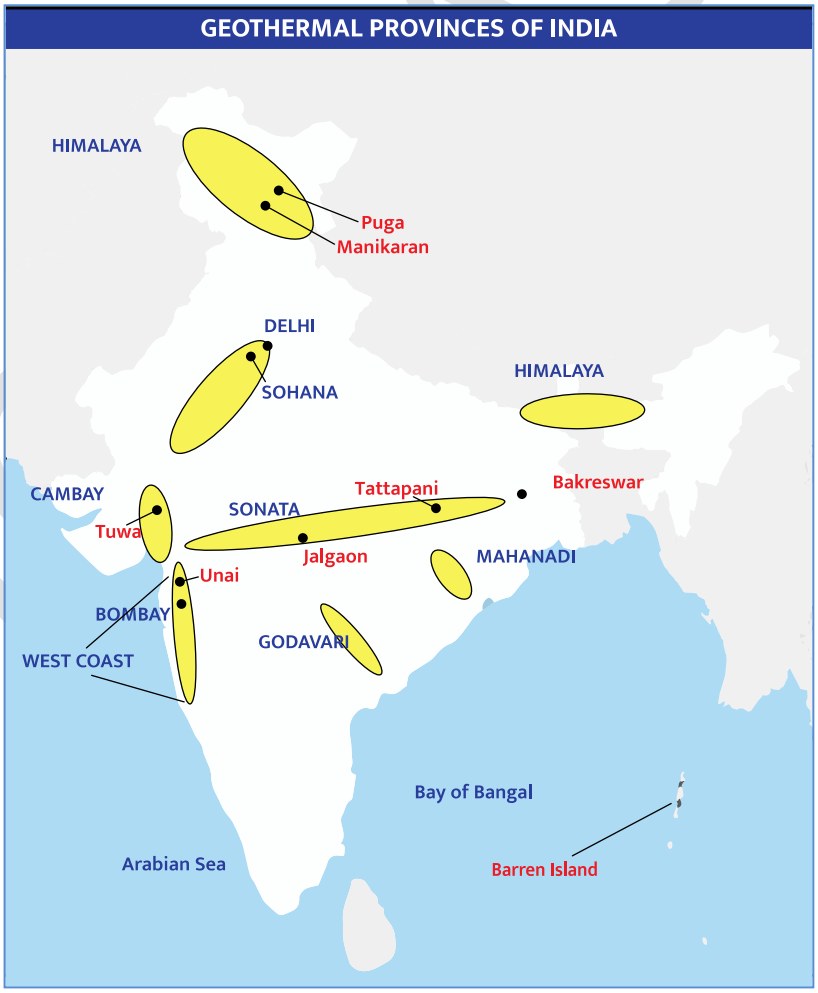
Dry steam plants	Flash steam plants	Binary cycle plants
Hot steam is piped directly from geothermal reservoirs into generators in the power plant. The steam spins turbines, which generate electricity.	Hot water is brought up through a well. Some of the water turns to steam, which drives the turbines. When the steam cools it condenses back into water and is returned to the ground.	These operate on **water at relatively lower temperatures**. These plants use the heat from the hot water to boil a liquid that boils at a lower temperature than water. When the fluid is heated it turns to steam and spins the turbines.

Geothermal energy in India

- GSI (Geological Survey of India) has identified 350 geothermal energy locations in the country which have a potential of 10000 MW GE power.
- **There are seven geothermal provinces in India:** Himalayas - Ladakh, Manikaran, Tapoban; Sohana - Haryana, Rajasthan; West coast – Maharashtra; Cambay – Khambet; Son-Narmada-Tapi (SONATA) - Tatapani, Anhoni-Samoni; Godavari – Manuguru; Mahanadi – Bakreshwar. (see map)

Uses of Geothermal energy (GE)

- **For houses:** To heat/cool down temperature in house during winter/hot seasons.
- **For Agricultural Farms:** used by farmers to **heat their greenhouses.** This makes it possible **to grow tropical plants such as citrus trees in the middle of the winter.**
- **For aquaculture:** Geothermal energy **is necessary is in fish farms.** Tropical fish and other aquatic animals need warm water to survive and geothermal energy system is a suitable way to provide it.
- **For Industries:** It can be used in the process of extracting precious metals from ore.
- **For Infrastructure:** It is a great source for preventing sidewalks and roads from freezing in winter. Ex. Netherlands has started to use geothermal energy to keep bike roads from icing in the colder seasons.



Advantages of Using Geothermal energy

- **Low carbon footprint:** Pollution is relatively minimal when compared to fossil fuels.
- **Renewable in nature:** The constant flow of heat from the Earth makes it inexhaustible and limitless.
- **Stable and Reliable:** GE **does not fluctuate, and the resource is always available to be tapped into,** unlike with wind or solar energy.
- **Fulfill energy need of remote locations**.
- **High Efficiency:** Geothermal heat pump systems use **25% to 50% less electricity** than conventional systems for heating or cooling, and require **less space for hardware** as opposed to conventional systems.

- **Minimal Maintenance:** Geothermal systems have only few movable parts therefore **the life span is relatively high**.
- **By-products:** Mineral by-products from hot springs like silica, borax, cesium etc. may be exploited.

Disadvantages of Geothermal energy

- **High Investment Costs:** The cost of drilling wells to geothermal reservoir is very expensive. Added to that is the cost of heating, and cooling system installation and the cost goes even higher.
- **Location specific**: Geothermal plants must be installed in locations that have access to energy, which ensures that certain regions cannot take advantage of this benefit.
- **Environmental Concerns about Greenhouse Emissions**: The gases stored under Earth's surface are released into the atmosphere during digging. While these gases are also released into the atmosphere naturally, the rate increases near geothermal plants.
- **Surface instability and Earthquakes**: Geothermal energy runs the risk of triggering earthquakes as geothermal power plant construction involves drilling hot rock that contains trapped water or steam in its pore spaces.
- **Sustainability issues**: Though most geothermal reservoirs are permanent; they can be depleted if the water is extracted faster than it can replenish itself.

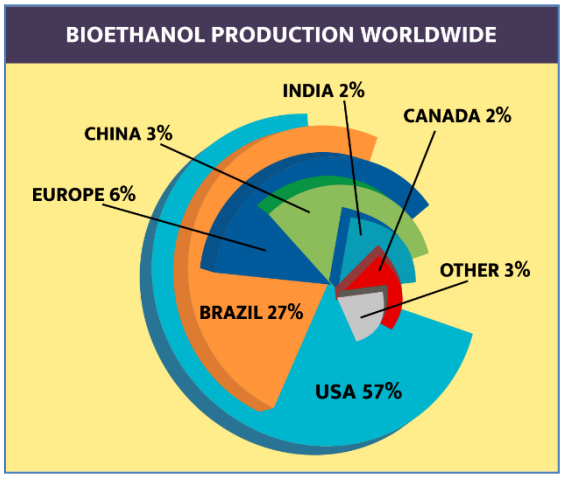
Government initiative to promote Geothermal Energy

- **Draft Indian geothermal energy development framework released by Ministry of New & Renewable Energy. Key goals include:**
  - Deployment of 1,000 MW (thermal) and 20 MW (electric) Geothermal Energy Capacity in the initial phase till 2022 and 10,000 MW (thermal) & 100 MW (elect) by 2030.
  - International collaboration to Harness 10,000 MW (10 GW) of geothermal energy by 2030 through active international collaboration with countries such as the US, Philippines, Mexico and New Zealand.
- **Draft National Policy on Geo-Thermal Energy** which envisions to establish India as a global leader in Geo-thermal power by deployment of Geo-thermal energy capacity of 1000 MW in the initial phase till 2022.
  - It proposes to **assess the potential of geothermal resources in country** and promoting R&D projects of Power production and Geo-exchange Pumps.

5.4. ETHANOL BLENDING IN INDIA

Why in News?

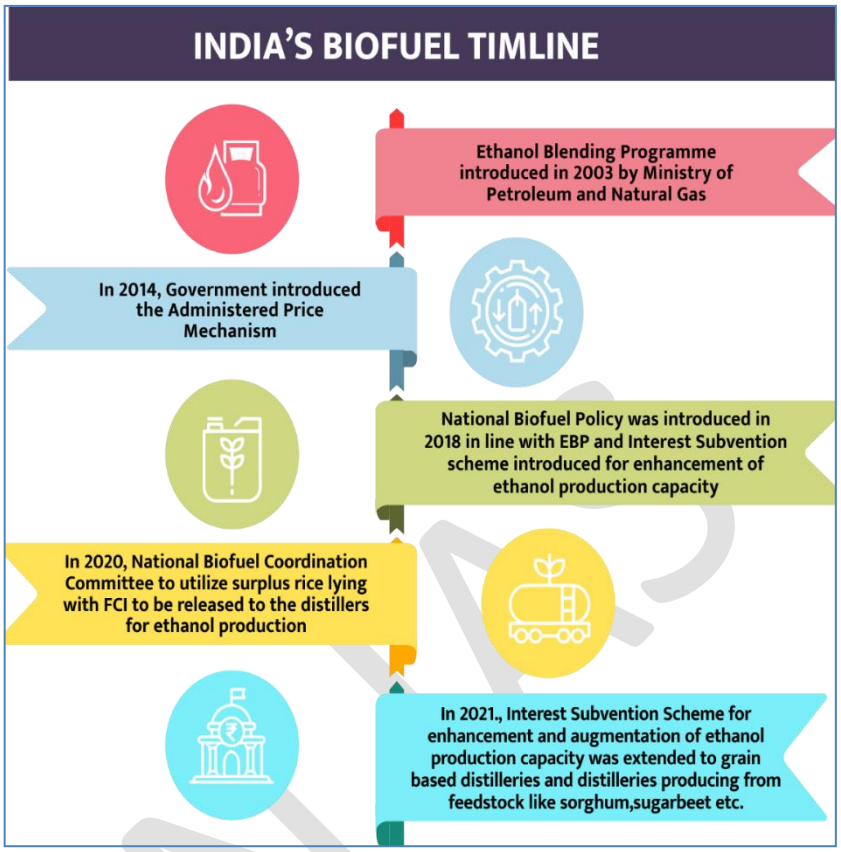
Recently, the central government has **advanced the target of 20% ethanol blending** in petrol (also called as E20)**, by five years to 2025, from 2030**.



More in News

- The Government has also released an **expert committee report** on the **'Roadmap for Ethanol Blending in India by 2025'**.
  - It proposes a **gradual rollout of ethanol-blended fuel to achieve E10 fuel supply by April 2022 and phased rollout of E20 from April 2023 to April 2025.**
  - Earlier, **National Biofuel Policy 2018 had envisaged an indicative target of 20% blending of ethanol in petrol and 5% blending of biodiesel in diesel by 2030.**
  - In 2020, **India had set a target of 10% ethanol-blending in petrol by 2022, 20% ethanol-blending in petrol by 2030 and 10% ethanol-blending in diesel by 2030.**
- It also recommends **introducing vehicles** that are compatible by **rolling out of E20 material-compliant and E10 engine-tuned vehicles from April 2023 and production of E20-tuned engine vehicles from April 2025.**
  - These efforts will **facilitate setting up of additional ethanol distillation capacities** and will provide timelines for **making blended fuel available across the country**.

- It will also **help increase consumption of ethanol** in the ethanol producing states and the adjoining regions before the year 2025.



What is ethanol blending?

- An ethanol blend is defined as a **blended motor fuel containing ethyl alcohol** that is at least 99% pure, derived from agricultural products, and blended **exclusively with gasoline.**
  - Since it is plant-based, it is **considered to be a renewable fuel.**
- Government has allowed ethanol production/ procurement from **sugarcane-based raw materials** viz. C & B heavy molasses, sugarcane juice / sugar / sugar syrup, **surplus rice with Food Corporation of India (FCI) and Maize**.
- The Oil Marketing Companies are to procure ethanol from domestic sources and blends ethanol at its terminals.
  - Government has been notifying administered price of ethanol since 2014.
- **Department of Food and Public Distribution (DFPD)** is the nodal department for promotion of fuel grade ethanol producing distilleries in the country.

Government Initiatives/Schemes/Policies

- Under **PM-JIVAN (Jaiv Indhan- Vatavaran Anukool fasal awashesh Nivaran) Yojana,** 12 commercial plants and 10 demonstration plants of Second Generation (2G) Bio-Refineries are envisaged to be set up in areas having sufficient availability of biomass so that ethanol is available for blending throughout the country.
- **2G plants utilise surplus biomass and agricultural waste** to produce bioethanol.
- Cabinet Committee on Economic Affairs (CCEA) approved ₹8,460 crore **Modified scheme for extending interest subvention for those setting up standalone ethanol distilleries** using grain, molasses, dual feed, sugar beet, sweet sorghum and cereals as a feedstock.
  - The focus is on **increasing India's ethanol production capacity.**
- Prime Minister has launched a **Pilot Project of E 100 dispensing stations at three locations in Pune.**

Significance of ethanol blending

- **Reduce Pollution:** By blending ethanol with petrol, **fuel mixture is oxygenated so it burns more completely and reduces polluting emissions.**
  - Using bioethanol in older engines can **help reduce the amount of carbon monoxide produced by the vehicle** thus improving air quality.
- **Carbon Neutral:** Combustion of ethanol made from biomass (such as corn and sugarcane) is considered atmospheric carbon neutral because as the biomass grows, it absorbs CO_2, which may offset the CO_2 produced when the ethanol is burned.
- **Help lower India's energy import dependency.**
- **Farmer's Income:** Increase in demand of ethanol will **benefit the sugarcane farmers.**
- **International commitment:** It helps India to fulfil its pledge to reduce its carbon footprint from the 2005 levels by 33-35% by 2030, as part of its commitments to the United Nations Framework Convention on Climate Change adopted under the Paris Agreement.

Challenges

- **Use of E20 will require Modification of vehicles.**
- **Cost of E20 compatible vehicles is expected to be higher** above the cost of conventional vehicles.

- **Water Footprint:** Sugarcane, a **water intensive crop**, continues to be the most lucrative food crop for ethanol.
- **Lack of Ethanol production facilities and capacity to fulfil target**.
- **Prices of ethanol produced in India are higher in comparison to global players**, since the cost of raw materials like sugarcane and food grains are fixed by the government to support the farming community.
- **Restrictions on inter-state movement** of ethanol due to non-implementation of the amended provisions of Industries (Development & Regulation) Act, 1951 by all the States.
- **Non-Availability of ethanol across the country:** Ethanol is not produced or available in some states for blending and about 50% of total pump nozzles in India are supplying only E0.
  - Also, blending has not been taken up in **North-East states due to non-availability of feedstock or industries**.
- **Transport of ethanol** to different places for blending will **increase the cost of logistics** and **transport related emissions**.

Way forward

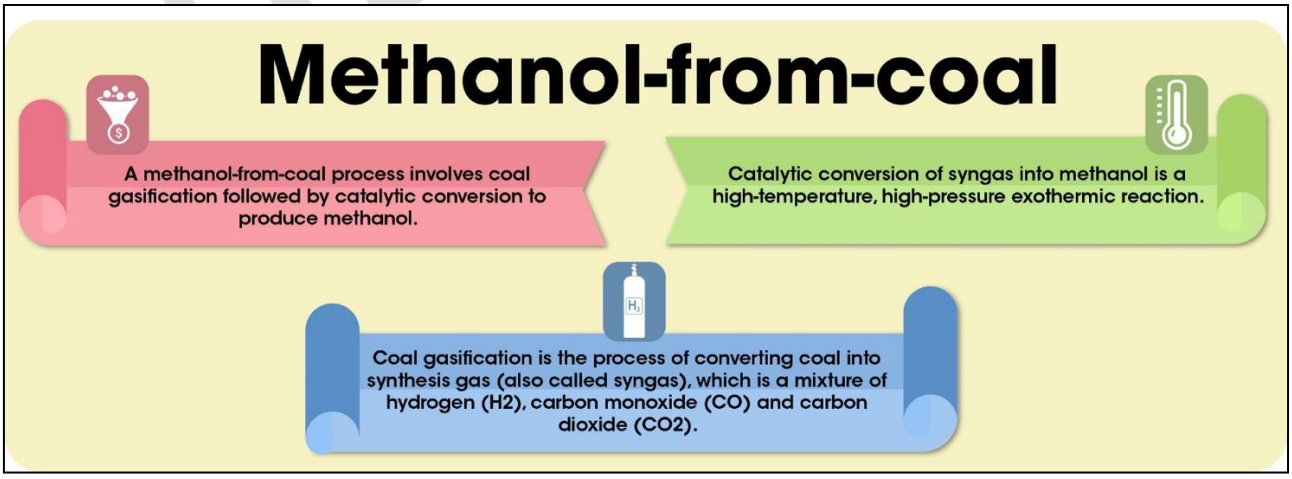
- **Pricing of Ethanol blended fuel**: For better acceptability of higher ethanol blends in the country, **retail price of such fuels should be lower than normal petrol** to compensate for the reduction in calorific value.
- **Diversify Crops:** There is need to explore the feasibility of other grains which can supplement sugar in ethanol production to meet the 2025 targets.
- **Incentives for EBP vehicles:** Globally, vehicles compliant with higher ethanol blends are provided with tax benefits.
- **Technology Upgradation:** Technology for production of ethanol from non-food feedstock should be promoted so as to tap abundantly available resource without causing any tradeoff with the food production system.
- **Ensure timely availability**: OMCs need to set up ethanol distillation facilities and need to provide timelines for making blended fuel available across the country.
  - The blending percentage of ethanol with petrol has gone up from 1.53% in 2013-14 to 8.5% in 2020-21.
- **Government support to enhance production:** Experts point out that many sugar mills which are best placed to produce bioethanol do not have the financial stability to invest in biofuel plants.

5.5. METHANOL ECONOMY

Why in News?

Recently, India's first Indigenously Designed High Ash Coal Gasification Based Methanol Production Plant was inaugurated at BHEL R&D Centre, Hyderabad.

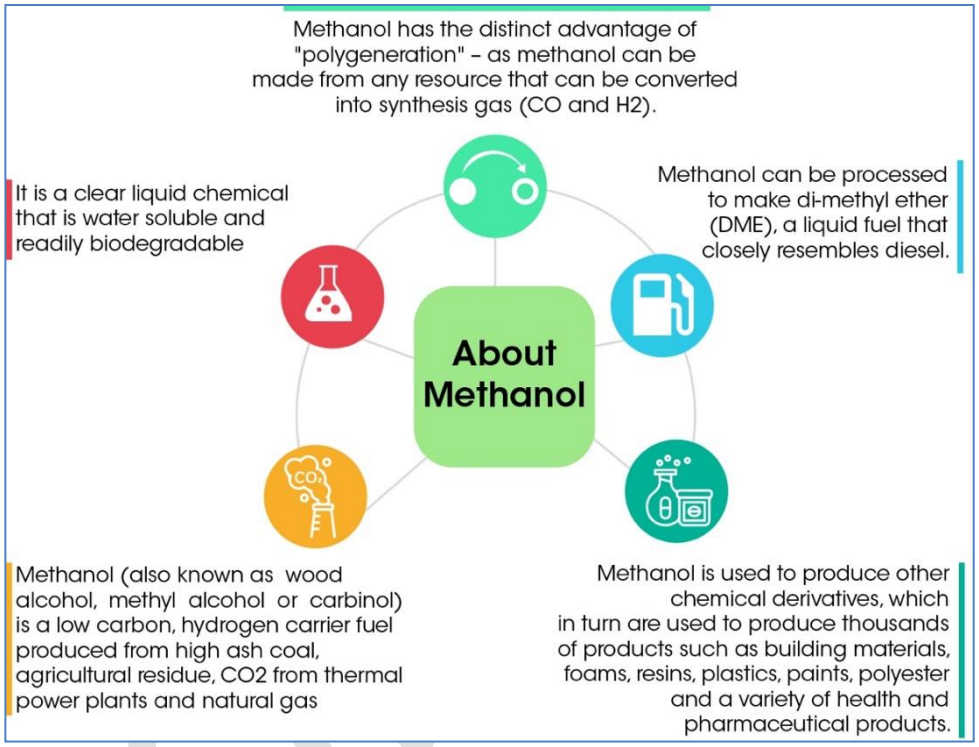
About methanol Economy



Methanol Economy is **based on the concept of replacing dependence on oil and coal with methanol.** It provides **following benefits:**

- **Energy Security:** Although slightly lower in energy content than petrol and diesel, methanol can replace both these fuels in:
  - Transport sector (road, rail and marine),
  - Energy sector (comprising DG sets, boilers, process heating modules, tractors and commercial vehicles) and
  - Retail cooking (replacing LPG [partially], kerosene and wood charcoal).
  - Gaseous version of DME can blended with LPG and can be excellent substitute for diesel in large buses and trucks.

Data Bank
Blending of 15% methanol in petrol will reduce pollution by 33% & diesel replacement by methanol will reduce pollution by more than 80%.



- **Reducing import dependency.**
- **Cheaper than conventional fuel.**
- **High efficiency** fuel.
- **Boost to Make in India:** Producing fuel indigenously and associated growth in automobile sector will add engineering jobs and also encourage investments in Methanol based industries .
- **Low Pollution:** Methanol burns efficiently in all internal combustion engines, produces no particulate matter , no soot , almost nil SOx and NOx emissions.

Challenges to methanol economy

- Due to the **high ash percentage of Indian coal**, most internationally accessible technology will not be adequate for our demands.
- Since **India doesn't have much of the natural gas reserves**, producing methanol from imported natural gas lead to outflow of foreign exchange and sometimes uneconomical due to excessive prices of natural gas.
- **Risks associated with transportation- corrosivity and materials compatibility, low energy content, Fire risks and toxicity.**
- **Methanol gets less gas mileage**, so it would require more frequent fuelling.
- **High costs of plunging in new technology** required for methanol production.

Government Initiatives/Schemes/Policies

- **NITI Aayog's road map for Methanol Economy**
  - Substitute 10% of Crude imports by 2030, by Methanol alone.
  - 20MT of methanol annually can be produced @ Rs. 19 a litre by 2025 by using Indian High Ash coal, Stranded gas, and Biomass
- **Methanol Economy Research Programme**, by Department of Science and Technology, for production of Methanol from various sources including Indian coal and CO_2 from thermal plants, steel plants etc.
- **Bureau of Indian Standards has notified 20% DME blending with LPG**, and a notification for M-15, M-85, M-100 blends has been issued by the Ministry of Road, Transport and Highways.
- **Test standards and plans for the M-15 blend are being evolved** in consultation with the Indian Oil Corporation Limited, Automotive Research Association of India and Society of Indian Automobile Manufacturers.
- **Railway is working towards blending methanol** in the range of 5-20% through direct fuel injection in locomotives.
- In 2018, Assam Petrochemicals launched **Asia's first canister-based methanol cooking fuel programme.**

Conclusion

Growing recognition of the **threat posed by man-made climate change** has spurred government institutions, industry and science **to find clean fuels to power economic activity.**

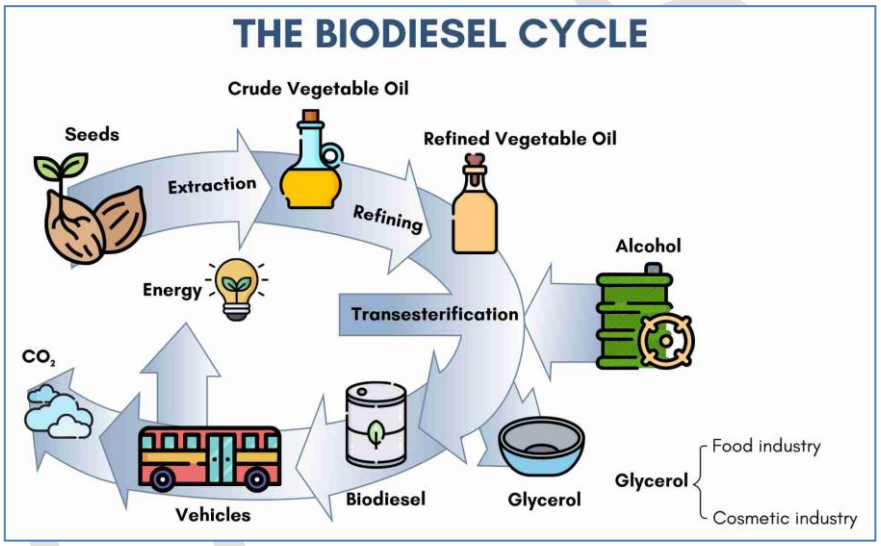
In this context, **methanol has risen as a clean alternative to fossil fuels,** offering a clear pathway to drastically cutting emissions in power generation, overland transportation, shipping and industry

India, with 125 Billion Tonnes of proven Coal reserves and 500 million tons of Biomass generated every year & the huge quantities of Stranded & Flared gases **has a huge potential for ensuring energy security based on Methanol.**

5.6. USED COOKING OIL BASED BIODIESEL

Why in News?

Recently, Indian Oil Corporation has kicked-off the supply of diesel that is blended with biodiesel made from used cooking oil.



About Used Cooking Oil (UCO)

- UCOs are oils and fats that have been used for cooking or frying in the food processing industry, restaurants, fast foods and at consumer level, in households.
  - UCO must contain only fats, oils, or greases **that were previously used for cooking or frying operations**.
- UCO is an **important source of raw material to produce biodiesel.**
- It is also used for making soap, cosmetics, cooking oil, and animal feed, etc**.**

Benefits of biodiesel made from UCO

- **Health: Removing reused or burnt cooking medium from the food chain** can help prevent people from **serious ailments such as hypertension, atherosclerosis, Cancer, Alzheimer's disease, liver diseases**. Overweight and Obesity are also major concerns of using UCO.
- **Environment:** UCO when discarded without any treatment **clogs drainage systems**. Hence, using it for other purposes can benefit the environment.
- **Economy:**
  - **UCO can be economically collected from bulk consumer** such as hotels, restaurants and canteens for conversion.
  - **Lowered import dependence.**
  - Using residue and waste oil as raw materials for biofuels contributes **to the needs of a Circular Economy**.

Issues with RUCO

- At present, there is **no established chain of collection for UCO.**
- **Presence of impurities** like free fatty acid and water in UCO.
- RUCO require **large food business operators to store UCO separately**, which they can then sell to authorized UCO aggregators or collection agencies.

Initiative taken to make biodiesel from UCO

- In 2019, Ministries of Petroleum and Natural Gas & Steel, along with Health & Family Welfare, Science & Technology and Earth Sciences, **had initiated Expressions of Interest for "Procurement of Bio-diesel produced from UCO"**
  - It aims to create an eco-system for collection and conversion of UCO into Biodiesel and developing entrepreneurship opportunities.
  - Under this initiative, OMCs offer periodically **incremental price guarantees for five years and extend off-take guarantees for ten years to prospective entrepreneurs.**

- **National Policy on Biofuels, 2018**, encourages setting up of supply chain mechanisms for **biodiesel production from non-edible oilseeds, Used Cooking Oil, short gestation crops**.
- **Food Safety and Standards Authority of India (FSSAI)** in association with the Biodiesel Association of India (BDAI) **launched 'Repurpose Used Cooking Oil (RUCO) project'** in 2019.
    - Project is aimed at purchasing used oils from hoteliers, caterers, snack makers and traders at a reasonable price and converting it into biodiesel at a plant.
- **RUCO sticker and a mobile phone application was launched** for collection of used cooking oil (UCO) to ensure that it does not come back to ecosystem.

Way forward

- Biodiesel companies should **set up a door to door collecting system** in order to collect directly from the "producers" of UCO.
    - Develop a mechanism where **Individuals can also take their UCO** to the collection centres and earn money.
- Biodiesel companies may **supply the raw vegetable oils** to the "producers" of UCO and **collects them for recycling as well.**
- All the UCO collecting agencies are **expected to pay food business operators immediately** at the time of collection of UCO, based on the quantity and quality.

6. CONSERVATION EFFORTS

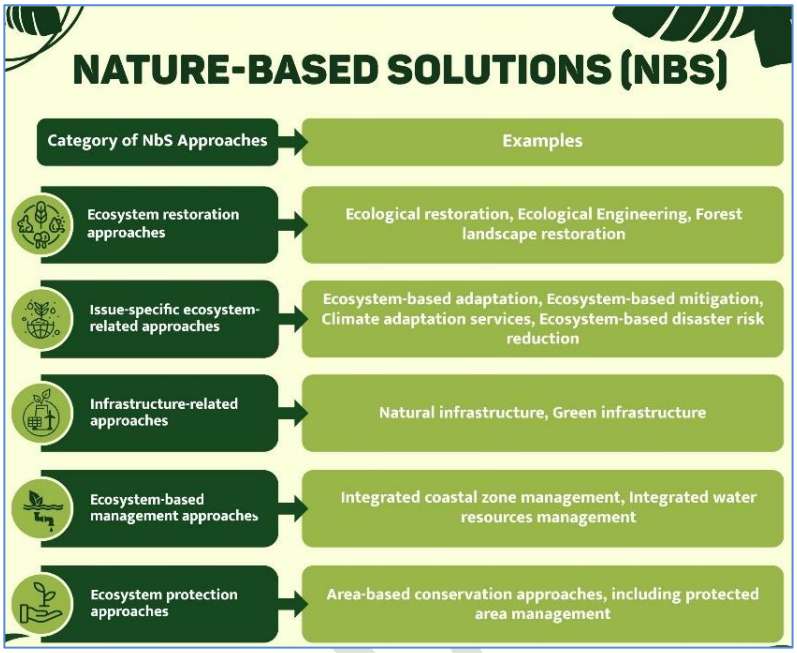
6.1. NATURE-BASED SOLUTIONS (NBS)

Why in news?

The Fifth Adaptation Gap Report places a **special focus on Nature-based Solutions** as low-cost options that reduce climate risks, restore and protect biodiversity and bring benefits for communities and economies.

About Nature-based Solutions (NbS)

- NbS are **actions to protect, sustainably manage and restore natural or modified ecosystems** that address societal challenges effectively and adaptively, simultaneously providing human wellbeing and biodiversity benefit.
- NbS are designed **to address major societal challenges, such as food security, climate change, water security, human health, disaster risk, social and economic development**
    - In adaptation, NbS are mainly used to address coastal hazards, intense precipitation, heat and drought.
- **As per IUCN, NbS:**
    - **Embrace nature conservation** norms.
    - **Can be implemented alone or in an integrated manner** with other solutions to the societal challenges (e.g. technological and engineering solutions).
    - Are **determined by site-specific natural and cultural contexts** that include traditional, local and scientific knowledge.
    - **Produce societal benefits in a fair and equitable way,** in a manner that promotes transparency and broad participation.
    - **Maintain biological and cultural diversity** and the ability of ecosystems to evolve over time.



How NbS can help in adapting to various hazards?

Hazard	NbS for adaptation	Potential additional benefits
Coastal hazards • Sea level rise • Storm surge • Coastal erosion	• Mangrove protection and restoration to anchor sediments and dissipate wave energy • Management and restoration of coastal marshes and/or dunes to dissipate wave energy and/or complement engineered protection • Coral reef management and restoration to attenuate wave energy	• Improved fish stocks • Biodiversity conservation • Carbon sequestration and storage • Sediment accretion • Tourism and recreation and associated employment
Intense precipitation • Flood • Soil erosion • Landslide	• Management and restoration of watershed vegetation to enhance infiltration, reduce run-off and peak flows, and stabilize slopes • Agroforestry to enhance canopy interception of rainfall and rainwater infiltration and reduce soil exposure, thereby reducing run-off and erosion • Urban watercourse restoration, and 're-naturing' to reduce assets at risk and secure riverbanks • Maintenance and restoration of urban greenspaces to improve rainwater infiltration and reduce run-off • Management and restoration of wetlands to store floodwater or slow its release and filter sediments	• Increased availability of wild-sourced food and other products • Pollination services • Carbon sequestration and storage • Improved soil fertility • Biodiversity conservation • Improved water quality • Improved physical and mental health among urban populations
Drought	• Management and restoration of watershed vegetation to enhance infiltration, recharge groundwater stores and maintain surface water flows • Establishment of 'Green Belts' to increase water availability, improve soil quality, provide shade and windbreaks	• Increased availability of wild-sourced food and other products • Pollination services • Carbon sequestration and storage • Improved soil fertility • Biodiversity conservation
Rising temperature • Heat stress • Urban heat islands • Wildfire	• Agroforestry to enhance canopy cover and provide shade • Rehabilitation and restoration of rangelands to repair ecological processes and enhance fire resistance • Creation of urban green spaces to increase vegetative canopies, which provide shade and evaporative cooling	• Carbon sequestration and storage • Improved soil fertility • Biodiversity conservation • Improved physical and mental health among urban populations

- Are applied at a landscape scale.
- Are an **integral part of the overall design of policies, and measures or actions,** to address a specific challenge.

- Analysis of investments by four major climate and development funds (the Global Environment Facility, the Green Climate Fund, the Adaptation Fund and the International Climate Initiative) has also suggested that **support for green and hybrid adaptation solutions has risen considerably over past two decades.**
- **More than half of the countries, including over 90% of LDCs, refer to protecting nature as an important motivation for adaptation planning and have added elements of NbS** to the adaptation components of their Nationally Determined Contributions under the Paris Agreement.
- **UNDP in 2020 Human Development Report also called for investment in Nature-Based Solutions.**
- At least 50% of National Biodiversity Strategies and Action Plans, which countries develop under UN Convention on Biological Diversity, emphasize **the importance of NbS in addressing vulnerability of ecosystems.**

6.2. HUMAN-WILDLIFE CONFLICT

Why in news?

With 88 human deaths, Maharashtra witnessed the worst-ever year with respect to HWC in 2020. This pattern is consistent with majority of states, highlighting increasing HWC.

What is the nature and extent of Human-Wildlife conflict prevailing in India?

- In India, human-animal conflict is seen across the country in a variety of forms, including **monkey menace in the urban centres, crop raiding** by ungulates and wild pigs, **depredation by elephants,** cattle lifting and **threats and injury by tigers, leopards and other wild animals**.
- Human-animal **conflict occurs both inside Protected Areas as well as outside Protected Areas**. The intensity of the conflict is generally more in areas outside Protected Area network than inside.

What are the reasons behind these conflicts?

Data Bank

- **2398 people in India were killed by elephants while tigers claimed 224 lives in the last five years.** (MoEFCC, 2019)
- **Over 100 elephants die due to human-related activities,** which include poaching for ivory or meat, poisoning, electrocution and collision with trains.

- **Habitat loss and fragmentation**: It increases the chances of wild animals moving out of natural habitat and encountering cultivation and people.
- **Increasing Population**: The substantial recovery of once dwindling populations of animals such as black buck, nilgai, tiger, leopard and elephant has also resulted in increased human-wildlife conflicts in the fringe areas of forests across the country.
- **Land Use Changes**: Land-use change outside forest areas, with irrigation from tube wells and canals aiding the cultivation of crops for longer time periods may also attract animals such as elephants.
  - Highly productive crop fields that provide more palatable and nutritious forage also promote conflicts with herbivores.
- **Adverse climatic events such as droughts, floods** have indirectly forced animals move towards human habitations for food, water and shelter.
- **Adaptability to anthropogenic ecosystems**: Many wildlife species have adapted to the changing landscape through behavioural changes for crop raiding. This is true for elephants and certain commensal wildlife species such as black buck, nilgai, rhesus macaque of northern India, as well as the bonnet macaque of southern India.
  - Even non-commensal animals such as leopard have adapted to surviving in human-inhabited areas.
- **Wildlife species are also impacted by accidental deaths due to development in infrastructures**, such as railway lines, roads, electricity wires etc. For instance, recently, a group of seven elephants died of electrocution in Odisha.

What are the consequences of increasing Human-Wildlife conflict?

- **Growing antipathy towards animals:** which leads to-
  - Further increase in conflicts, creating a vicious cycle.
  - Increasing difficulties for forest departments and limited community engagement in forest management.

- Public opinion tilting negatively with respect to conservation and associated activities.

- **Retaliation against animals:** In several cases, extreme steps such as immediate culling of wild animals is resorted.
  - For example, recently, a six-year old tigress Avni, accused of killing 13 human beings, was shot dead by a private hunter's son in the Pandharkawada region of Maharashtra.
- **Loss of life and property:** Alongside loss of lives and conflict related injuries in human habitations, the HWC many times leads to destruction of large agricultural habitations.
  - Also, the associated compensation provided by the Government to affected parties entails a large cost for the Government.

What are the initiatives taken by the Government?

Recently, the **Standing Committee of National Board of Wildlife (SC-NBWL)** approved the advisory for management of HWC in the country. Following can be cited as the key steps given by the advisory-

- **Empowering gram panchayats** in dealing with the problematic wild animals as per the section 11 (1) (b) of Wild Life (Protection) Act, 1972.
- **Utilising add-on coverage under the Pradhan Mantri Fasal Bima Yojna** for crop compensation against crop damage due to HWC. Also, payment of a portion of ex-gratia should be given as interim relief within 24 hours of the incident to the victim/family.
- **Augmenting fodder and water sources** within the forest areas.
- **Prescribing inter-departmental committees** at local/state level.
- **Adoption of early warning systems** and creation of barriers.
- **Dedicated circle wise Control Rooms** with toll free hotline numbers which could be operated 24X7.
- **Identification of hotspots and formulation and implementation of special plans** for improved stall-fed farm animal.

Other initiatives taken by the Government:

- **National Wildlife Action Plan (NWAP-3) (2017-2031)** prescribes guidelines to mitigate the human wildlife conflict.
  - These include creation of **national, regional and state level database for HWC**, **scientific management of wildlife populations** as well as **land use practices** and comprehensive, **species and region specific conflict-migration plans.**
  - It further talks about **encouraging community participation in the HWC mitigation** through extensive education and awareness programmes by well-trained and adequately equipped workforce.
    - ✓ Some of the examples of successful community participation and co-existence include **Bishnoi tribe of Rajasthan, Soligas in the BRT Tiger Reserve and Baigas of the Kanha National Park.**
  - It provides for a **Centre of Excellence (CoE) on HWC mitigation,** under the aegis of MoEFCC, to address develop and implement long-term and short-term measures to reduce the adverse impacts of HWC.
  - **Draft National Forest Policy, 2018** also reasserts the objectives and guidelines of NWAP-3.
- **Provision for dealing with errant animals-**
  - The Wildlife Protection Act, 1972 empowers the concerned authorities to deal with problematic **animals including declaring any protected species as vermin and to be culled.** E.g. monkeys in Himachal Pradesh and Nilgai and Wild Boar in Bihar were declared Vermin in recent times.
  - **Mass sterilization drive** is conducted to control the faster population growth of monkeys and boars as seen in Himachal Pradesh.
- UP Government has given its in-principle approval to **bring man animal conflict under listed disasters in the State Disaster Response Fund** to ensure better coordination and relief during such incidents.
- The NGT has asked MoEFCC to consider **declaring all elephant corridors in India as Eco-sensitive zones.**
- **Indo-German Human Wildlife conflict mitigation project** with an objective to frame guidelines and SOPs so that humans and wildlife could co-exist.

Way Forward

- **Recognizing the key sources of conflict:** It is imperative to understand that HWC are largely a human-induced phenomenon combined with the specific behavioural ecology of animals, and external environmental factors.

- **Community centric management and conservation:** Any long-term conservation measures such as taking a landscape approach to integrate Protected Area management with outside lands are only possible through people's cooperation. Thus, all conflict mitigation measures should be developed on the basic premise of engagement of all primary stakeholders, especially local communities.
- **Improved Forest Governance and management:** 24×7 monitoring using technology, management of corridors, building up the frontline capacity, creating village teams for reporting wild animal presence, and, an inter-sectoral portfolio at the landscape level akin to the "master plan" envisaged for an eco-sensitive zone should all be employed for HWC mitigation.
- **Using alternative and unconventional ways** such as re-creating a fear barrier for monkeys and boars, one- shot contraception and keeping dead animals on jungle tracts for wild carnivores, bio-fencing using cactus etc.

Landscape level approach to address human-animal conflicts

- A study involving close monitoring of elephants on daily basis for 2 years in Karnataka has concluded that **landscape-level management in necessary for mitigating human-animal conflicts.**
- As per the FAO, landscape level strategy deals with large scale processes in an integrated and multidisciplinary manner, combining natural resources management with environmental and livelihood considerations.
- It can be used as a viable solution for minimising the Human-Elephant conflicts, such as-
  - **Scientific management of Monoculture Plantations:** Since elephants prefer to stay in monoculture plantations (for example Acacia, Eucalyptus), forest departments should think strategically when to clear-fell these plantations. If these places are not available, elephants will start using agriculture habitats more frequently which may aggravate human- elephant conflict situation
  - **Regular Monitoring of land-use practices:** Proper planning needs to be done before making any change in the land –use practices in habitats such as coffee, agriculture or forest patches as it may have negative effects on elephant conservation or aggravate human- elephant conflict.
  - **Preserving Forest remnants and monoculture refuges:** These refuges are vital for elephants and helpful in containing conflicts as most of the forest is fragmented.

6.3. FOREST RIGHTS ACT, 2006

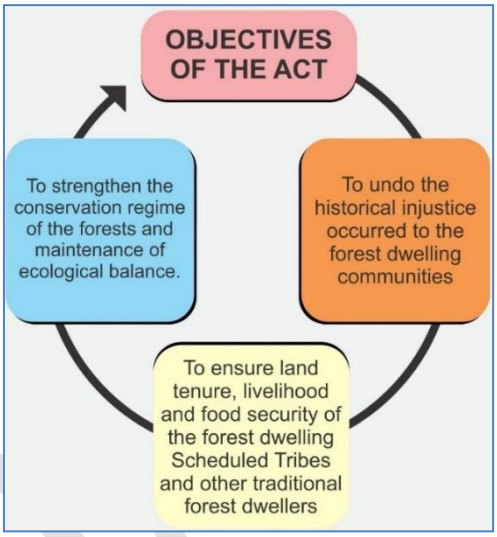
Why in news?

Ministry of Environment, Forest, and Climate Change (MoEFCC) and the Ministry of Tribal Affairs (MoTA) sent a joint communication to all state governments for the "expeditious implementation" of the **Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006,** commonly known as Forest Rights Act (FRA).

About the act

- It provides the forest dwelling scheduled tribes (FDSTs) and other traditional forest dwellers (OTFDs) for the **individual and community forest rights** that are categorised into following types:
  - **Title rights:** Ownership - to land that is being cultivated by tribals or forest dwellers as on 13 December 2005, subject to a maximum of 4 hectares.
  - **Community rights** - to grazing areas, fishing, accessing water bodies in forests, to pastoralist routes, etc. and to **intellectual property and traditional knowledge** related to biodiversity and cultural diversity
  - **Relief and development rights** - to rehabilitation in case of illegal eviction or forced displacement, and to basic amenities, subject to restrictions for forest protection.

- **Forest management rights** - to protect, regenerate or conserve or manage any community forest resource which the communities have been traditionally protecting and conserving for sustainable use.
- **Right to collect and sell minor forest produce (MFP):** These include forest products like tendu leaves, honey and other products that have commercial value.
- **Knowledge Rights:** Right to intellectual property and traditional knowledge, recognition of traditional customary rights.
- The **Gram Sabha is the authority to initiate the process** for determining the nature and extent of Individual Forest Rights (IFR) or Community Forest Rights (CFR) or both that may be given to FDST and OTFD.



- **The Act also defines:** Community Forest Resource, Minor Forest produce, FDST, OTFD, Critical Wildlife Habitat, Forest villages.

Importance of Forest rights in India

- **Reversing the historical Injustice**: By recognising the rights that were denied to FDST and OTFD since colonial times.
- **Curbing extremism:** Implementation of FRA in Left Wing Extremism affected districts not only leads to the development of forest dwellers but also build a relationship of trust and bond between them and the government, thereby reducing land conflict and other grievances.
- **Conservation of forests:** By recognizing the symbiotic relationship of the forest dwelling communities with the forests.
- **Decentralization:** It provides for democratic decentralisation through Gram Sabhas which facilitates communities to discuss, debate, decide, and effectively implement forest management plans.

Issues in effective implementation of the Act

- **High rejection of claims:** A large number of claims are being rejected; pending or limited rights are recognised.
- **Lack of awareness and capacity:** Many tribal communities or grama sabhas are unaware of the provisions of FRA (and especially CFR). Hence, they have not taken adequate efforts to file their claims.
- **Diversion of tribal Lands:** As per a study, there has already been a diversion of around 0.39 million hectares (ha) of forest land between 2008 and 2019.
- **Lack of Political will: Rights of** forest dwelling communities is in direct conflict with the ease of doing business and also challenges the power and authority of the Forest Department that may not be willing sharing of power with Gram Sabha for conservation and management of forest resources.
- **Administrative challenges:** There are multiple laws (like state laws, excise laws) that are in conflict with FRA, inadequate financial and administrative support to implement the law; lack of coordination between the tribal, revenue and forest department; poor or non-functioning of district and sub-division level committees; dissatisfactory Rehabilitation and compensation, etc.

Way Ahead

The implementation of FRA should not be seen as a strategy merely to enhance the welfare of the tribal communities but also as an effective strategy for the protection of forests too.

- **Institutional capacity building:** Relevant maps and documents should be made available to simplify the task of the Gram Sabha. Also, ensure training and capacity building along with promoting **learning and experience sharing** among concerned authorities such as Panchayats, Gram Sabha, etc.
- **Sensitising bureaucracy:** To encourage forest officials at different levels to assume a positive attitude towards the implementation of FRA.
- **Using technology to strengthen outreach:** For instance, GPS survey maps can be used to resolve competing claims at the local level.
- **Expedite the process of claims:** There is a need for reviewing all rejected and pending claims to individual and community forest rights expeditiously.
- **Transparency and accountability**: on decision making related to claims procedure. The reasons for rejection or delay in recognition of claims should be conveyed to the claimants.

- **IEC:** Large-scale awareness and information dissemination campaigns are required at local level informing both tribal and lower level officials.

6.4. NATIONAL GREEN TRIBUNAL (NGT)

Why in news?

The National Green Tribunal (NGT) recently completed 10 years.

NATIONAL GREEN TRIBUNAL AT-A-GLANCE

- A **statutory and quasi-judicial body** established under the National Green Tribunal Act, 2010.
- **Aim:** Effective and expeditious disposal of cases relating to environmental protection and conservation of forests and other natural resources.
- Guided by **principles of natural justice**.
- **Principles applied to pass orders**: Principle of sustainable development, the precautionary principle and the polluter pays principle.

Powers

- NGT by an order, can provide-
  - relief and compensation to the victims of air pollution and different environmental damage,
  - restitution of property damaged
  - for restitution of the surroundings for such vicinity or areas
- Power to **regulate its own procedure**.
  - Not bound by the procedure laid down under the Code of Civil Procedure, 1908 or by the rules of evidence as enshrined in the Indian Evidence Act, 1872
- Oder/decision/award **executable as a decree of a civil court**.
- **Mandated to dispose applications/appeals within 6 months of filing.**
- Appeal against the order/decision/ award of the NGT can be filed in the **Supreme Court** (usually within 90 days).
- **Penalty for not complying with the Tribunal's orders**: Upto 3 years imprisonment and/ or fine of Rs 10 crores for individuals (Rs 25 crores for companies).

Jurisdiction

- The Water (Prevention and Control of Pollution) Act, 1974
- The Water (Prevention and Control of Pollution) Cess Act, 1977
- The Forest (Conservation) Act, 1980
- The Air (Prevention and Control of Pollution) Act, 1981
- The Environment (Protection) Act, 1986
- The Public Liability Insurance Act, 1991
- The Biological Diversity Act, 2002

Chairperson
Retired/Sitting Judge of a Supreme Court (SC) or Chief Justice of a High Court (HC)

Appointed by Central Govt. in consultation with CJI

Judicial Members (10-20)
Retired/Sitting Judge of a Supreme Court (SC) or Chief Justice of a High Court (HC)

Expert members (10-20
Professional qualification and a minimum of 15 years experience in the field of environment/forest

Appointed by Central Govt. on recommendation of a Selection Committee

Important Judgements

- **2012**: Suspended a POSCO steel project in favour of the local communities and forests.
- **2012 Almitra H. Patel vs. Union of India case**: Ordered complete prohibition on open burning of waste on lands, including landfills.
- **2013 in Uttarakhand floods case**: Alaknanda Hydro Power Co. Ltd. ordered to compensate to the petitioner using the principle of **'polluter pays'**.
- **2015:** Banned all diesel vehicles over 10 years old in Delhi-NCR.
- **2017**: The Art of Living Festival on Yamuna Food Plain was declared violating the environmental Norms and fined Rs. 5 Crore.
- **2017**: Imposed an interim ban on plastic bags of less than 50-micron thickness in Delhi because "they were causing animal deaths, clogging sewers and harming the environment".

Achievements of NGT

- **Speedy environmental justice in environmental matters**: Since it began operations in July 2011 majority of its cases have been disposed of.
- **Strengthened the concept of Environmental Justice in India:** Over the years NGT has emerged as a vital player in environmental regulation, passing strict orders on issues ranging from pollution to deforestation, waste management to protection the rights of tribal communities.
- **Technical judgments**: NGT has employed legal and scientific methods and assessed environment impact assessment reports before deciding,
- **Created a new breed of legal practitioners** with expertise in environmental laws.

Significance of NGT
- Is less formal, less expensive
- Since its members are not eligible for reappointment it **can deliver judgements independently**, without succumbing to any pressures
- **Reduces the burden of higher courts** by providing an alternative dispute decision mechanism.

Challenges/Issues associated with its functioning

- **Lack of institutional mechanism to ensure compliance of its orders**: or to re-work its orders if found infeasible to implement.
  - Most of the landmark orders of the NGT related to Ganga water pollution, Delhi air pollution, illegal mining, and solid waste management remain unenforced.
- **Generic orders:** Since July 2018, the Tribunal has disposed of over 700 cases, all at different stages of hearing, with directing the concerned authorities "to look into the matter and take appropriate action in accordance with law".
- **Large number of dismissals**: Since 2018, the NGT dismissed many appeals filed before it, most of them on procedural grounds.
- **Restricted jurisdiction in case of forest rights**: Two important acts - Wildlife (Protection) Act, 1972 and Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006 have been kept out of NGT's jurisdiction.
- **Obstacle to development**: Decisions of NGT have additionally been criticised and challenged due to their repercussions on monetary growth and development.
- **Vacancies**: NGT only has three judicial and three expert members against the sanctioned strength of 10 each. This forces the tribunal to **outsource most of its technical work and constitute external committees** to look into various aspects of cases.
  - This gives the impression that the NGT is abrogating its own jurisdiction on cases pertaining to environmental protection
- **Other issues**- Absence of a formula-based mechanism in determining the compensation, Restricted number of regional benches, **Prolonged litigation** due to the option of challenging orders of the NGT before the Supreme Court etc.

Way forward

- Amendment to the NGT Act to give the tribunal powers to follow-up its directions and to establish a mechanism for enforcing its directions.
- NGT can provide specific reasons for dismissal of cases or appeals.
- Filling up vacancies in NGT, especially among expert members, to enable the tribunal to become self reliant while inspecting technical aspects of cases.

6.5. CONCEPTS IN BRIEF

Concept	Details
Cultural model of Conservation	• This is based on a **respect for the rights of indigenous peoples** and other bearers of "traditional knowledge" and prevents social conflicts. • It involves forest dwellers in forest management and governance and acknowledges traditional rights of tribal over minor forest produce and provisions for making conservation more effective and more transparent. • The **Kinshasa Resolution of 1975** (under IUCN) provides international recognition to cultural model of conservation. It acknowledges the importance of traditional ways of life and land ownership and called on governments to maintain and encourage customary ways of living.

Forest Landscape Restoration (FLR)	• It is the ongoing **process of regaining ecological functionality and enhancing human well-being** across deforested or degraded forest landscapes. • FLR focuses not only on forests but on the restoration of the whole area, to **create multiple benefits and different land uses.** Its examples include Wasteland Reclamation Strategies and approaches like Coastal Regulation Zone (CRZ) demarcations. 
Environmental Fiscal Reform (EFR)	• It is the **reengineering of tax systems** into more friendly and environmentally growing ones where the **tax burden is shifted from income resources**, and instead **imposed exponentially on factors that adversely affect the environment** such as pollution, consumption, resource depletion, non-recyclable waste, and civil construction.

Miyawaki Technique	• It is an **afforestation method** based on the work of **Japanese botanist Akira Miyawaki in the 1980s.**
	  ○ The technique **compresses layers of a forest – shrubs, trees, canopies – on small plots of land**, turning them into tiny forests.
	• **Miyawaki technique process involves following steps**
	  ○ Planting **three to four saplings per square meter**, using native varieties adapted to local conditions.
	  ○ Wide variety of species – **ideally 30 or more – are planted** to recreate layers of a natural forest.
	  ○ **Mulching, natural water retention and perforation material** like rice husk and use of organic compost is done to support their growth.
	  ○ The site is monitored and **maintained for a period of 2 to 3 years**, after which the **sites become self-sustainable**.
	• **Benefits of Miyawaki technique -**
	  ○ Works effectively **irrespective of soil and climate conditions**.
	  ○ **Mini forests grow 10 times faster** and **become 30 times denser and 100 times more bio-diverse** than those planted through conventional methods.
	  ○ Help **lower temperatures in concrete heat islands**
	  ○ Heat islands are urbanized areas that experience higher temperatures than outlying areas as urban infrastructure absorbs and re-emits sun's heat more than natural landscapes.
	  ○ **Reduce air and noise pollution, attracts local birds and insects** and **create carbon sinks**
	  ○ **Up to 30 times or more Carbon-dioxide absorption** as compared to conventional forest.
	  ○ Miyawaki forests are designed to **regenerate land in far less time than the time it takes a forest to recover on its own,** which is over 70 years.
	• However**,** such forests lack some qualities of natural forests, **such as medicinal properties and the ability to bring rain.**

7. DISASTER MANAGEMENT

DISASTER MANAGEMENT IN INDIA AT- A- GLANCE

Disaster Risks in India

27 of its 28 states and 8 union territories exposed to recurrent natural hazards.
58.6% of the landmass is prone to earthquakes of moderate to very high intensity.
Over 40 million hectares (12% of land) is prone to floods and river erosion.
5,700 km of the 7,516 km long coastline is prone to cyclones and tsunamis.
68% of the cultivable area is vulnerable to drought.

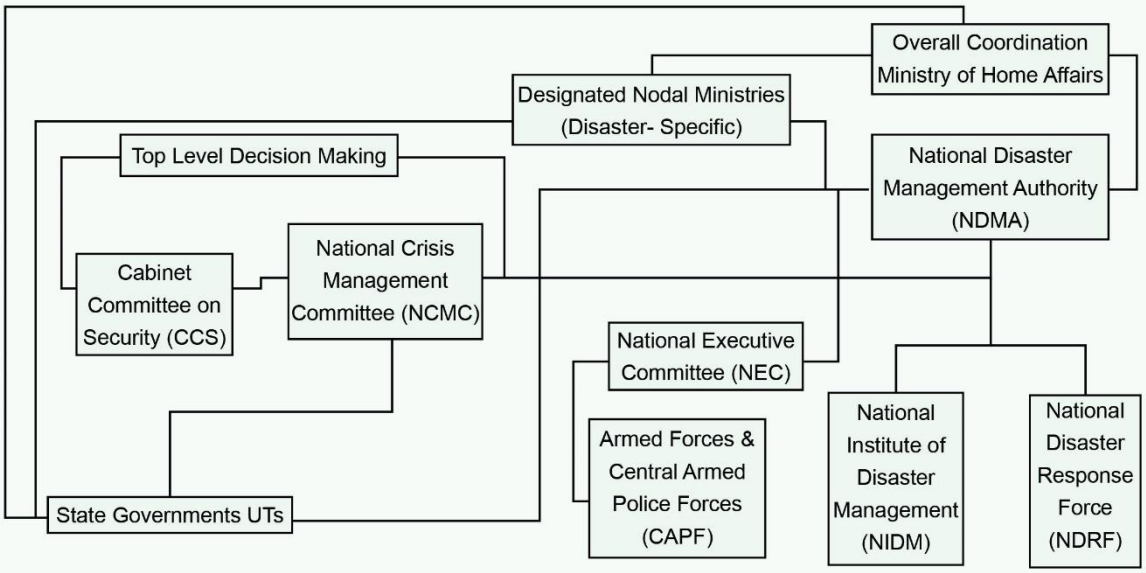
India's Vision and Approach to DM

- **Approach:** Proactive prevention, mitigation and preparedness-driven approach for conserving developmental gains and to minimise loss of life, livelihood and property.
- **Vision as per NDMP, 2016:**
  - Make India disaster resilient across all sectors.
  - Achieve substantial and inclusive disaster risk reduction by building local capacities starting with the poor.
  - Decreasing significantly the loss of lives, livelihoods, and assets (economic, physical, social, cultural, and environmental).
  - Enhancing the ability to cope with disasters at all levels.

Government Initiatives/Schemes/Policies/Acts

- **National Disaster Management Act, 2005**
- **National Disaster Management Plan (NDMP), 2016**
- **NDMA guidelines** for disasters like earthquakes, cold wave, cyclone etc.
- **National Policy on Disaster Management, 2009**
- **Prime Minister released a ten point agenda** on Disaster Risk Reduction
- **National Disaster Response Fund** managed by the Central Government.
- Signed **Sendai Framework for Disaster Risk Reduction 2015-2030 (SFDRR)**
- Launched **Coalition for Disaster Resilient Infrastructure (CDRI)**
- Model Building Bye Laws, 2016

National Disaster Management Institutional Mechanism



DISASTER MANAGEMENT IN INDIA AT- A-GLANCE

Challenges

- **Climate change is expected to increase disaster frequency and intensity.**
- **Weak compliance of policies,** e.g., violation/poor implementation of building laws.
- **Asymmetric impact of disasters on vulnerable sections** like poor, migrants, elderly etc.
- **Difficulties in mobilization of largescale financing** at all levels.
- **Absence of specific goals and targets** in NDMP.
- **Poor co-ordination** among multiple authorities, especially at local level.
- **Lack of fundamental infrastructure** (early warning system, search and rescue facilities etc.) in several disaster-prone areas.
- **Paucity of trained dedicated clinicians** for relief and rescue operations.
- **Low community empowerment and capacity building** to effectively mitigate, prepare and respond to Disasters.

Way Forward

- Strengthening DM plans and strategies to **prepare for predicted impacts of Climate change.**
- **Incorporate programs to protect the most vulnerable segments** of society—the poor, marginalized, women, children, disabled, and elderly.
- **Expanding financial resources** through international collaborations, public-private partnerships etc.
- **Raising awareness about insurance** among citizens for financial resilience.
- **Equipping existing infrastructure** like Common Service Centres (CSCs) for early warning, relief and rescue etc.
- **Developing and popularising innovative, location-specific technologies**, materials, designs and methods.
- **Undertaking adequate capacity building** to prepare citizens and administrative authorities at local levels.
- Setting specific **goals and targets aligned with Sendai Framework.**

7.1. CYCLONE MANAGEMENT

Why in News?

Recently, Indian coastal areas were struck by two cyclones- **Tauktae** from Arabian Sea and **Yaas** from Bay of Bengal, in a short span of few weeks, leading to loss of life and property.

About Cyclones

- Tropical cyclones—also called typhoons or hurricanes—are intense water-rotating systems formed by strong winds around low-pressure areas.
- **Conditions favorable:**
  - Large sea surface with temperature higher than 27° C;
  - Presence of the Coriolis force;
  - Small variations in the vertical wind speed;
  - A pre-existing weak low-pressure area or low-level-cyclonic circulation;
  - Upper divergence above the sea level system
- April-May and October-December periods are conducive for cyclones.
- The Indian subcontinent experiences **cyclones from two basins**: The Bay of Bengal basin and the Arabian Sea basin.
- Of the two, **more cyclones are generated in the Bay of Bengal and cyclones here have also been more severe than the one generated over the Arabian Sea.**
  - The Bay of Bengal receives higher rainfall and constant inflow of fresh water from the Ganga and Brahmaputra rivers. This means that the Bay's surface water keeps getting refreshed, making it impossible for the warm water to mix with the cooler water below, making it ideal for a depression.

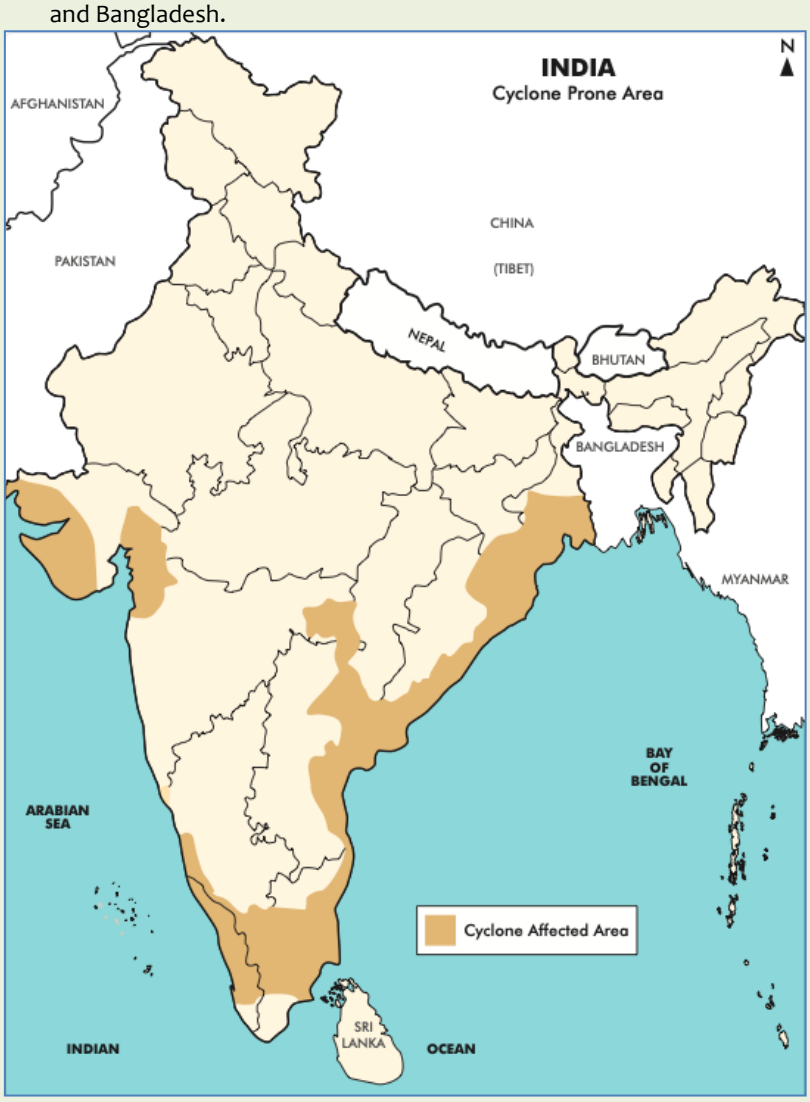
- On the other hand, the Arabian Sea receives stronger winds that help dissipate the heat, and the lack of constant fresh water supply helps the warm water mix with the cool water, reducing the temperature.

India's cyclone management framework

- **National Cyclone Risk Management Project** from Ministry of Home Affairs, with financial aid from World bank, works as the holistic strategy by clubbing all of India's disaster management efforts under four components as
  - **Component A: Improvement of early warning dissemination systems** through improved cyclone forecasting, involving IMD and ISRO.
  - **Component B: Cyclone risk mitigation investment** through
    - ✓ Building cyclone shelters and infrastructure based on ISO standards,
    - ✓ Holistic coastal management and conservation of coastal wetlands through **Coastal Regulation Zones (CRZ), Integrated Coastal Zone Management (ICZM)** and protection of **bio-shields** like Mangroves,
    - ✓ Building a community-based Disaster management system.
  - **Component C: Technical assistance for hazard risk management and capacity building** through Vulnerability Analysis and Risk Assessment and community capacity building.
  - **Component D: Project management and institutional support** through National, State and District level institutional mechanism and coordination.

Data Bank

- India is exposed to **nearly 10 percent of the world's tropical cyclones.**
- In the last 270 years, **21 out 23 major cyclones** have occurred in India and Bangladesh.



IMD's Warning System

- IMD recently announced to launch a dynamic, impact-based cyclone warning system that will use **meteorological data in combination with geospatial and population data** to assess the impact of the cyclone in a particular area.
- IMD has incorporated four color coded warnings (**green, yellow, orange and red**) in its forewarning system for easy identification on the intensity of cyclones

What are the limitations of the current framework?

- **Technological limitations vis-à-vis forecasting:** The technical and observational limitation from limited number of Weather buoys to limited analytical capacity slows down the identification and dissemination process.
- **Poor infrastructural development:** Infrastructural measures such as embankments, cyclone shelters, cyclone resilient critical infrastructure have not been up to the mark.
- **Low awareness and community engagement:** The awareness among the local public with regard to the do's and don'ts as a first responder during a cyclone is extremely low as can be seen in the case of Tauktae as well as Yaas.
- **Absence of coordination among stakeholders:** Multiple stakeholders such as local panchayat, NGOs, State Government, Central Government and coastal authorities do not act in consonance. This leads to duplication of effort at the ground level.
- **Long response time:** The immediate aftermath of Tauktae and Yaas have again highlighted the long response time that is required for the authorities to respond to a calamity.

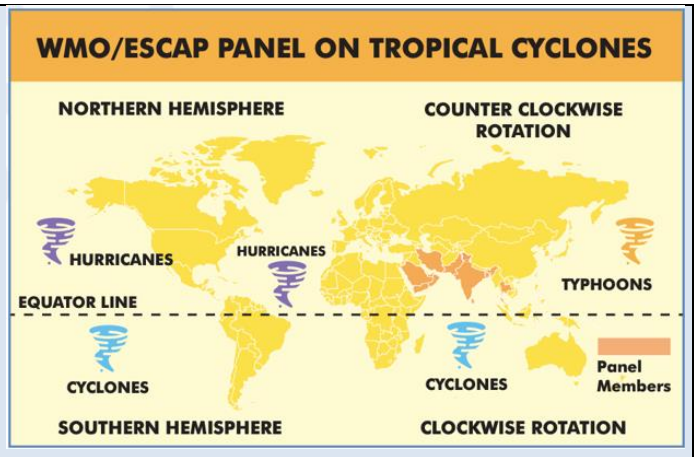
What can be done overcome these challenges and further improve the Cyclone Management Framework?

- **Establishing a state-of-the-art cyclone Early Warning System (EWS)** involving observations, predictions, warnings and customized local-scale advice for decision makers for managing the impact of cyclones.
  - Additionally, an **Aircraft Probing of Cyclone Facility** can be created for India to effectively fill the critical observational data gaps.
- **Infrastructural measures** like ensuring safety of critical infrastructure, development of multi-purpose cyclone shelters, all weather road links etc.
  - Idea of Public-Private Partnership can be explored to mobilize the finances.
- **Steps in coastal areas** including mapping and delineation of the coastal wetlands, mangrove areas etc. and adopting an eco-sensitive approach to development in the area. The coastal area defenses like mangroves, shelterbelts act as natural defenses.
- **Developing an integrated hazard mitigation framework** taking into account cyclone and associated storm surge, wind hazard, rainfall run-off etc.
- **Establishing a comprehensive Cyclone Disaster Management Information System (CDMIS)** covering all phases of Disaster Management.

NDMA guidelines for the Management of Cyclones	
Non – Structural Measures	• **Early Warning Systems:** It consists of Automatic Weather Stations, Doppler radars, High Wind Speed Recorders, Ocean buoys, Unmanned Aerial Vehicles etc. They provide critical information for tracking and forecasting intensity of cyclones. • **Communication and Dissemination Systems:** They are a pre-requisite for the proper functioning of cyclone warning. It consists of **cellular telephone network, Disaster Warning System (DWS) terminals,** etc. • **Management of Coastal Zones:** A holistic approach to Coastal Zone Management (CZM), like proper planning of the coastal areas for locating communities and infrastructure in safer areas, protecting and restoring natural bio-shields etc., can minimise loss of life and damage to property to a considerable extent. • **Mangrove forests and shelterbelts** constitute Bio-shields in coastal areas and provide ecological security. Their preservation is to be done by effective implementation of **Coastal Regulation Zone (CRZ) Rules.**
Structural Measures	• Ensure availability of a**dequate numbers of shelters, community centres/school buildings, places of worship**, etc., which can be utilised for moving people from vulnerable areas to safety. • To **provide at least one all-weather link road** for each village that is accessible during cyclone or flooding periods. • **Construction of 'saline embankments'** is carried out to protect habitation, agriculture crop and important installations along the coast.
Disaster Risk Management and Capacity Development	• Establishment of a **comprehensive Cyclone Disaster Management Information System** covering all phases of disaster management to provide online services to the states. • **Community Based Disaster Management (CBDM)** to building the capacity of communities to assess their vulnerability to both human induced and natural hazards and develop strategies and resources necessary to prevent and/or mitigate the impact.
Awareness Generation	Awareness encompasses a wide range of modes of sensitising communities, neighbourhoods and various functionaries from the local to the national level.

Naming of cyclones

- The names for cyclones are suggested by **13 member countries of WMO/ESCAP Panel on Tropical Cyclones from the regions: Bangladesh, India, Iran, Maldives, Myanmar, Oman, Pakistan, Qatar, Saudi Arabia, Sri Lanka, Thailand, United Arab Emirates and Yemen.**
- This naming of cyclones in Arabian Sea and Bay of Bengal **started in 2004**, based on **WMO/ESCAP Panel on Tropical Cyclones 2000** agreement to it, offering benefits like-
  - **Removing confusion** through easy identification of cyclones
  - **Easy remembrance** for rapid and effective dissemination of warnings
  - **Create Awareness** among people



- The list of names on tropical cyclones is maintained by WMO with naming to be done by the regional specialised meteorological centres (RSMCs) and Tropical Cyclone Warning Centres (TCWCs) for the ocean basin.
- For Arabian Sea and Bay of Bengal, **Indian Meteorological Department** (IMD) acts as the RSMCs (one among six in the world).

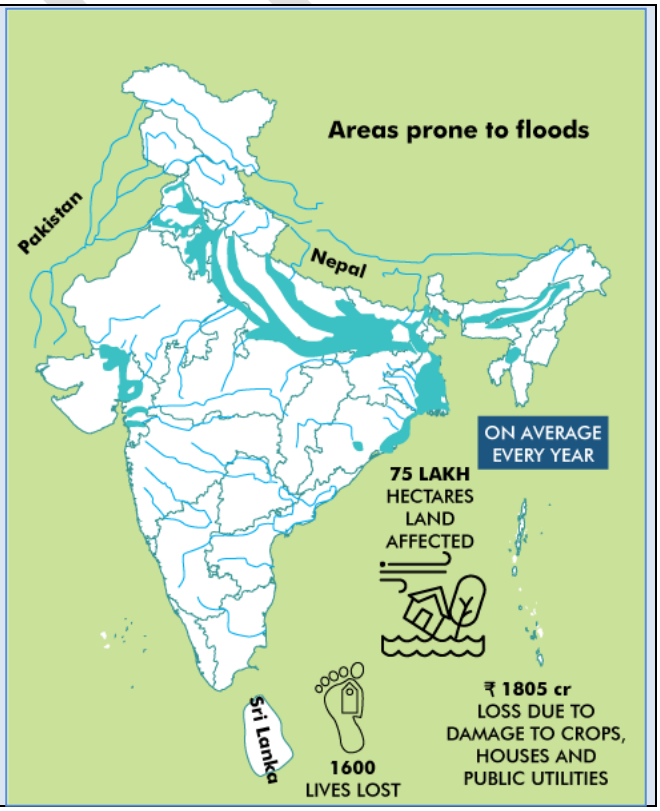
7.2. FLOOD MANAGEMENT

Why in news?

NITI Aayog recently released a report on Strategy for Flood Management in the country.

Data Bank

- **More than 40 mha ~12% of the total area of India is flood prone.**
- Some of the **biggest flood disasters in the last 10 years** besides the recurring floods in north-eastern India include-
  - Uttarakhand in 2013
  - Kashmir in 2014
  - Chennai in 2015
  - Kerala in 2018 and 2019
  - Patna in 2019.



Existing Flood Management Mechanisms in India

- **Statutory Provisions**
  - The **subject of flood control does not figure as such in any of the three legislative lists** included in the 7th schedule of the Constitution.
  - However, **Drainage and Embankments**, are two of the measures specifically mentioned in **entry 17 of List II** (State List), subject to Entry 56 of List I (Union List).
  - It may thus be seen that the **primary responsibility for flood control and the subject "flood management" falls within the purview of the States.**
  - The **role of central government is technical, advisory, catalytic and promotional in nature.**

- **Existing approaches to manage flood:** Different measures have been adopted to reduce the flood losses and protect the flood plains. Depending upon the nature of work, Flood protection and flood management measures may be broadly classified as Structural and Non-structural:
  - **Structural Approaches include**
    - ✓ An **artificially created reservoir** behind a dam across a river that can moderate the intensity and timing of the incoming flood.
    - ✓ **Detention basins/Wetlands** usually formed by utilizing natural depressions/ swamps and lakes by improving their capacity for regulating the release of stored waters.
    - ✓ **Diversion** of a part of the peak flow to another river or basin, where such diversion would not cause appreciable damage.
    - ✓ By **constructing a parallel channel** bye passing a particular town/reach of the river prone to flooding.
    - ✓ **Creating Embankments** which artificially raise the effective riverbank and thereby prevent spilling and
    - ✓ **Channel and drainage improvement works**, which artificially reduce the flood water level so as to keep the same, confined within the riverbanks and thus prevent spilling.
  - **Non-structural/ Administrative Measures include**
    - ✓ Facilitating timely evacuation of the people and shifting of their movable property to safer grounds by having advance warning of incoming flood i.e., **flood forecasting, flood warning** in case of threatened inundation.
    - ✓ Discouraging creation of valuable assets/settlement of the people in the areas subject to frequent flooding i.e., enforcing **flood plain zoning** regulation.

Challenges in flood management

- **Resistance on part of states** to implement the model draft bill, 1975 for flood plain zoning.
- **Divergent views on the utility of constructing embankments** due to the insufficient number of performance evaluation studies of existing embankments.
  - It has been experienced that while some embankments have provided sustained protection against floods, some have aggravated the flood problem by raising riverbed levels..
- **India's land policy hasn't been congenial for efficient flood management:** Modern land use gradually encroaching on the natural environment has an impact on all three dimensions of flood risk, namely hazard, vulnerability and exposure.
- **Lack of an integrated approach:** The complete river morphology not studied before the implementation of the piece-meal approach of the channelization/embankment projects.
- **Lack of coordination among several Central and State agencies.**
- **Outdated estimates:** Remapping of the entire flood-prone area is required to get a realistic picture of present scenario.

Government Initiatives/Schemes/Policies

- **NDMA has released National water policy 2012** suggesting that reservoir operation procedures should be evolved and implemented in a manner so as to have flood cushion and to reduce trapping of sediment during flood season.
  - It has also suggested incorporating coping strategies for possible climate changes, such as increasing water storage capacity in dams.
- In the last few years, India has focused on building a **robust early flood warning system** for better flood resilience.
- Chennai became the first city in India to get an intelligent flood warning system.
- Mumbai got the integrated flood warning system (IFLOWS) in June 2020.
- TERI is now launching a similar flood forecasting system for Assam which has been prepared in collaboration with the IMD and the NDMA.

Recommendations of the NITI Aayog Report

- **National Water Model:** This model can be used to feed the information into a decision support system which can provide support services to Nation by predicting precipitation and forecasting flood and other water related events.
- **Legislative actions to ensure Dam safety**: Passing of Dam Safety Bill to be taken up on priority and Integrated Reservoir Operation (IRO) for flood management to be promoted by giving Central Government a proactive role and mandate.
- **Formation of Flood Management Plans** can help in rescue and relief works during and after the floods.

- **Emphasize the use of advanced technology** like artificial intelligence, satellites, remote sensing and GIS for flood forecasting and warning systems.
- **Improvised city planning:** In order to check the threat of urban flooding, each city should have their flood mitigation plans (floodplain, river basin, surface water, etc.) amalgamated within the overall land use policy and master planning of the city.
  - **Yongning river park in Taizhau, China** has been designed as wetlands or floodplains to **allow periodic flooding.**
- **Balancing between the Structural and Non-Structural Measures:** Priority must be given to non-structural measures such as flood forecasting, flood plain zoning, flood proofing etc. to mitigate the floods and long term and medium-term structural measures shall be used when and where those are unavoidable.
- **Integrated flood management** which calls for a paradigm shift from the traditional, fragmented and localized approach and encourages the use of the resources of a river basin as a whole and setting up of River Basin Organization for its effective implementation.
  - For example, **Buoyant buildings or "Amphibian houses"-** which sit on dry but can float vertically during flooding- have been built in **Maasbommel (Netherlands).**
- **Data Collection:** Continuous efforts to be made towards **modernization in collection of hydrometeorological data**, flood forecast formulation and forecast dissemination.

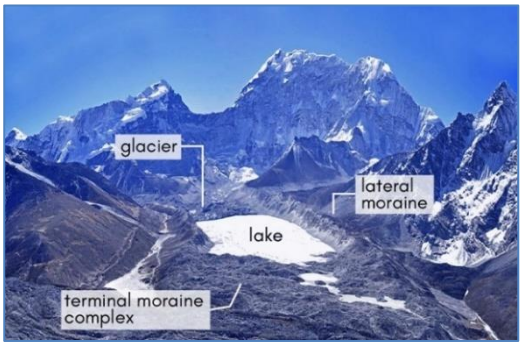
7.2.1. GLACIAL LAKES OUTBURST FLOODS (GLOFS)

Why in news?

Using remote sensing data, researchers from Germany have mapped the evolution of Gya glacial lake outburst flood (GLOF) of 2014 in Ladakh.

More about news

- Report by researchers mentions that cause of GLOF was not a spillover due to an avalanche or landslide, rather **there was a thawing of the ice cores in the moraine which drained through the subsurface tunnels.**
  - **Moraine is any accumulation of unconsolidated debris,** sometimes referred to as glacial till, that has been previously carried along by a glacier or ice sheet.
- Researchers noted that such **thawing of ice cores may accelerate in the future due to climate change**, and there is an urgent need to use multiple methods for better risk assessment and early warning.
- According to report, **bathymetric studies are needed to analyse lake volumes and its dynamics**. New, technologies can also be put to understand the stability of the moraines, but also need to asses land use planning.



About Glacial Lakes and GLOFs

- Glacial lakes are **ice-dammed, moraine-dammed, and bedrock-dammed lakes**.
  - These lakes are formed by the **trapping of melt water from the glacier** within dammed structure.
  - Due to global warming glaciers are retreating and **glacier lakes are expanding** in the size and numbers.
- **Glacial lake outburst flood (GLOF)** is a sudden release of a significant amount of water retained in a glacial lake, irrespective of the cause.
  - The formation of moraine-dammed glacial lakes and glacial lake outburst flood (GLOF) is major concern in the Himalayan states of India.
- **Factors triggering GLOFs include**
  - **Rapid slope movement into the lake:** Fast slope movement (slides, falls and avalanches) into the lake produces displacement waves which, in turn overtop the dam or cause direct rupture of the dam.
  - **Increased water inflow into a lake** due to heavy rainfall/snowmelt & cascading processes (flood from a lake situated upstream)
  - **Earthquake:** The direct mechanism of earthquake-triggered lake outburst floods is dam rupture and failure.
  - **Long-term dam degradation:** Successive changes in the internal structure of the dam leading to increased hydrostatic pressure induced by basal ice melting that results in dam failure.

- **Black carbon:** Due to incomplete combustion of fossil fuels, wood and other fuels amount of black carbon is increasing, which reduces the albedo of earth and melts the glaciers.
- **Anthropogenic activities:** Mass tourism, developmental interventions such as roads and hydropower projects and the practice of slash and burn type of farming in certain pockets of the Indian Himalayan region.

Impact of GLOFs

- **Societal Impact:** The sudden and intense flooding that results can cause destruction and disruption of property, infrastructure and deaths.
- **Impact on ocean circulation and climate:** Sudden release of an extremely large amount of cold freshwater into the ocean reduces the salinity of the surface layer and subsequently alters ocean circulation. This also influence the associated climate.
- **Geomorphological impact:** GLOFs, have significant potential to influence erosion-accumulation interactions and sediment dynamics, like bank and depth erosion of the stream/river channel, meander shift, replacement of existing channels and formation of new ones or formation of erosional terraces **etc.**

Government Initiatives/Schemes/Policies

- **Indian Space Research Organisation (ISRO)** among many other organisations are engaged in glacial lake monitoring and water bodies in the Himalayan region of Indian River Basins.
- **Sikkim has installed a Lake monitoring and information System** (water level Sensor) at South Lhonak lake. The sensor gives the water level of the lake and also monitored the lake level when there is sudden fluctuation in water level.
  - **Also high density polyethylene (HDPE) pipes have been installed to siphon off water** from the glacial lake.

NDMA guidelines for management of Glacial Lake Outburst Floods (GLOFs):	
Hazard and risk mapping	Hazard and risk assessment provide the basis for prioritising, designing, and implementing risk management strategies, and is therefore considered to be a cornerstone of Disaster Risk Management.
Monitoring, risk reduction and mitigation measures	Early Warning Systems (EWS) are commonly agreed upon as the most effective approach to disaster risk reduction.
Awareness and preparedness	Building awareness and strengthening preparedness can be effective on short, mid, and longer time. In particular, attention should be given to the most vulnerable members of society, including women, children, disabled, elderly, and marginalised communities.
Capacity development	A successful and sustainable implementation of the framework for GLOF risk assessment and management requires scientific, management, engineering and institutional capacities. Efforts to develop capacities should focus both on training and strengthening academic education in relevant disciplines from natural and social sciences.
Disaster response	Well-established disaster response procedures at national, state district, and community levels. Also, response strategies need to consider a multi-hazard perspective, considering access and evacuation routes and relief camps.
Research and development	Repeated monitoring using advanced space-borne and terrestrial technology is required for regular re-assessment of lakes across the entire Himalayan region.
Action plan and implementation	Comprehensive disaster management plans will be prepared at the National, State and District levels.

7.2.2. URBAN FLOODING

Why in news?

Recently, Ministry of Earth Sciences (MoES) in coordination with Municipal Corporation of Greater Mumbai developed an Integrated Flood Warning System for Mumbai called **'IFLOWS-Mumbai'**.

About Urban Flooding

- Urban flooding is the inundation of property in a built environment, particularly in densely populated urban areas, caused by intense rainfall (on impermeable surfaces) which **overwhelms the capacity of drainage systems.**
- It is significantly different from rural flooding as urbanisation leads to developed catchments which **increases the flood peaks from 1.8 to 8 times** and **flood volumes by up to 6 times.** Consequently, flooding occurs very quickly due to faster flow times, sometimes in a matter of minutes.

- There has been an increasing trend of urban flood disasters in India in recent years whereby major cities like Mumbai, Chennai, Delhi, Kolkata etc. have been severely affected.
- Urban flooding has wide ranging **impacts:**
  - Damage to vital urban infrastructure causing disruptions in transport and power
  - Loss of life and damage to property
  - Risk of epidemics due to exposure to waterborne and vector borne infections
  - Deterioration of water quality
  - Economic losses due to disruption in industrial activity, supply chains etc
  - Displacement of population in low lying areas
  - Accidents and fires due to short circuit

Factors Contributing to Urban Flooding

Meteorological Factors	Hydrological Factors	Human Factors
• Heavy Rainfall • Cyclonic storms • Small-scale storms • Cloudburst • Bursting of glacial lakes	• Synchronization of runoffs from various parts of watershed • High tide impeding drainage • Presence of impervious/ impermeable cover • High Soil moisture levels • Low Natural surface infiltration rate • Absence of over bank flow, channel network	• **Land use changes** (e.g. surface sealing due to urbanization, deforestation) increase runoff and sedimentation • **Encroachment** of the flood plain and thereby obstructing flows • Inefficiency or non-maintenance of flood management infrastructure • Climate change affects magnitude and frequency of precipitation and floods, and also causes **extreme weather events** • Changing Urban micro-climate due to **urban heat island effect** may enforce precipitation events • Sudden release of water from dams located upstream of cities/towns • Indiscriminate disposal of solid waste leading to blocked drainage systems

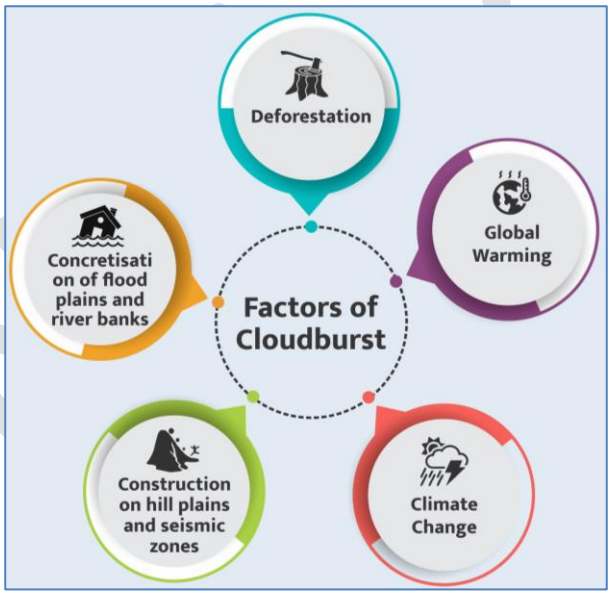
Way forward

- **Integrated approach** should be adopted for **sustainable urban planning** by empowering and educating Urban Local Bodies in decision making and planning of flood mitigation infrastructure.
- Focus on increasing the resilience of communities and adaptive capacity of our infrastructure is needed.
- Urban design and planning should be **water sensitive** and take into consideration the topography, types of surfaces (pervious or impervious), natural drainage etc.
- **Vulnerability analyses and risk assessments** should form part and parcel of city master plans.
- Disabling encroachment in sensitive zones through **robust anti-encroachment laws and by providing adequate affordable housing** can help reduce number of persons vulnerable to changing climate.
- Prevent encroachment on the river basin & natural lakes to ensure natural flow of the water.

NDMA guidelines on urban flooding	
Early Warning System and Communication	• Create a **National Hydro-meteorological Network**- for providing **early warning** in all urban centres, particularly those located on river banks, upstream and downstream of major and medium dams and island cities. • Developing **local networks for real-time rainfall data collection** with a **'Local Network Cell'** in the IMD headquarters. • Use of **Doppler Weather Radars** to be expanded to cover all urban areas in the country. • Establishing **Technical Umbrella for Urban Flood Forecasting and Warning** at the National and state levels.
Design and Management of Urban Drainage System	• An **inventory of the existing storm water drainage system** to be prepared. The inventory will be both watershed based and ward based. • Catchment to be the basis for planning and designing the storm water drainage systems in all ULBs • Every building in an urban area must have **rainwater harvesting** as an integral component of the building utility. • Low-lying areas in cities have to be reserved for parks and other low impact human activities. • **Encroachments** on the drain should attract penal action.

Urban Flood Disaster Risk Management	• **Annual Pre-monsoon desilting of all major drains.** • Urban Flooding has to be dealt as a separate disaster, **de-linking it from riverine floods**, which affect the rural areas. • Suitable **interventions in the drainage system** like traps, trash racks can be provided to reduce the amount of solid waste going into the storm sewers. • **Concept of Rain Gardens** to be incorporated in planning for public parks and on-site storm water management for larger colonies and sites those are to be developed. • Effort must be taken to protect, restore and revive all **urban water bodies**.
Capacity Development, Awareness Generation and Documentation	• **Flood hazard assessments** should be done on the basis of projected future scenarios of intensities and duration of rainfall and land use changes. • **Massive Public Awareness programmes** covering Solid Waste Disposal, problems of Encroachment, Insurance etc. can be undertaken to improve urban flooding education.
Strengthen Techno-Legal Regime	• Stormwater drainage concerns to be made a part of all EIA norms.
Preparation of DM Plans	• Detailed Incident Response System, Evacuation Plan, Search and Rescue plan etc. must be prepared for an **effective response** by state and civil society.

7.3. CLOUDBURSTS

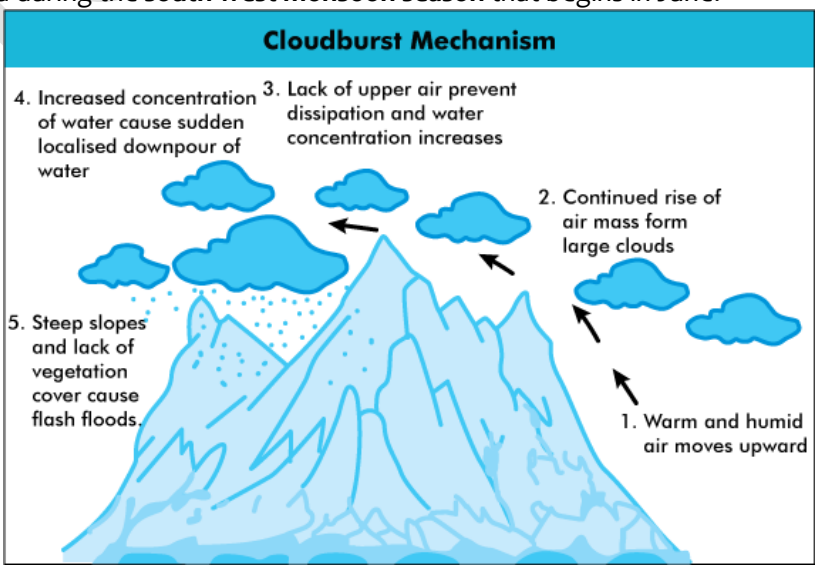


Why in news?

Recently **'cloudbursts'** were observed **in Uttarakhand's Chamoli, Tehri and Rudraprayag districts.**

What is Cloudburst?

- Cloudbursts are **sudden and extreme rainfall events** over a limited area in a short span of time.
- The **India Meteorological Department (IMD)** defines a cloudburst as any event where **100 millimetres of** rainfall have fallen in a span of an hour over a region that is 20-30 square kilometres in area.
- It is very difficult to predict the cloud bursts due to its very small scale in space and time.
- It is generally more common in India during the **south west monsoon season** that begins in June.
- **National Disaster Management Authority (NDMA)** is the nodal agency responsible for monitoring the relief operation.



How does it happen?

- A cloudburst occurs when **moisture-carrying air moves up a hilly terrain**, forming a **vertical column of clouds known as 'cumulonimbus' clouds.** Such clouds usually cause **rain, thunder and lightning**. This upward motion of the clouds is known as an '**orographic lift**'.
- Cloudbursts do **happen in plains as well,** but there is a greater probability of them **occurring in mountainous zones.**
- Raindrops, instead of dropping down, are carried upwards by the air current. **New drops are formed and existing raindrops gain in size**.
    - After a point, the raindrops become too heavy for the cloud to hold on to, and they drop down together in a quick flash.

- **Hilly terrains aid in heated air currents** rising vertically upwards, thereby, increasing the probability of a cloudburst situation.

- The energy necessary for the cloudburst comes from the **upward motion of air**. Cloudbursts mostly occur at **elevations between 1,000-2,500 metres above sea level**.
- The moisture is usually provided by a low pressure system (usually associated with cyclonic storms in the ocean) over the Gangetic plains associated with low level winds flowing in from the east.
- Sometimes **winds flowing in from the north-west also aid the occurrence of cloudbursts**. The many factors that have to come together to make a cloudburst event happen make them highly unlikely.

Impact of Cloudburst

- **Flash flood:** It usually happens downstream from the storm as heavy rains produce more water than the area can handle.
- **Landslides**: Mountainous terrain adds momentum to large amounts of water gushing down, leading to landslides, mudslides and flooding.
  - Sheet erosion and landslides contribute substantially to soil loss resulting in the **decline of productivity of agricultural land.**
- **Loss of life and property**: It is the consequences of **heavy rain in the hilly terrain** that causes loss of human lives and destruction of infrastructure.

Way Forward

- **Radar Network**: To monitor the cloud burst, there is need to have **dense radar network over the cloud burst prone areas** or one need to have a **very high resolution weather forecasting models** to resolve the scale of cloud burst.
- **Best practice**: A useful model in cloudburst mitigation is **Copenhagen climate adaptation plan** which has organized a **cloudburst master plan coupled with concretization plans and creation of canals**. The plan is envisioned with a view to cope with the effects of climate change.
- **Avoiding constructing settlements** in fragile shops and along the streams.
- **Imparting training to the rural people** for minimizing damage.

7.4. DROUGHTS IN INDIA

Why in News?

Recently, Global Assessment Report on Disaster Risk Reduction (GAR) was released by UN Office for Disaster Risk Reduction (UNDRR).

Data Bank
Over 68% of India is vulnerable to drought.

What is drought?

- Drought is characterized by a **lack of precipitation**—such as rain, snow, or sleet—**for a protracted period of time**, resulting in a water shortage.
- While droughts occur naturally, human activity, such as water use and management, can exacerbate dry conditions.

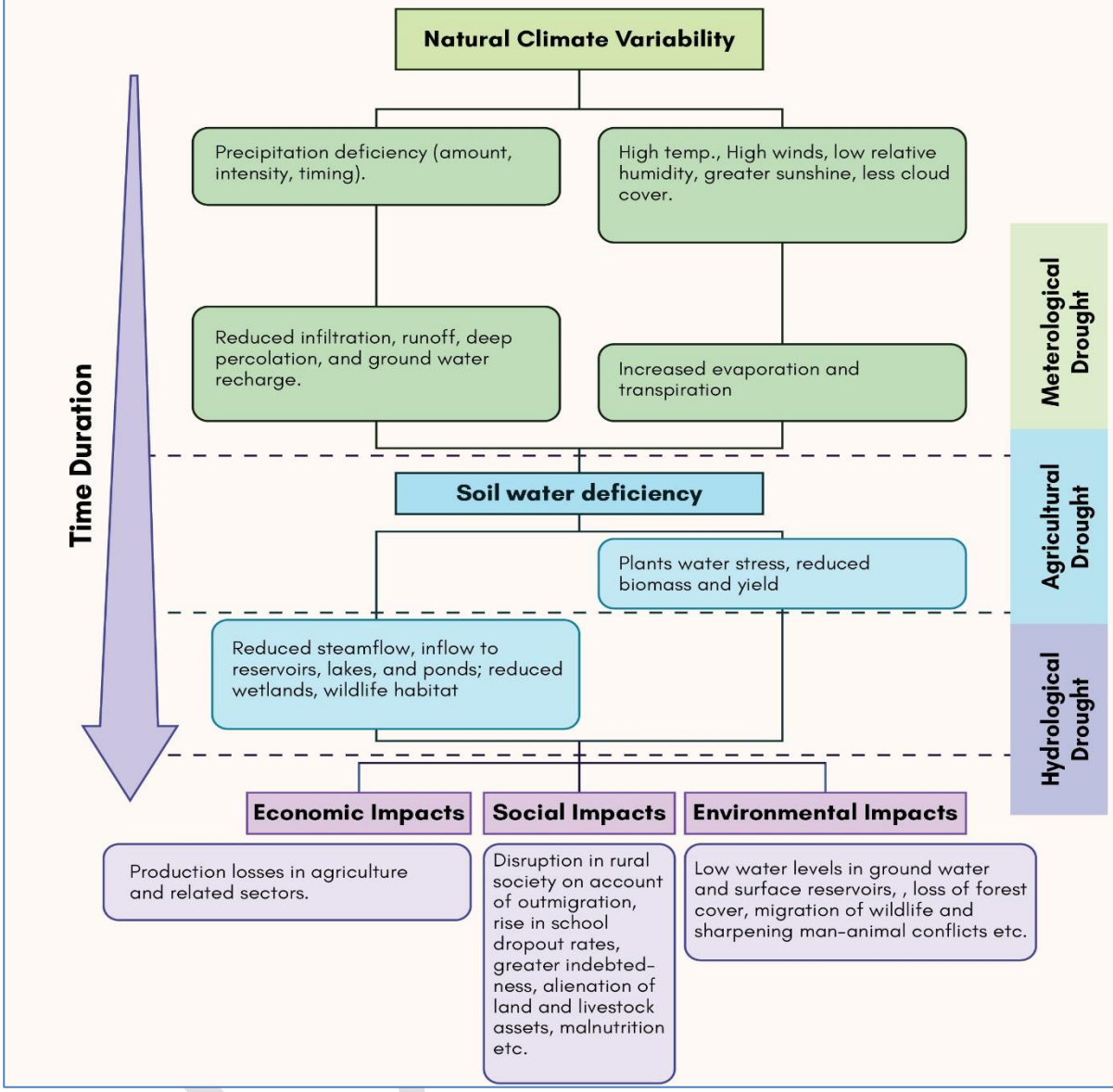
India specific classification of drought

- A drought year as a whole is defined by the IMD as a year in which, the **overall deficiency is more than 10% of Long Period Average (LPA) v**alue and **more than 20% of its area is affected by drought conditions**, either moderate or severe or combined moderate and severe.
- IMD has officially expunged the word "drought" from its vocabulary as part of a decision to do away with or re-define terms that are not scientifically precise.
- Instead of using terms like "All India Drought Year"' or "All India Severe Drought Year", the IMD has adopted "deficient" year or "large deficient" year.

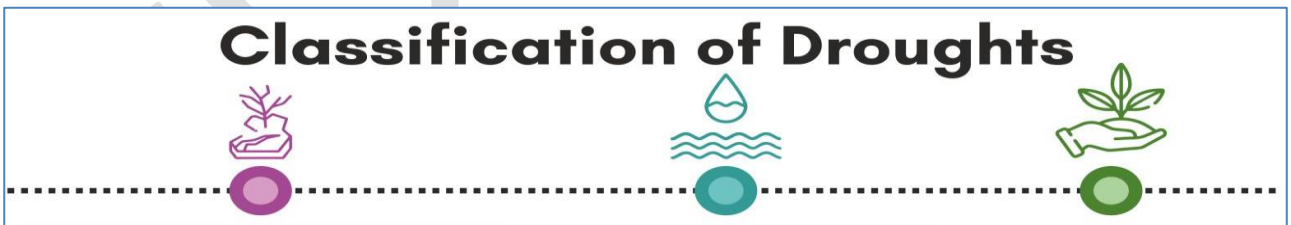
- On the basis of severity of droughts, **India can be divided into the 3 regions:**

Extreme Drought Affected Areas	• Most parts of Rajasthan, particularly areas to the west of the Aravali hills, i.e. Marusthali and Kachchh regions of Gujarat fall in this category.
Severe Drought Affected Areas	• Parts of eastern Rajasthan, most parts of Madhya Pradesh, eastern parts of Maharashtra, interior parts of Andhra Pradesh and Karnataka Plateau, northern parts of interior Tamil Nadu and southern parts of Jharkhand and interior Odisha.
Moderate Drought Affected Areas	• Northern parts of Rajasthan, Haryana, southern districts of Uttar Pradesh, the remaining parts of Gujarat, Maharashtra except Konkan, Jharkhand and Coimbatore plateau of Tamil Nadu and interior Karnataka.

Droughts: Genesis and impacts



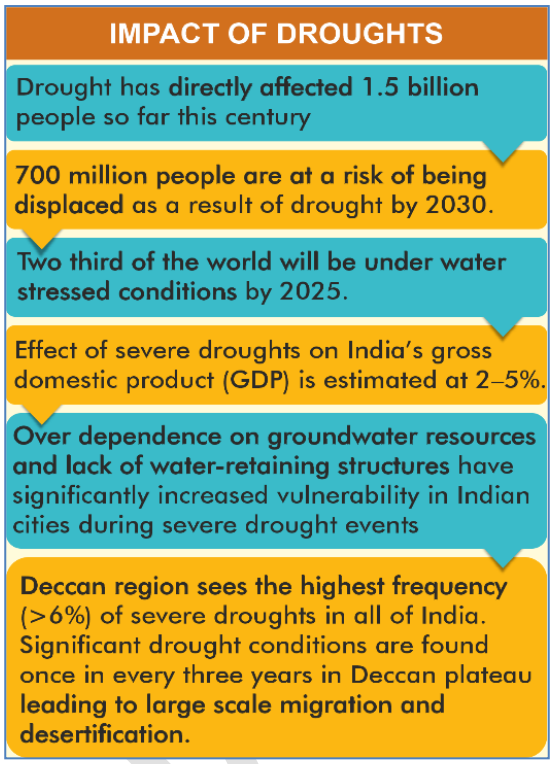
Classification of Droughts



Meteorological drought	Hydrological drought	Agricultural drought
■ Defined as the deficiency of precipitation from expected or normal levels over an extended period over time. It is said to occur when seasonal rainfall received over an area is less than 25% of its long-term average value. ■ It is further classified as moderate drought if rainfall deficit is 26-50% and severe drought when deficit exceeds 50% of the normal.	■ Defined as deficiencies in surface and subsurface water supplies leading to a lack of water for normal and specific needs. ■ Such conditions arise, even in times of average (or above average) precipitation when increased usage of water diminishes the reserves.	■ Usually triggered by meteorological and hydrological droughts, occurs when soil moisture and rainfall are inadequate during the crop growing season causing extreme cross stress and wilting.

Causes of recurring drought in India:

- **Considerable seasonal/regional variations:** in spite of a high average annual rainfall.
  - There is a relatively short window of **less than 100 days during the South-West Monsoon season** (June to September) when about 73% of the total annual rainfall of the country is received.
  - **Uneven distribution of rainfall over different parts of the country** in that some parts bear an inordinately high risk of shortfalls, while others tend to receive excessive rainfall.
  - **Low average annual rainfall of 750mm over 33% of cropped area** heightens susceptibility to drought.
- **Over-exploitation:** of ground water and sub-optimum conservation of surface water leading to inadequate water availability for irrigation. Traditional **water harvesting systems have been largely abandoned.**
- **Limited irrigation coverage and poor irrigation techniques:** (net irrigated area in the country is less than 50%) exacerbates the impact of drought on account of complete dependence of agriculture in such areas on rainfall. India's farm water efficiency is presently amongst the lowest in the world.



Current challenges in drought management

- **Reactive and relief centric approach:** There is a need to shift from relief-centric approach to integrated management emphasising on prevention, mitigation and preparedness, to minimise losses.
- **Issues in Assessment and Early Warning:** Forecasts are general in terms of space and time, timing does not match user needs, information received from different sources sometimes has conflicting messages etc.
- **Lack of proper, reliable data on water:** Data in the water sector exists in silos, with very little horizontal and vertical data sharing across the value chain of water thereby reducing efficiency.

Related Concept
Flash Drought

- Unlike conventional droughts that develop over months, Flash Drought refers to a **severe drought kind of situation that develops very rapidly.**
- They are caused by **high evapo-transpiration rates due to abnormally high temperatures (Heatwave flash drought), winds, and high insolation** and rain staying away (Precipitation deficit flash drought) for 15-20 days at a stretch.
- It **can be classified as agricultural droughts** due to their direct association with soil moisture and crop stress.

NDMA Guidelines on Drought Management

Institutional framework and financial arrangements	• **Separate Drought Monitoring Cells (DMCs)** will be created at the state level with adequate staff under the control of State Disaster Management Authorities (SDMA's). • State DMCs will undertake the **preparation of vulnerability maps** for their respective States. • **Watershed development approach** is an important facet of drought management initiatives, taken up through the programmes of the Government of India.
Assessment and Early Warning	• **Integrate ground-based information with space-based information** for comprehensive reporting. • Automatic weather stations will also **include moisture sensors for obtaining information about the soil moisture levels** under natural environment. • **Unit of deceleration of drought should be standardised** and alternative methods of quicker assessment of crop yield need to be evolved so as to mitigate the impact of drought in time.

Prevention, Preparedness and Mitigation	• **Automatic weather station and rain-gauges will be put in place** at appropriate spacing to enable micro level analysis and forecasting.
	• **Mitigation measures to be taken will include:**
	  ○ Conduct of **pilot studies in all categories of drought prone areas** for suggesting long term mitigation measures.
	  ○ **Cloud-seeding as a possible measure of mitigation** will be considered.
	• **Promote crop diversification** and utilization of sprinklers/Drip irrigation systems.
	• **Promote protective irrigation** through micro irrigation systems through incentives.

	• **Afforestation** with subabul, seemaruba, casurina, eucalyptus and bio diesel plantation like jetropha and pongomia will be encouraged. • **Insurance products will be developed for different agro-climatic zones** providing coverage against drought.
Capacity Development	• A **national training and capacity building programme** for drought management will be formulated and implemented. • The agricultural universities and National Research Centres of ICAR will be encouraged to undertake **contractual research for industries/farmers as a means of revenue generation** and providing solutions to immediate problems. • **Panchayati Raj Institutions (PRIs) and Urban Local Bodies (ULBs) will ensure capacity building of their officers and employees** to carry out relief, rehabilitation and reconstruction activities.
Relief and Response	• Agencies will be sensitized regarding their value in **generating employment in the drought-affected areas** and building assets such as tanks and wells which reduce the impact of drought. • **Provision of consumption loan** will also be encouraged in drought prone areas and efforts will be made to **bring agricultural labours into the net of social security.**
Preparation of Drought Management Plans (DMP)	• **National Executive Committee (NEC)** will prepare a National DMP, incorporating plans prepared by central ministries and state governments for drought affected States and districts. • States are requested to modify the existing plans according to GoI-United Nations Development Programme (UNDP) Programme on Disaster Risk Management.

7.5. URBAN FIRES

Why in News?

Recently, various urban fires were witnessed in various cities of India for instance at least 18 people were killed in a fire that engulfed a hospital in Bharuch, Gujarat.

About Urban Fire

- Urban fire occurs primarily in cities or towns with the **potential to rapidly spread to adjoining structures.** These fires damage and destroy homes, schools, commercial buildings, and vehicles.
- According to **National Crime Records Bureau**, in 2019, 330 people died in commercial building fires and **6329 in residential or dwelling buildings** fires.

Issues with Fire Safety Management in India

- **Limited firefighting resources:** According to Ministry of Home Affairs, **in 144 towns** with population over 1 lakh, there is a **huge deficiency of firefighting infrastructure.** It makes it **difficult to provide adequate fire safety cover** to the population.
- **Lack of data:** The last government data on the country's **fire safety infrastructure** came out in 2012. The lack of numbers **gravely affects the country's preparedness** towards accidental fire.
- **Inadequate monitoring mechanisms**: To ensure **adherence to National building code** and other fire safety regulations and lack of clarity regarding fire audits.
- **Limited scope of Act/Rules**: Apart from response, **fire prevention and mitigation** assume more importance considering the increasing number of fire incidents day by day. However, scope of the Fire Service Act/Rules in many states/UTs is still **restricted to managing local fires**.

Fire safety regulations in India

- Fire service is a **state subject** and has been included in the **Twelfth Schedule** of the Constitution of India in terms of **Article 243W.**
- **National Building Code (NBC) Guidelines** related to fire Safety: The **Part 4 (Fire and Life Safety)** of NBC contains the detailed requirements for **fire prevention, life safety in relation to fire and fire protection of buildings**. The code specifies **construction, occupancy and protection features** that are necessary to **minimize dangers** to life and property from fire.

- Published by **Bureau of Indian Standards,** NBC is a comprehensive building Code that provides **guidelines for regulating the building construction** activities across the country.
- Ministry of Home Affairs had issued advisories in 2017 to all the State Governments to **incorporate and implement the latest Code** - Part 4 in their building bye-laws.

- **The Model Building Bye Laws, 2003:**
  - The Chief Fire Officer issues the 'No Objection Certificate' from the view point of fire safety and means of escape.
  - This is done after ensuring that all the fire protection measures have been implemented and are functional as per approved plans.
- **National Disaster Management Authority Guidelines** for scaling, type of equipment and Training of fire Services provide following:
  - Fire party should reach the incident site **between 3 to 5 minutes in urban areas and 20 minutes in rural areas.**
  - A **general scale of equipment** based on population area and traffic congestion and **a suggestive list of special equipment** has been prescribed.
  - Acquisition and deployment of **smaller vehicle / motor cycle mounted water mist fire fighting units** at strategic vulnerable locations or setting up of **adequate number of fire posts** at strategic locations should be considered.
- **Model Bill to Provide for the Maintenance of Fire and Emergency Service for the State** (Revised in 2019) covers various aspects like operational structure, enforcement of fire protection code, special clauses for multi storied and special buildings, issue of fire safety certificates etc.
  - It proposes to include a **new chapter on "Fire Prevention and Line Safety Measures" in the state legislations** which comprise of additional provisions like **Occupier's liability** to provide fire and life safety measures and **Preventive measures** for pandals/temporary structures, buildings, multi-storied/special buildings.

Measures needed to tackle Urban Fires in India

- **Enactment of a Fire Act in every State/UT:** All States/UTs should enact their Fire safety Act/rules in line with **Model Fire Service Bill 2019. Also, should** make **heavy fire liability insurance compulsory** for all public buildings, which would offer protection to occupants and visitors.
- **Fire Safety Audits:** Fire safety legislations should provide **clarity regarding the scope, objective, methodology and periodicity** of a fire safety audit. Regular Fire safety Audits can be made **mandatory via third party agencies** for all the buildings.
- **Adopting modern technologies:** For instance, **LIDAR-based (Light Detection and Ranging) technologies can be used** to aerially keep a track of setbacks and the presence of fire exits. Facility like **automatic alarm, sprinklers, gas leakage alarm** should be promoted. **Built-in fire suppression systems** are more reliable than an external source of fire safety.
- **Educating architects and engineers** of better built-in fire safety innovative plans for fire safety in infrastructure development activities.
- **Other measures: Early evacuation, first aid and fast transportation** system also help in saving lives. Awareness should be raised regarding importance of **owner driven community participation for fire safety** measures for residential buildings.
  - Organising fire fighting workshop once in six months in localities/schools can help in building awareness among citizens.
  - Along with fire safety, **smoke management should be taught** since suffocation and reduced visibility are main reason for majority of deaths in fire incidents.

Why fire instances are increasing in hospitals during pandemic and possible solutions:

Reasons	Possible Solutions
Overstressed Hospital system: With increase in beds, equipment and staff to admit more COVID patients, it is not possible to **immediately expand the electrical wiring system. Overheating of medical equipment or wires carrying current** is causing fire in many cases.	Apart from fire audit, periodical **electrical audit** must be carried out.
ICUs (Intensive Care Unit) lack cross-ventilation as they are **sealed for the purpose of keeping them sterile.** In addition, due to COVID, there has been an **increase of inflammable material** (sanitiser spills and vapour, higher oxygen content etc), which are made of **synthetic material** that spread fire quickly.	**Air handling units (AHU) must be installed in ICUs** as they take air from the atmosphere, "recondition" it -cooling or heating as required and circulate it within a building or a section of the building through ducts.

Setting up Temporary hospitals that are made of **highly inflammable materials**, and sprinklers or fire alarms are difficult to install.	Need **to reduce response time** through fire extinguishers. **Installing sprinklers**. If temperature rises to 78°C, sprinkler automatically starts dispensing and can become first form of response.

- **National Disaster Management Guidelines** for Hospital Safety provides **measures to limit the development and spread of a fire** by providing appropriate arrangements within the hospital through **adequate staffing & careful development of operative and maintenance procedures**.
- It provides **design guidelines on maintaining sufficient open space in and around the hospital building, protected exit mechanisms, dedicated staircases, and crucial drills** to carry out evacuations.
- Supreme Court in 2020 had **directed all the states to carry out fire safety audit of dedicated COVID-19 hospitals** across the country to prevent fire incidents in medical institutions.

8. MISCELLANEOUS

8.1. WEATHER FORECASTING IN INDIA

Why in News?

A string of wrong monsoon forecasts by India Meteorological Department (IMD) has raised questions about weather forecasting models in India.

About Weather Forecasting

- It is the **application of technology and science to predict the state of the atmosphere** for a future time and a given location.
- Weather forecasts are made by **collecting as much data as possible about the current state of the atmosphere** (particularly the temperature, humidity, and wind) by using ground observations, observations from ships, aircraft, radio sounds, doppler radar and satellites.
    - This **information is sent to meteorological centers** where the data are collected, analyzed, and made into a variety of charts, maps, and graphs.
    - Modern **high-speed computers transfer thousands of observations** onto surface and upper-air maps.

Objectives of weather forecasting

- Ensure that no severe weather goes undetected and unpredicted.
- Improve impact-based forecasts
- Make updated weather information available to everyone, every hour.

Importance of accurate weather forecasting

USE OF WEATHER FORECASTING

To Protect Life and Property

> Accurate **prediction of genesis, track, intensity, landfall point and time,** as well as associated adverse weather like storm surge, rainfall wind helps in their early response and actions.

Agricultural Development

> Weather forecasting enables farmers to **adjust their farming activities to suit the expected weather condition.**
> It has a **profound influence on the growth, development and yields** of a crop, incidence of pests and diseases, water needs and fertilizer requirements.

For Transportation

> The **aviation industry** is especially sensitive to the weather and accurate weather forecasting is essential. Also, **Commercial and recreational use of waterways** can be limited significantly by wind direction, speed, wave periodicity, high tides and precipitation.

Utility Companies

> **Electricity and gas companies rely on weather forecasts** to anticipate demand, which can be strongly affected by the weather.

Military Applications

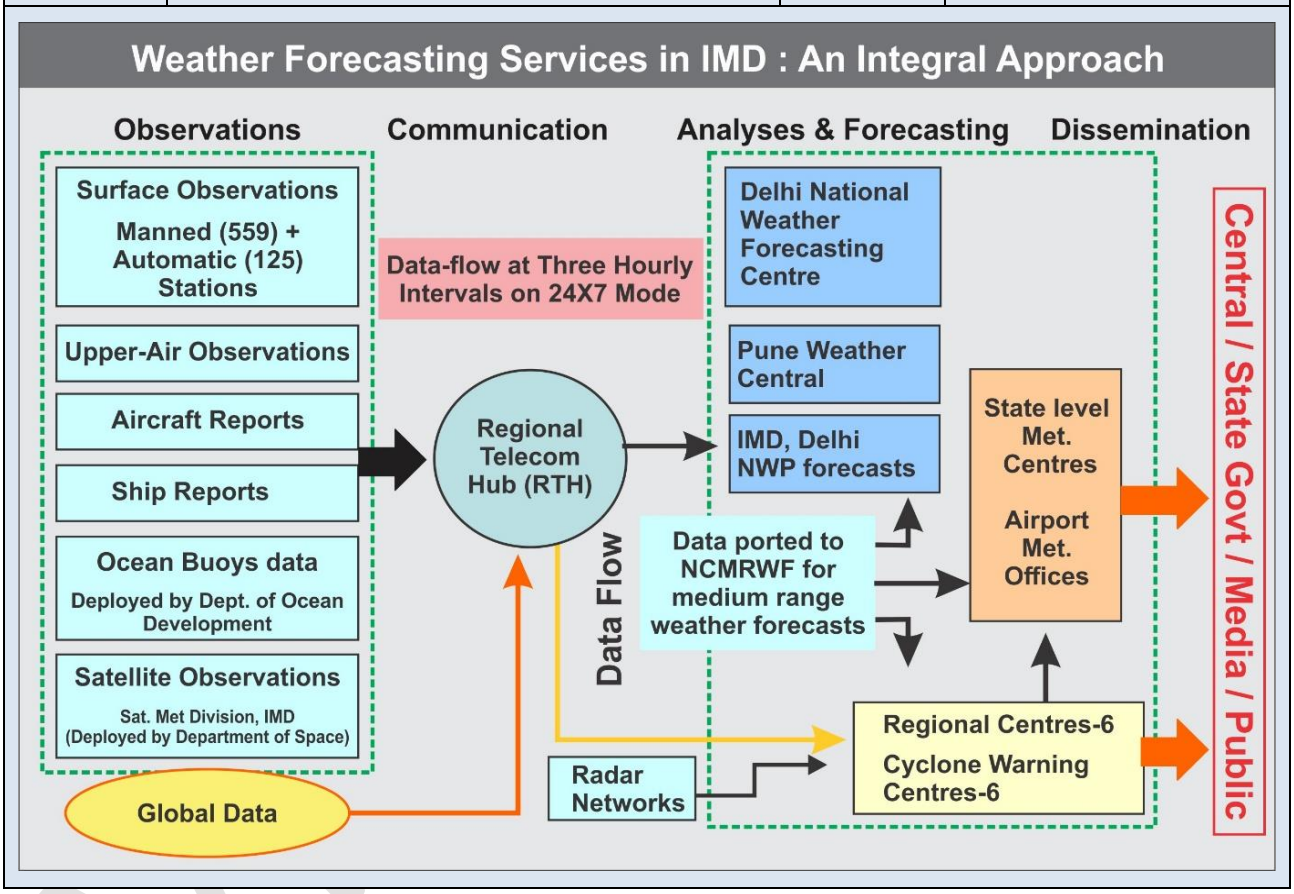
> Military weather forecasters provide **pre-flight and in-flight weather briefs to pilots** and provide real time resource protection services for military installations. Naval forecasters cover the waters and ship weather forecasts.

Avoiding Forest Fires

> Weather forecasting of wind, precipitations and humidity is essential for **preventing and controlling wildfires.**

Types of Weather Forecasts issued by IMD

Range	About	Time period	Utility
Nowcasting	In which the details about the current weather and forecasts for next few hours are given.	6 hours	Severe Weather Warnings (~ 500 m)
Short range forecasts	This forecast range is mainly concerned with the weather systems observed in the latest weather charts, although generation of new systems is also considered.	1 to 3 days	Conventional Forecasting resolution (3-25 km)
Medium range forecasts	Average weather conditions and the weather on each day may be prescribed with progressively lesser details and accuracy than that for short range forecasts.	4 to 10 days	Conventional Forecasting resolution (25 – 50 km)
Long range /Extended Range forecasts	There is no rigid definition for Long Range Forecasting, which may range from a monthly to a seasonal forecast.	10 days to a season	Droughts and Heat / Cold Waves



Forecasting models used by IMD

- **Statistical Ensemble Forecasting system (SEFS)** based on following parameters:
  - Sea Surface Temperature (SST) Gradient between North Atlantic and North Pacific
  - Equatorial South Indian Ocean SST
  - East Asia Mean Sea Level Pressure
  - Northwest Europe Land Surface Air Temperature
  - Equatorial Pacific Warm Water Volume
- **Dynamical global climate forecasting system** that simulates land, atmosphere and ocean state on supercomputers and extrapolate it into the monsoon months.
- **Multi-Model Ensemble forecasting system** based on coupled global climate models from different global climate prediction and research centers.

Challenges in India's weather prediction

- **Meteorological issues:** The atmosphere is vast and complex and it is impossible to accurately monitor every part of it, so inevitably there are gaps in those observations.

- Also, **weather systems destabilise faster in the tropics than they do in the extra-tropics,** where they persist for longer durations.
- Cyclones, the monsoon, thunderstorms are characteristic of tropical weather systems. The intense heating of the **Earth's surface plays a dominant role in the genesis, evolution, characteristics, propagation, and movement of the weather in these areas.**

- **Climate change:** Increase in frequency and intensity of extreme events (Ex Uttarakhand disaster, Mumbai floods, Chennai floods etc.) is an impact of changing climate patterns. It introduces fresh uncertainties in weather forecasting.
- **Issue with present models:** Although the numerical models used by the IMD are state-of-the-art, their forecast capacity is still weak. Longer the period of forecast, the more uncertainty there is.
- **Data gaps:** There are major data gaps (in terms of availability, timeliness, and quality of observational data), like those involving dust, aerosols, soil moisture and maritime conditions. India needs more radars to collect precipitation data at the wider and vertical levels in the atmosphere.
- **Lack of software professionals:** Only a small fraction of the modelers and atmospheric scientists that graduate from institutes like the IISc are recruited by the IMD and its associated agencies.
- **Lack of research:** There aren't many dedicated groups of Indian scientists conducting long-term experiments examining the complexities of Indian weather systems and incorporating that data into models.

Government Initiatives/Schemes/Policies

- **Under the National Monsoon Mission initiative**, the Indian Institute of Tropical Meteorology (IITM), Pune, Indian National Centre for Ocean Information Services (INCOIS), Hyderabad and National Centre for Medium Range Weather Forecasting (NCMRWF), NOIDA have built **a state-of-the-art coupled ocean atmospheric model for improved prediction of:**
  - Monsoon rainfall on extended range to seasonal time scale (16 days to one season).
  - Temperature, rainfall and extreme weather events on short to medium range time scale (up to 15 days).
- Government has initiated a **comprehensive modernization programme for IMD** covering up-gradation of (i) observation systems (ii) advanced data assimilation tools (iii) advanced communication and IT infrastructure (iv) high performance computing systems and (v) intensive/sophisticated training of IMD personnel.
- Farmers are using the **Gramin Krishi Mausam Seva (GKMS) service products of IMD** for various farm operations.
- To upgrade the forecasting capabilities, various programs are being implemented in IMD under the umbrella scheme **"Atmosphere & Climate Research-Modelling Observing Systems & Services (ACROSS)"** of the Ministry of Earth Sciences.

Way forward

- **Improve coordination between all relevant operational centres** across the country in the national, regional, and state level.
- **Issue district level forecast and nowcasts** and bring out further improvements in the system.
- **Provide impact-based warning services** related to different weather scenario including heavy rainfall for the capital cities.
- **Enhance the computing capacity of the existing weather and climate research centres** to accelerate prediction research.
- **Accelerate efforts to improve traditional parameterizations of atmospheric processes** such as convection, boundary layer, clouds, precipitation and atmospheric chemistry in climate and weather models.
- **Observation and communication systems must be improved** to make updated weather information available to everyone, every hour.

8.2. NATIONAL RIVER LINKING PROJECT (NRLP)

Why in news?

On the occasion of World Water Day (22 March), a memorandum of agreement was signed between Union Minister of Jal Shakti and the chief ministers of Madhya Pradesh and Uttar Pradesh to implement the Ken-Betwa Link Project (KBLP).

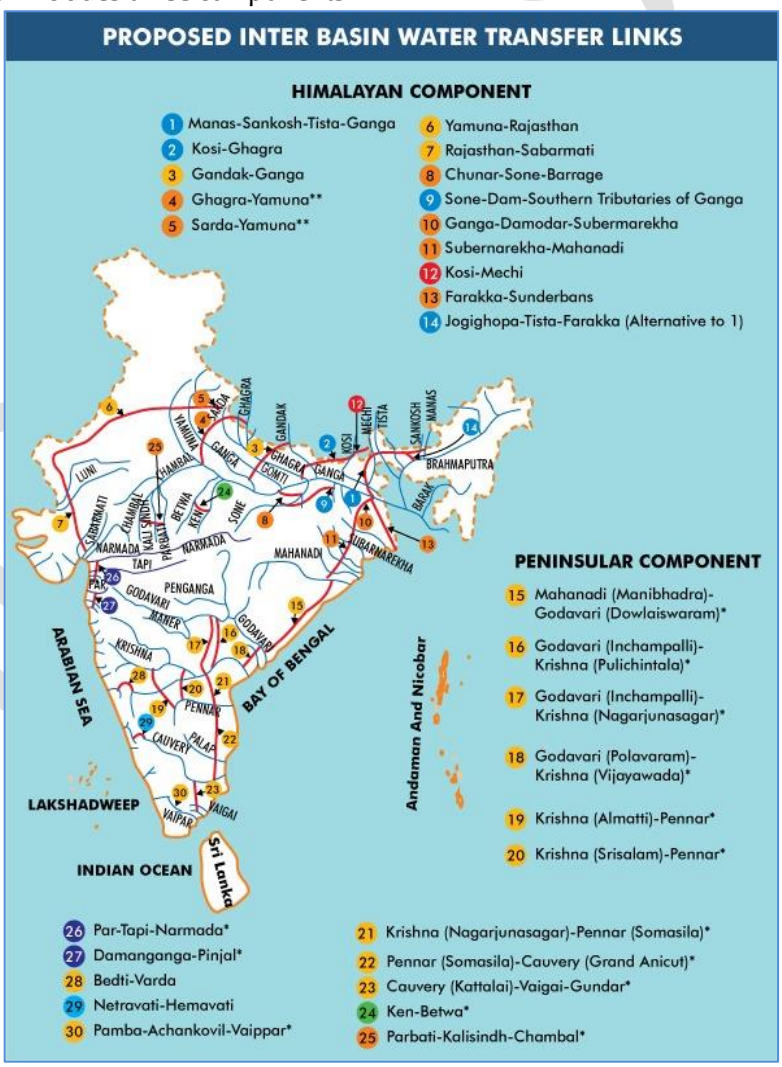
More about news

- The KBLP is the first project under the National River Linking Project (NRLP)**.** Under this project **water from the Ken River will be transferred to the Betwa River.** Both these rivers are **tributaries of River Yamuna.**

- It would be implemented in 2 phases.
  - **Phase-I:** Daudhan dam complex and its appurtenances like Low Level Tunnel, High Level Tunnel, Ken-Betwa link canal and Power houses will be completed.
  - **Phase-II:** Lower Orr dam, Bina complex project and Kotha barrage will be constructed.
- **The Centre will create a special purpose vehicle,** the Ken- Betwa Link Project Authority, for implementation of the project in eight years and will bear **90% of the total cost.**

About National River Linking Project (NRLP)

- The idea of interlinking of rivers was **first proposed by Sir Arthur Cotton in 1850s**. It was then revived in 1972 **by K.L. Rao,** then India's minister of power and irrigation.
- Subsequently, **a total of 30 river links** were identified under NRLP **formally known as the National Perspective Plan** across.
- It envisages the **transfer of water from water 'surplus' basins** where there is flooding to water **'deficit' basins** where there is drought/scarcity, through inter-basin water transfer projects.
- It is being managed by the **National Water Development Agency (NWDA)**. The project is also called as the **inter-basin transfer of water which** includes three components:
  - The northern Himalayan rivers interlinking component.
  - The southern peninsular component.
  - The intrastate river linking component.
- On completion of the project country will **have 30 river links, 3,000** storage structures, a canal network stretching almost 15,000 km and can generate **34 GW of hydroelectric power,** create some **87 million acres of irrigated land,** and transfer 174 trillion liters of water a year.



Challenges in making NRLP a success

- **Adverse human-ecological impact**
  - **Displacement and rehabilitation of people:** It must be noted that those who were evicted for the construction of the Bhakra and the Pong dams, two of the oldest in India, have still not been fully rehabilitated**.**
  - **Huge adverse impacts on the ecology:** Changes in the hydrological profile of Indian rivers, whether by climate change or changes in the volume of water withdrawn from them, could leave current surplus rivers with a deficit.
    - ✓ Moreover, these projects would lead to **submergence of huge areas of land, forest, flora and fauna.** It is estimated that the KBLP will lead to a loss of "10,500 hectares of wildlife habitat" in the Panna Tiger Reserve.
- **Implementation challenges:**
  - **High economic cost.**
  - **Bringing States on board:** To implement the project successfully, the Government will have to convince States to come on board, as water is a State subject. For example: Uttar Pradesh and Madhya Pradesh had a dispute over sharing of river water and other benefits.

- **Legal challenges:** It would be difficult to get all the mandated 4-5 types of clearances on time. Delay in clearance may increase the cost of the project. These clearances are
  - ✓ Techno-economic (given by the Central Water Commission);
  - ✓ Forest Clearance and Environmental clearance (Ministry of Environment & Forests);
  - ✓ Resettlement and Rehabilitation (R&R) Plan of Tribal Population (Ministry of Tribal Affairs)
  - ✓ Wildlife clearance (Central Empowered Committee).

- **Bad international experience:** China, which also faces recurrent droughts and floods simultaneously, started its south-north water transfer project to transfer extra water from the southern part to the dry northern part. The project has dislocated farmers and even increased the incidence of drought in some parts of the southern province where rivers were already running dry.

Way ahead

- **Overcoming implementation challenges**
  - **Special implementing body:** In 2014 the Supreme Court had directed the Government to create an appropriate body to plan, constructs, and implement this massive project. Institutionalizing such a body would expedite the implementation of the project.
  - **Concerned states should meet halfway on the deal:** The dispute between the states could be settled by ensuring some gain and some loss for all the concerned states. For example, in KBLP Uttar Pradesh agreed to drop its demand for a higher share and Madhya Pradesh is also not allowed to use the entire quantum of surplus water at the Daudhan dam site in the upper catchment area.
- **Explore alternative options:** Some experts suggest that such grand infrastructure projects are not the only options available to India. Other options could have equal or better outcomes for water security. Small-scale conservation i.e, traditional practices of water conservation, which are effective and also environment-friendly, need to be adopted to tackle the problem of drought. They include
  - Increased irrigation efficiency
  - Growing crops that are appropriate for the climatic conditions of the region in which they are grown
  - Managing water demand
  - Increasing rainwater harvesting
  - Ensuring that existing infrastructure is maintained and operating effectively

Conclusion

NRLP has its own boon and bane. Therefore, a balanced path of development could be pursued through a mix of traditional water conservation methods with the river linking projects. However, river linking projects should be considered as the last resort.

8.3. DAM SAFETY

Why in news?

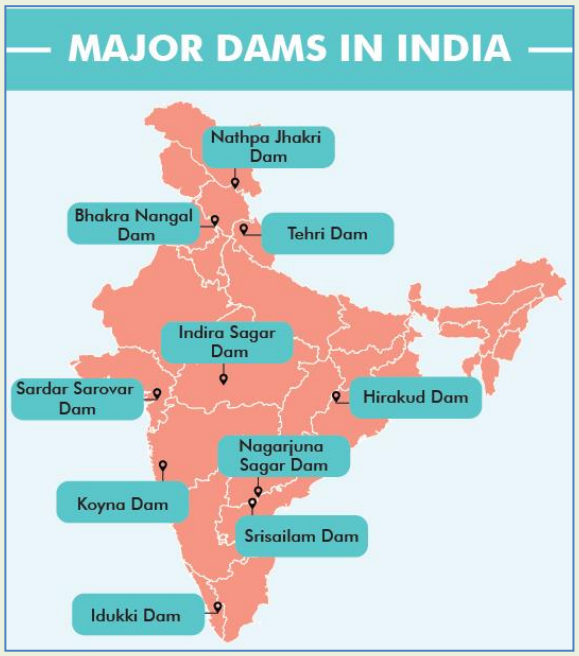
Recently, **India and World Bank signed a $250 million project** for **Dam Rehabilitation and Improvement Project (DRIP Phase II)** to make existing dams safe and resilient.

About Dam Rehabilitation and Improvement Project (DRIP)

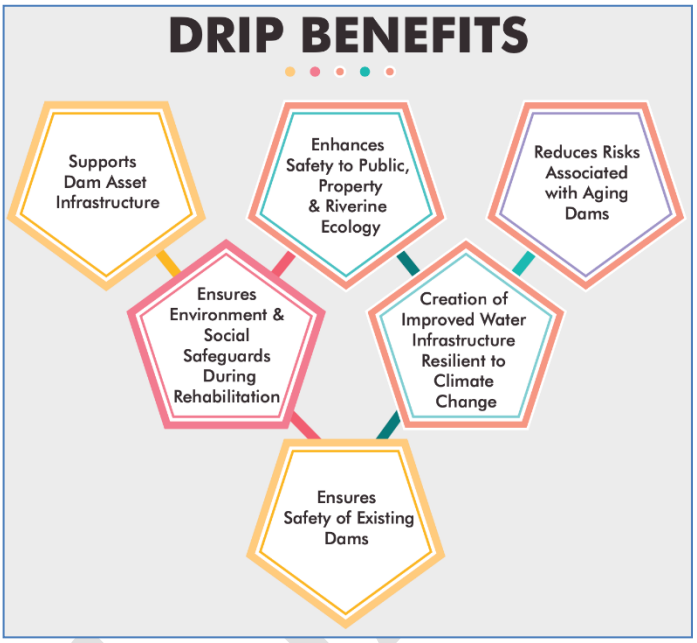
- It is a **State Sector scheme** with a central component, **initiated in 2012** by Government of India with financial assistance from the World Bank to **bridge the funding gap** and **provide urgent finance to States for repair** and maintenance of dams.
  - 80% of the total project is provided by the World Bank as loan/credit and remaining 20% is borne by the States/ Central Government.
  - It is touted as the **World's largest dam management program.**

Dams in India

- **India ranks third globally** after China and U.S in number of dams.

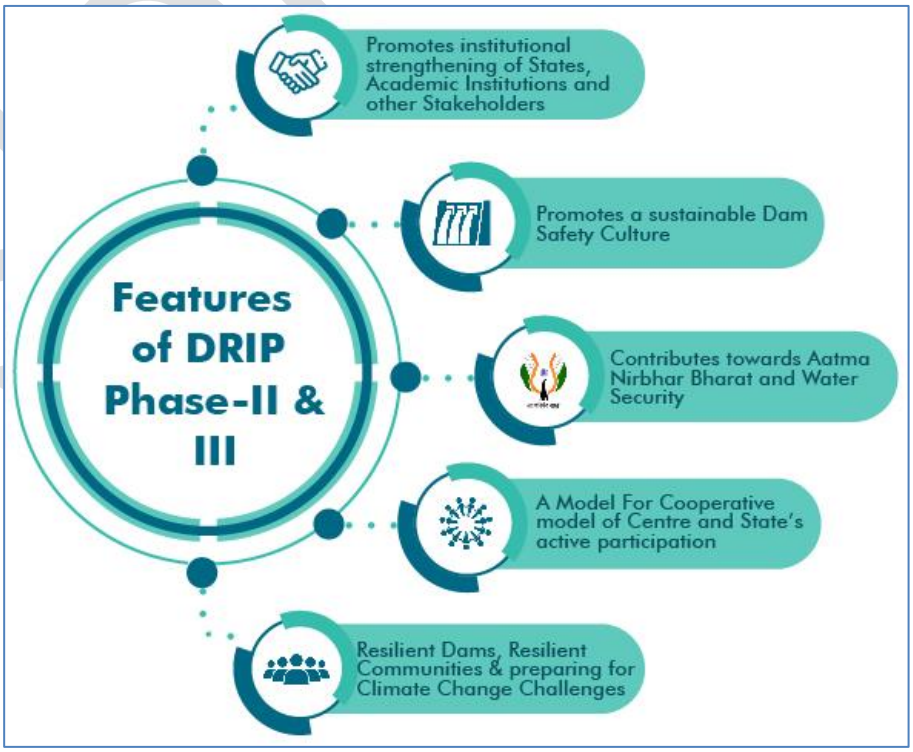


- **DRIP Phase-I:**
  - It has comprehensively addressed hydrological, structural, and operational safety of **223 dams located in seven States** (Jharkhand, Karnataka, Kerala, Madhya Pradesh, Odisha, Tamil Nadu, and Uttarakhand) with 10 Implementing Agencies on board. Out of 223, major rehabilitation **works have been completed at 221 dams.**
  - The **Central Water Commission (CWC)** had been entrusted with **overall coordination and supervision.**
  - It was successfully **closed in March 2021.**



- **DRIP Phase II and Phase III:**
  - Based on the success of DRIP Phase-I, **Ministry of Jal Shakti initiated** another **externally funded Scheme DRIP Phase II and Phase III.** This new Scheme has **19 States,** and **three Central Agencies** on board. It was approved in 2020 for rehabilitation provision of **736 dams.**
  - The Scheme is of **10 years duration,** proposed to be implemented in **two Phases,** each of six-year duration with two years overlapping.
  - DRIP Phase-II is being co-financed by two multi-lateral funding Agencies - **World Bank** and **Asian Infrastructure Investment Bank (AIIB),** with **funding of US$ 250 million each.**
  - The funding pattern of Scheme is **80:20**(Special Category States), **70:30**(General Category States) and **50:50**(Central Agencies). The Scheme also has provision of **Central Grant of 90% of loan amount for special category States** (Manipur, Meghalaya and Uttarakhand).

Issues associated with Dam Safety



- **Structural issues:**
  - **Ageing of Dams:** Dams in India are designed to last 100 years. All large storage structures become **weak with time** because construction materials such as concrete and steel deteriorate due to abrasions caused by waves, silt, sand and gravel. Dams also **lose strength due to thermal expansion and cavitation.**
  - **Forecasting systems:** Real time inflow forecasting systems are not in place even in important reservoirs. Such systems can add to dam safety measures besides improving operational efficiencies.
- **Implementation issues:**
  - **Absence of monitoring**: Lack of systematic assessment and monitoring, coupled with inadequate resources, is the primary cause of poor maintenance of dams and appurtenant works.

- **Lack of trained manpower:** Dam Safety Organizations (DSO) in states is short of adequate man power and need to be strengthened.
- **Lack of funds:** For repair and maintenance of dams.

- **Environmental issues:**
  - **Flood detention**: Increased flow into reservoirs lead to **flood risk**, increase in sedimentation during flood events could lead to **reduction in flood storage capacity** and/or **blockage of spillways** due to increased mobilisation of vegetation in flood flows.
  - **Siltation**: It **reduces the water storage capacity** of the reservoir, **undermines its effectiveness for power-generation, irrigation and flood control** and renders it usefulness in the long term. De-siltation of reservoir is difficult in many cases owing to environmental concerns related to sediment disposal.
  - **Soil erosion:** Dams hold back the sediment load normally found in a river flow, depriving the downstream of this. In order to make up for the sediments, the **downstream water erodes its channels and banks**. This lowering of the riverbed **threatens vegetation and river wildlife**.
  - **Extinction of species**: Large dams have led to the extinction of many **fish and other aquatic species**, the **disappearance of birds in floodplains**, huge losses of forest, wetland and farmland, and erosion of coastal deltas etc.
- **Social issues:**
  - **Human displacement**: Lack of regulatory framework in construction of Dams forces settled population to homelessness due to submergence of large areas of human settlements, loss of life and property.

Government Initiatives/Schemes/Policies

- **DHARMA (Dam Health and Rehabilitation Monitoring):** It is a **web tool to digitize all dam related data** effectively that will help to document authentic asset and health information pertaining to the large dams in the country, enabling appropriate actions to **ensure need-based rehabilitation**.
- **Seismic Hazard Assessment Information System (SHAISYS):** It is a **web based interactive application tool,** being developed in CWC (Central Water Commission) under Dam Safety Organisation (DSO) to estimate Seismic Hazard at a point in South Indian region.
- **Dam safety Act, 2019**: It provides for the **surveillance, inspection, operation, and maintenance** of all specified dams across the country.
- It constitutes **National Committee on Dam Safety** to **formulate policies and regulations** regarding dam safety standards and to analyse causes of major dam failures to suggest changes in safety practices.
- **National Dam Safety Authority** to **implements policies of the National Committee**, and resolves matters between State Dam Safety Organisations (SDSOs), or between a SDSO and any dam owner in that state.

Way Forward

- **Proper assessment**: It is important that the possible inflow and outflow of water is assessed. Maximum rainfall must be estimated while planning the project.
  - Local factors such as climate and catchment areas etc. need to be taken into consideration.
- **Rehabilitation**: Restoration of old dams using the latest materials and technologies can enhance the life of a dam for many more decades.
  - Inundation maps have been prepared which can be used for Emergency Actions Plans.
- **Timely monitoring**: Well-planned monitoring systems based on data collection and evaluation using modern instrumentation is the key to early detection of defects and ageing scenarios.
- **Capacity Building**: Training of Dam engineers for inspection & monitoring, operation & maintenance, construction supervision, and emergency action planning & latest know-how can ensure competence building in dam safety.
  - **Institutional Capacity building is needed** in design flood estimation and flood routing for most of the states.
- **Technology upgradation:** Latest technologies should be adopted not only at the time of constructing the dam, but also during periodic review of the dams.
  - The prevention and mitigation of ageing dams can be achieved best through carefully thought-out designs, and implementation of well-managed operation and maintenance programs.

8.4. KIGALI AMENDMENT TO MONTREAL PROTOCOL

Why in News?

Recently, the Union Cabinet approved the ratification to the Kigali Amendment of the Montreal Protocol.

About Ozone layer, its depletion, and Montreal Protocol

- **Ozone (O_3) layer** is a high ozone concentration region in the **stratosphere** (**15-35 km** above earth surface), protecting life on earth by absorbing harmful ultraviolet radiations from the Sun.

UV, ANNEXES TO MONTREAL PROTOCOL AND SPECIAL SITUATION DEVELOPING COUNTRIES

Types of UV Radiation	Susbstances Controlled by Protocol	Classification of Countries
1. UVA- long wavelength (315-400 nm), Good for Health and pass through atmosphere. **2. UVB-** Medium wave-length (280-315), harmful for skin, most of it is filtered by atmosphere. **3. UVC-** Short wavelength (100-280 nm), most damaging and competely absorbed by Ozone.	**1. Annexes A** (CFCs, halons) **2. Annexes B** (other fully halogenated CFCs, carbon tetrachloride, methyl chloroform). **3. Annexes C** (HCFCs). **4. Annexes F** (HFCs or Hydrofluorocarbons).	**1. Non-Article 5 parties:** Developed Countries. **2. Article 5 parties:** Developing Country and whose annual calculated level of consumption of the controlled substances in Annex A is less than 0.3 kilograms per capita on the date of the entry into force of the protocol for it.

- Though produced and destroyed continuously, in the mid-1970s, scientists first realized the **threat to ozone from gases containing halogens (chlorine and bromine).**
- **Ozone depletion**, i.e., thinning of the ozone layer by ozone depleting substances was **confirmed in 1985** through formation of ozone hole over the **Antarctic** during the **Southern Hemisphere spring**.
- Growing evidence on ozone depletion and global consensus among scientists and policy makers **finally lead to the adoption of:**

Vienna Convention on Protection of Ozone Layer	Montreal Protocol on Substances that Deplete the Ozone Layer
Adopted in 1985 (entered into force in 1988), it: • **Promotes research and monitoring of human activities on the ozone layer.** • **Take concrete action against activities with adverse effects on ozone layer.**	**Adopted in 1987** (entered into force in **1989**), it: • Calls for **specific actions** to **protect ozone layer** by **phasing out** the **consumption** and **production** of **most chemicals** that deplete ozone. • Developing and developed countries have **equal but differentiated responsibilities,** but most importantly, both groups of countries have **binding, time-targeted and measurable commitments.** • The Montreal Protocol also led to the adoption of a **Multilateral Fund.** The objective of this fund is to **aid developing countries in implementation of the protocol.** • In 1990 the **Technology and Economic Assessment Panel (TEAP) was established as the technology and economics advisory body** to the Montreal Protocol Parties.

India and Montreal Protocol

- India became Party to the **Vienna Convention and the Montreal Protocol in 1991 and 1992** respectively.
- India has **proactively phased out the production and consumption of CFCs** except use in Metered Dose Inhalers (MDIs) used for treatment of Asthma and Chronic Obstructive Pulmonary Disease (COPD) ailments from 2008.
  - Subsequently, the **use of CFCs in MDIs has been phased out from 2012.**
- An **Ozone Cell has been setup** (under the Environment Ministry) **as a National Ozone Unit (NOU)** to render necessary services for effective and timely implementation of the Montreal Protocol and its ODS phase-out program in India.

Hydrofluorocarbons (HFCs) and the Kigali Amendment to Montreal Protocol

HFCs are a group of industrial chemicals **primarily used for cooling and refrigeration as replacements for ozone-depleting substances**.

- Though they are **not ozone depleting substances, they are part of Short-Lived Climate Pollutants (SLCPs) with high global warming potential** (ranging from 12 to 14,000 of carbon dioxide Global Warming Potential).
- The **Kigali Agreement** (adopted in **2016** and **entered** into **force** in **2019**), categorized nations into **3 groups** with a **four-step path** to achieve 80% reduction in HFCs consumption by 2047.
  - It is a **legally binding agreement** designed to create rights and obligations in international law.

- Up till July 2021, **122 countries have ratified** the Kigali amendment.

- Being in **Group 2,** India will develop its **national strategy** for phasing down of **Hydrofluorocarbons by 2023** (after consultation with industry stakeholders).

The healing of the ozone layer with **99% phase out** of harmful ozone depleting substances and the **ratification of Montreal Protocol by all UN members** makes it a huge environmental success.

Also, from 1990 to 2010, the treaty's control measures are estimated to have **reduced greenhouse gas emissions by the equivalent of 135 gigatons of CO_2.**

With many other ongoing efforts and plans to protect environment, it teaches some lessons for successful **multilateral negotiations** and putting policy into practice.

What are the lessons that can be learned from the success of Montreal Protocol?

- **Bring all stakeholders to same understanding through a clear message,** providing public support with commitment to the goals of the treaty.
- **Encourage Leadership and innovation** through flexible instruments. For instance, the flexibility of Montreal Protocol allowed moving from modest to strict controls.
- **Following principles** of Common but Differentiated Responsibilities and Respective Capabilities (CBDR-RC) to allow greater time limit for developing countries.
- **Transfer of Technology** or **substances** to assist developing countries in energy efficient and environment friendly technologies/products.

TARGETS FOR REDUCTION

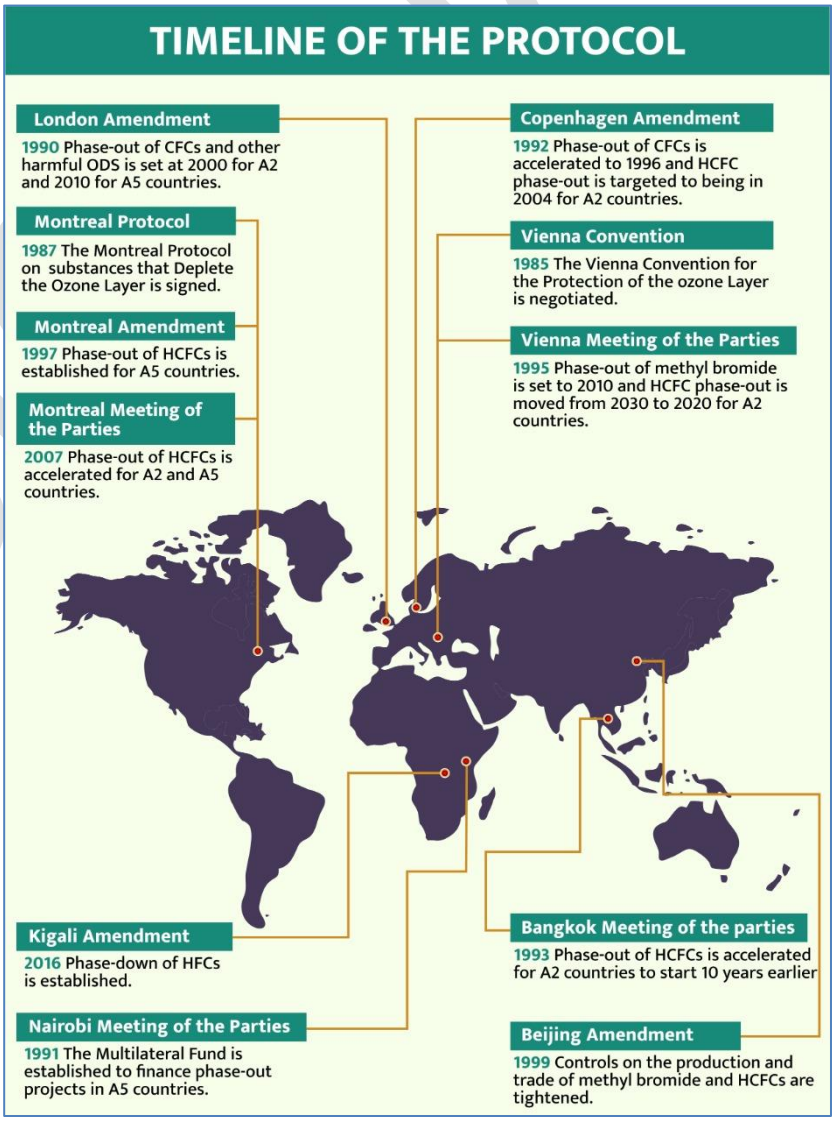
	As parties (Developing countries) - Group 1	As parties (Developing countries) - Group 2	Non parties (Developing countries)
Baseline formula	Average HFC consumption levels for 2020-2022 + 65% of hydrochloroflucarbon (HCFC) baseline	Average HFC consumption levelsfor 2024-2026 + 65% of hydrochloroflucarbon (HCFC) baseline	Average HFC consumption levels for 2011-2013 + 65% of hydrochloroflucarbon (HCFC) baseline
Freeze	2024	2028	-
1st step	2029 - 10%	2032 - 10%	2019 - 10%
1nd step	2035 - 30%	2037 - 20%	2024 - 40%
3rd step	2040 - 50%	2042 - 30%	2029 - 70%
4th step			2034 - 80%
Plateau	2045 - 80%	2047 - 85%	2036 - 85%

*For Belarus, Russian Federation, Kazakhstan, Tajikistan, Uzbekistan, 25% HCFC component of baseline and different initial two steps (1) 5% reduction in 2020 and (2) 35% reduction in 2025.

Notes:

1. **Group 1:** Article 5 parties not part of Group 2
2. **Group 2:** Bahrain, India, the Islamic Republic of Iran, Iraq, Kuwait, Oman, Pakistan, Qatar, Saudi Arabia and the United Arab Emirates.
3. Technology review in 2022 and every five years.
4. Technology review four to five years before 2028 to consider the compliance deferral of two years from the freeze of 2028 of Article 5 Group 2 to address growth in relevant sectors above certain threshold.

TIMELINE OF THE PROTOCOL



- **Incremental Funding** to promote performance and assist in capacity building.
- **Trade provisions** which limit restrictions between signatories only. E.g., once primary CFC producing countries signed, others had to sign up or face loss of access to associated technologies.
- Follow **'Precautionary Principle'** i.e., to take action even if science is still in doubt, preventing more damaging consequences if actions are postponed.
- **Provide a stable framework,** promoting long-term research and innovation from industry for mutual benefits.
- **Non-punitive compliance procedure** with **institutional support** to prepare action plans.

8.5. CRITICAL MINERALS

Why in news?

Exploration, excavation and setting up critical material value chains through adequate downstream investments have become imperative for India in today's world.

About Critical minerals

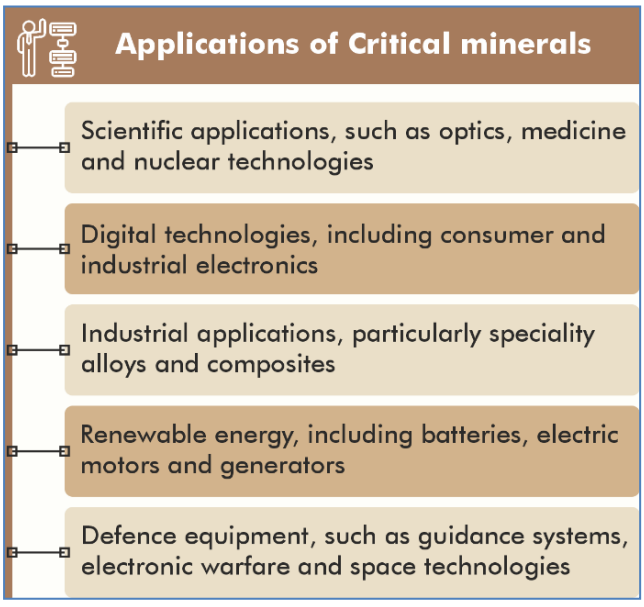
- Critical minerals are metals and non-metals that **are considered vital for the economic well-being of the world's major and emerging economies**, yet whose **supply may be at risk** due to geological scarcity, geopolitical issues, trade policy or other factors. There is **no universal classification** of critical materials.
- Some examples include minerals such as - **Rare-earth elements (REE), lithium, cobalt,** tungsten, platinum, magnesium, molybdenum, antimony, vanadium, nickel, chromium, manganese etc.

Rare Earth Elements (REE)

- REE are a set of **seventeen metallic elements.** These include the fifteen lanthanides on the periodic table plus scandium and yttrium.
- These are characterised by **high density, high melting point, high conductivity and high thermal conductance**.
- They are **considered 'rare'**, because they're scattered in tiny bits all over the planet, not clustered together in veins, like other minerals.
- REE and alloys that contain them are **used in many devices that people use every day such as computer memory, DVDs, rechargeable batteries,** cell phones, catalytic converters, magnets, fluorescent lighting etc.
- **China provides more than 85 per cent of the world's REE.**

Risks associated with Critical Minerals

- **High geographical concentration:** Production of critical minerals is highly concentrated. E.g., for lithium, cobalt and rare earth elements, the **world's top three producing nations control well over three-quarters of global output**.
  - High levels of concentration, compounded by complex supply chains, **increase the risks that arise** from major producing countries.
- **Long Project development times:** It takes 16.5 years on average for mining projects from discovery to first production. This poses risk for ramping up supply if demand were to pick up.
- **Resource as 'Diplomatic weapon':** It is a form of economic sanction, where a government withholds (or threatens to withhold) supply of a natural resource to extract some kind of concession from a target. For e.g.: In 2010, rare earth minerals were subject of trade conflict between China and Japan, which had originally begun over disputed Senkaku/DiaoyuIslands.
- **Environmental risks:** Production and processing of mineral resources leads to toxic and radioactive by-products dumped in the environment that harms flora-fauna and local communities.
- **Declining resource quality:** In recent years ore quality has continued to fall across a range of commodities. Extracting metal from lower-grade ores requires more energy and leads to higher production costs, greenhouse gas emissions and waste.



- **Low number of market players:** The complexity of the value chains, high investment overheads for processing and small markets imply only a handful of businesses or countries participate in the critical materials market.

Reasons for India's low resource security vis-à-vis critical minerals

India is **almost 100% import dependent** for supply of many critical minerals. Some reasons for this are:

- **Supply constraints:** Supply is constrained due to the **lack of suitable technology adoption** and **inefficient policy mechanisms** to drive mining and mineral exploration.
- **Lack of financial resources:** Expenditure on R&D activities has been **low (~ 1% of overall GDP)** as compared to the developed economies.
- **Poor mapping of mineral reserves:** Efforts to **map the mineral reserves** of country are **not at par** with other nations. For eg: **Australia** has mapped **90%** of its total land mass against **India's30-40%.**
- **Lack of skilled workforce:** There is an **absence of a trained workforce** with the requisite technical expertise which affects mineral exploration adversely.
- **Geo-political volatility:** India also has had **geopolitical stand-offs poor trade relationships** with countries that hold majority reserves of critical minerals. E.g.: Standoff with China in Ladakh.

Way forward

International Energy Agency released report titled 'The Role of Critical World Energy Outlook Special Report Minerals in Clean Energy Transitions' in 2020 where it gave six key recommendations for mineral security:

- **Diversification of value chains:** There is an immediate need to expand supply networks by bringing in new up-stream mineral producers. These will reduce the prevalence of monopoly and allow competition.
- **Promote technology innovation at all points along the value chain for** more efficient use of materials, allow material substitution and unlock sizeable new supplies.
- **Scale up recycling.** Policies for incentivising recycling for products reaching the end of their operating lives, supporting efficient collection and sorting activities and funding R&D into new recycling technologies.
- **Enhance supply chain resilience and market transparency:** Given the complexity, no single country can control the entire critical material value chain and needs different partners contributing to mining, processing and manufacturing activities.
- **Mainstream higher environmental, social and governance standards:** If players with strong environmental and social performance are rewarded in the marketplace, it can lead to greater diversification among supply.
- **Strengthen international collaboration between producers and consumers:** An overarching international framework for dialogue and policy co-ordination among producers and consumers can play a vital role.

Government Initiatives/Schemes/Policies

- **Critical Minerals Strategy for India (2016),** with a focus on India's resource requirements till 2030 has **identified 49 minerals**.
- **KhanijBidesh India Ltd (KABIL):** It was set up in 2019 for consistent supply of critical minerals through acquisition, exploration, mining and processing of strategic minerals.
- **National Mineral Policy (2019):** This policy was aimed to bring transparency, better regulation and enforcement, balanced social and economic growth as well as sustainable mining practices for exploration of non-fuel minerals in India.
- **Production Linked Incentive (PLI) Scheme for High Efficiency Solar PV Modules: This scheme was launched to enhance India's manufacturing capabilities and exports.**

8.6. ANTARCTIC TREATY

Why in news?

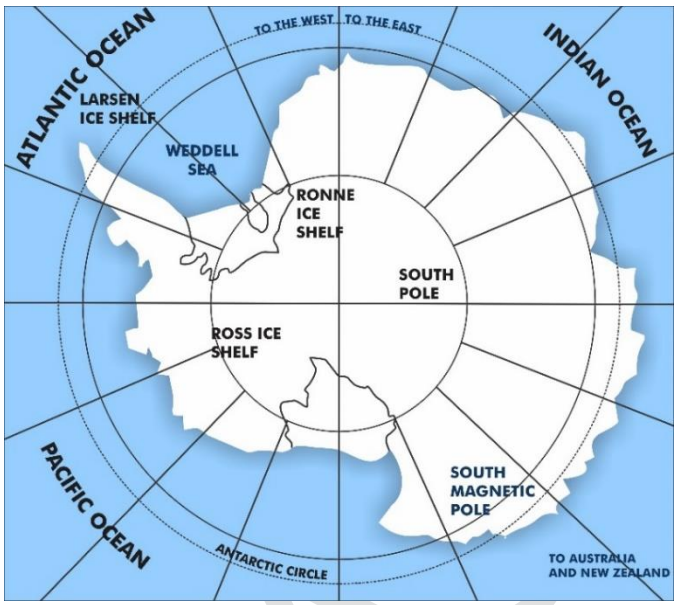
Recently, India Extended support for protecting Antarctic environment and for designating East Antarctica and Weddell Sea as Marine Protected Areas (MPAs).

More on news

- India also urged the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) member countries to ensure **that India remains associated with the formulation, adaptation, and implementation mechanisms of these** Marine Protected Areas (MPAs) **in future.**
  - Designating East Antarctica and the Weddell Sea as the MPAs are **essential to regulate illegal unreported and unregulated fishing (IUUF).**

- MPAs provides **protection for all or part of its natural resources, certain activities within an MPA are limited or prohibited** to meet specific conservation, habitat protection, ecosystem monitoring, or fisheries management objectives.

- **CCAMLR,** with an aim to conserve marine life, came into force in 1982**, as part of the Antarctic Treaty System (ATS),** which is at the heart of **Antarctic Treaty 1959.**
  - It is an international treaty to **manage Antarctic fisheries to preserve species diversity and stability of the entire Antarctic marine ecosystem.**



Marine Protected Areas (MPAs)

- An MPA is essentially **a space in the ocean where human activities are more strictly regulated than the surrounding waters** - similar to parks we have on land. These places are given **special protections for natural or historic marine resources by local, state, territorial, native, regional, or national authorities**.
- **MPAs and their network offer nature-based solution to support global efforts towards climate change adaptation and mitigation**.
  - As of March 2021, the **World Database on Protected Areas reported that only 7.65% of the global seas** had been covered.
  - This is far from the commitments of States made in relation to the Convention on Biological Diversity's (CBD) **Aichi Target 11 of 10% MPA coverage by 2020,** and even further from the recommendations made at the IUCN World Parks Congress 2014 that at least 30% no-take MPA coverage worldwide is needed.

About Antarctica

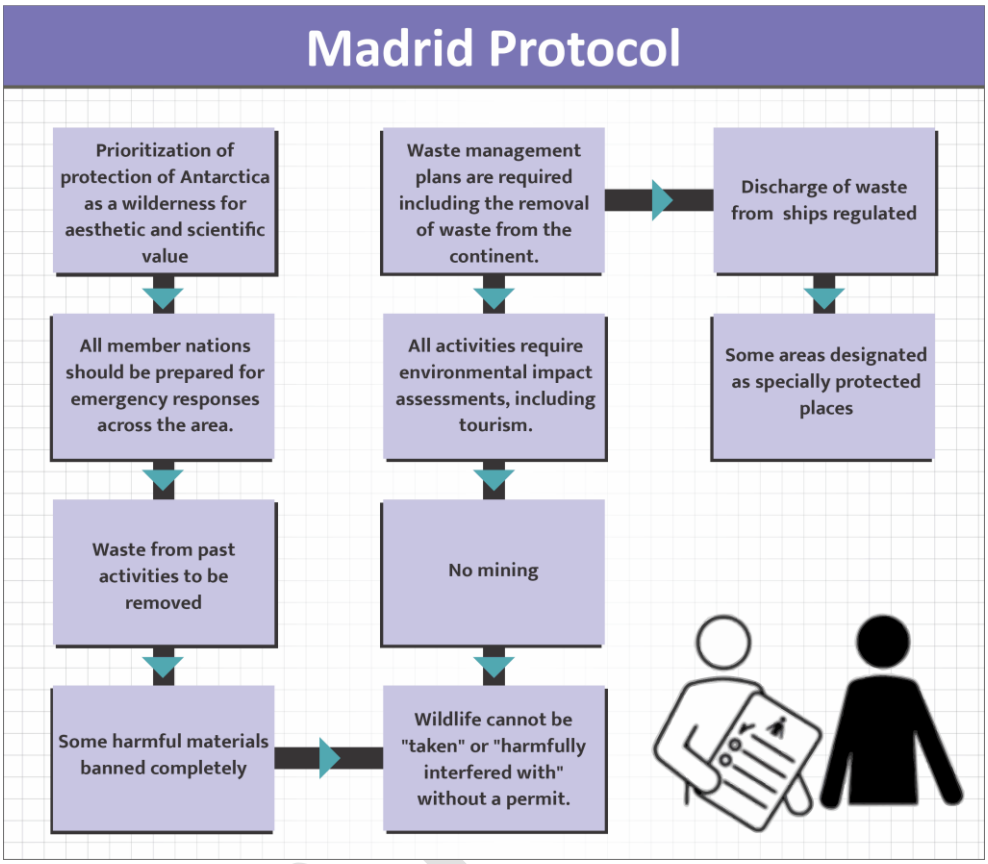
- Antarctica is not a country. I**t has no government and no indigenous population**. Instead, the entire continent is set aside as a scientific preserve.
- The Antarctic Treaty was **signed i**n Washington in 1959 by the **twelve countries whose scientists had been active in and around Antarctica** during the International Geophysical Year (IGY) of 1957-58.
  - **These 12 countries are:** Argentina, Australia, Belgium, Chile, France, Japan, New Zealand, Norway, South Africa, USSR (now Russia) the UK, and the US.
  - The **total number of Parties to the Treaty is now 54 (including India).**
  - The Treaty **entered into force in 1961** and has since been acceded to by many other nations.
  - It is also the **foundation of a rules-based international order for a continent** without a permanent population**.**
- The treaty is framed to ensure 'in the interests of all mankind that **Antarctica shall continue forever to be used exclusively for peaceful purposes** and shall not become the scene or object of international discord.'
  - To this end it **prohibits military activity, except in support of science;** prohibits nuclear explosions and the disposal of nuclear waste; promotes scientific research and the exchange of data; and holds all territorial claims in abeyance.
- The **Protocol on Environmental Protection to the Antarctic Treaty was signed in Madrid in 1991** and entered into force in 1998.
  - Its purpose was **to enhance protection of the Antarctic environment** and dependent and associated ecosystems.

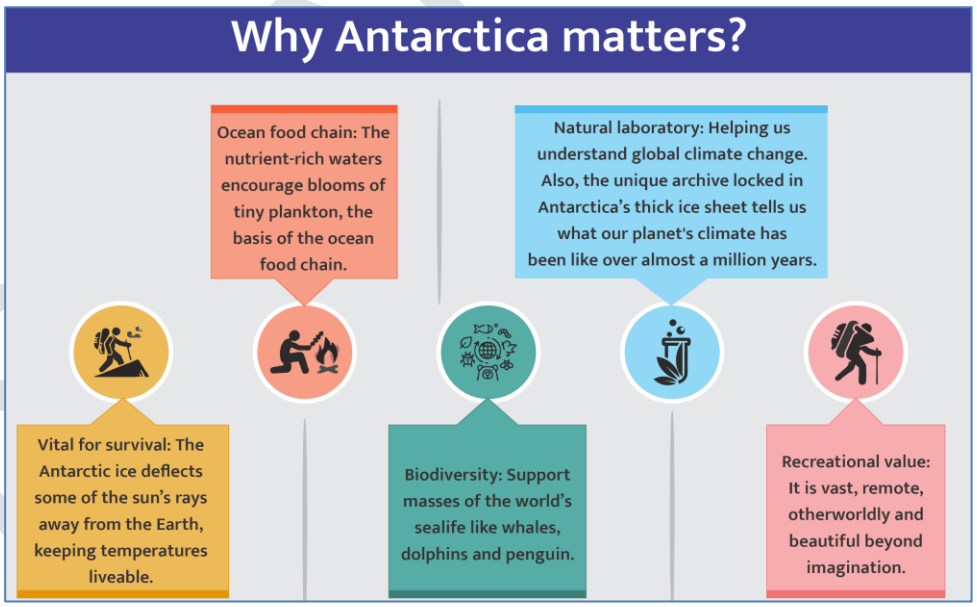
Challenges faced by the Antarctica

- **Territorial dispute between parties:** Argentina and the UK, for instance, have overlapping claims to territory on the continent. When combined with their ongoing dispute over the nearby Falkland (Malvinas) Islands, their Antarctic relationship remains frosty.
- **Assertive China:** China is spending huge amount of money, every year, on Antarctica. There is considerable speculation as to China's interests in Antarctic resources, especially fisheries and minerals,

and whether China may seek to exploit weaknesses in the treaty system to secure access to those resources.

- **Climate change:** Climate change has the potential to cause significant biophysical change to Antarctica through changing patterns of sea ice formation and destabilization of ice sheets.
- **Changing circumstances:** Tourism, rise in IUU (i.e., illegal, unreported, and unregulated) fishing, biological prospecting (commercialization of knowledge gained from research with regard to bio-organisms) etc. are gaining momentum. All these together may put threat to the fragile ecosystem of Antarctica.
- **Conflict with the provisions of other laws:** Since the conclusion of the Antarctic Treaty in 1959, international law underwent profound changes.
    - For example, under the United Nations Convention on the Law of the Sea (also known as UNCLOS), 1982 an International Seabed Authority (ISA) has been founded which is responsible for granting permits for the exploitation of mineral resources from the deep seabed. The question has therefore arisen whether the ISA could grant permits for mineral exploitation of the deep seabed in the Antarctic region, despite the Madrid Protocol, which prohibits mineral exploitation in the Antarctic.





Way ahead

- **Effective implementation of the Treaty:** To resolve this situation, firstly, the Antarctic Treaty Members must pressure every member state to the Antarctic Treaty System (ATS) to implement the rules of the ATS in a strict manner. New, more stringent environmental protection regulations will be of no avail if they are not properly implemented.

- **New regulation based on scientific findings:** For this, scientists will have to learn how to translate scientific findings into policy-relevant information. This will be a condition sine qua non for a performant environmental protection system.
- **A dedicated tourism convention for the region**: This convention could serve to reaffirm the philosophic base of the Antarctic Treaty, namely international cooperation in scientific research, and in doing so combat the commercialization of the Antarctic region.
- **Behavioral change**. People need to be taught how fragile the Antarctic environment and ecosystem are. They need to understand the problems posed by cumulative impacts.

India's endeavor in Antarctica

- India **signed Antarctic Treaty in 1983** and soon received consultative status.
- The Protocol on Environmental Protection to the Antarctic Treaty (the Environmental Protocol or **Madrid Protocol**) **entered into force for India in 1998.**
- India is also **a member of** Council of Managers of National Antarctic Programme **(COMNAP**), Scientific Committee of Antarctica Research **(SCAR)** and Commission for Conservation of Antarctic Marine Living Recourses **(CCAMLR).**
- **India's Research stations: Maitri** at Schirmacher Hills, **Bharati** at Larsemann Hills (Dakshin Gangotri was the first Indian base established in 1984).
- The Antarctic operations of India are currently funded from the **budget allocated to the Ministry of Earth Sciences** under relevant head.
- **The Indian Antarctica Bill, 2021**
  - The Bill aims at **having India's own national measures for protecting the Antarctic environment** and dependent and associated ecosystem.
  - Provides a **regulatory framework for India's Antarctic activities and protection of the Antarctic environment** as per the Antarctic Treaty, and the CCAMLR.

8.7. HUMAN DEVELOPMENT AND THE ANTHROPOCENE

Why in News?

The 2020 Human Development Report titled "The next frontier: **Human Development and the Anthropocene**" was released by the **United Nations Development Programme (UNDP)**.

About the Human Development Report (HDR)

- HDR is released and was released for the first time in the year 1990.
- HDI is released as part of the first HDR. This measures achievement in the basic dimensions of human development across countries. The **HDI ranks countries on the basis of three parameter:**
  - Life Expectancy
  - Education
  - Gross National Income (GNI) per capita
- **HDR 2020 findings with respect to India**
  - India dropped two ranks in HDI this year, standing at **131 out of 189 countries**. Norway topped the index, followed by Ireland.
  - India's **gross national income per capita fell to $6,681 in 2019** from $6,829 in 2018 on purchasing power parity (PPP) basis.
  - **Life expectancy** at birth in 2019 was **69.7 years.**

What is the relationship between Anthropocene risks and human development?

- Report argues that people and the p**lanet are entering an entirely new geological epoch, the Anthropocene or the Age of Humans**, in which **humans are a dominant force** shaping the future of the planet.
- Core concept that the term Anthropocene is trying to capture is that **human activity is having a dominating presence on multiple aspects of the natural world** and the functioning of the Earth system.
- **Recent Manifestation of pressures leading to Anthropocene age**
- **Covid-19 pandemic has shown how the effects of large-scale shocks** emerge out of ecological systems under pressure from social activities. COVID-19 is rooted ultimately in unbalanced interactions between people and the planet.
- **Climate change is weakening economic progress** and increasing inequality, with a greater burden for developing countries.

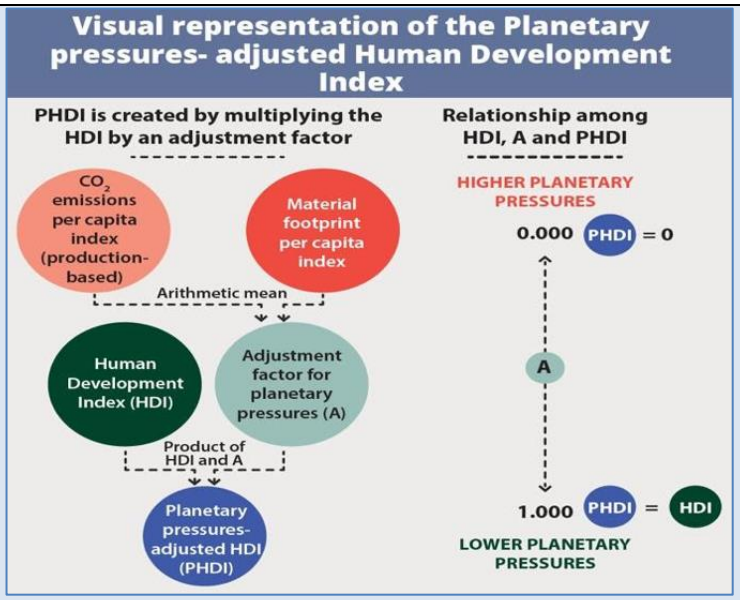
- **Increasing hunger** as after two decades of progress the number of people affected by hunger (undernourished people) has been increasing since its low of 628 million in 2014.
- Effects of **natural hazards have been increasing** since the turn of the millennium.

What are the measures required to ease planetary pressures?

Transformational changes	• **Equity** which can rebalance power asymmetries so that everyone can benefit from and contribute to easing planetary pressures. • **Innovation**—which gave humans many of the tools to influence Earth systems—can be harnessed to ease planetary pressures. • **Instilling a sense of stewardship of nature** can empower people to rethink values, reshape social norms and steer collective decisions in ways that ease planetary pressures.
Social Norms	• Social norms can **inform choices on transportation, production and consumption** can evolve towards norms that reduce planetary imbalances. • They are **powerful determinants of people's choices** and can change faster than commonly assumed. And new forms of information sharing can support social processes of ethical reasoning.
Incentives for Change	• Incentives determine in part **what consumers choose to buy, what firms produce and trade, where investors put their money** and how governments cooperate. • Incentives help **explain current patterns of consumption, production, investment** and other choices that lead to the planetary pressures. • Incentives could **evolve ways that would ease planetary pressures**.

Nature-based solutions	• These **can protect, sustainably manage and restore ecosystems,** simultaneously promoting wellbeing and mitigating biosphere integrity loss.
	• Even though they are bottom-up and context-specific, they **can contribute to transformational scale at higher levels for two reasons.**
	  ○ First, many local and community decisions add up to substantial global impact.
	  ○ Second, planetary and social and economic systems are interconnected, and local decisions can have impacts elsewhere and at multiple scales.
	 

Developing New tool for Measuring human development and Anthropocene	• **By adjusting the HDI to include two more elements:** a country's carbon dioxide emissions and its material footprint. • **The adjustment corresponds to multiplying the HDI by an adjustment factor, creating the PHDI** (refer diagram).

	 • If a country puts no pressure on the planet, its PHDI and HDI would be equal, but the PHDI falls below the HDI as pressure rises.
Reimagining the human development journey (where do we want to go?)	• **Decoupling economic growth from emissions and material use** is key to easing pressures on the planet while improving living standards. • It calls on **all countries to improve wellbeing equitably** while easing pressures on the planet. • **Reducing pressure on the biosphere** by protecting biodiversity and restoring landscapes and seascapes

WEEKLY FOCUS: ENVIRONMENT

ISSUE	DESCRIPTION	LEARN MORE
 Climate Change and its impact on Indian Region	Warming induced mainly by anthropogenic factors since 1950s has contributed to a significant increase in weather and climate extremes globally (including in the Indian Ocean Region). The impact on the Indian Ocean Region will have a direct bearing for the Indian sub-continent. To accept this and understand 'what are the challenges India may face' and 'what policy options India has' should be the topmost priority to mitigate and adapt to this situation.	
 Climate Change Negotiations	Climate change is one of the most heard of phenomena in the present times that is impacting lives across the globe. COVID pandemic is also being touted as the latest manifestation of this phenomenon. Dealing with the widespread impacts of climate change hence calls for coordinated international efforts. This document describes the tale of emergence of various global climate change negotiations and agreements and discusses the issues plaguing their sincere adoption and effective implementation.	
 Transitioning to a Sustainable Energy Ecosystem	Energy is the engine that fuels our economies and modern human activities. Societal and economic disruptions due to the COVID-19 pandemic have given rise to calls for nations to "build back better", and to steer economies towards more sustainable trajectories. The document analyses the developmental benefits of investing in a sustainable energy ecosystem and India's progress in this domain. It further discusses models such as Energy Trilemma to develop greener and more inclusive energy systems that offer greater resilience to future crises.	
 Conserving the Forests: Save Today, Survive Tomorrow	Energy is the engine that fuels our economies and modern human activities. Societal and economic disruptions due to the COVID-19 pandemic have given rise to calls for nations to "build back better", and to steer economies towards more sustainable trajectories. The document analyses the developmental benefits of investing in a sustainable energy ecosystem and India's progress in this domain. It further discusses models such as Energy Trilemma to develop greener and more inclusive energy systems that offer greater resilience to future crises.	
 Sustainable Development Goals: The Pathway to the Future	The 2030 Agenda for Sustainable Development is more than the sum of measurable Goals, targets, and indicators. It provides a shared blueprint for peace and prosperity for people and the planet, now and into the future. With less than a decade left, countries across the world, including India, still remain off track to achieve the Sustainable Development Goals, with the pandemic threatening to reverse years of progress. This document provides an assessment of India's current actions and progress towards achieving the SDGs, whilst listing the obstacles it faces in its way and suggesting measures to overcome these barriers.	

10 IN TOP 10 SELECTIONS IN CSE 2020

from various programs of **Vision Ias**

1 AIR

SHUBHAM KUMAR
(GS FOUNDATION BATCH CLASSROOM STUDENT)

2 AIR

JAGRATI AWASTHI
(ALL INDIA TEST SERIES)

3 AIR

ANKITA JAIN
(ALL INDIA TEST SERIES)

4 AIR

YASH JALUKA
(ABHYAAS TEST SERIES)

5 AIR

MAMTA YADAV
(ALL INDIA TEST SERIES)

6 AIR

MEERA K
(ALL INDIA TEST SERIES)

7 AIR

PRAVEEN KUMAR
(ALL INDIA TEST SERIES)
ESSAY TEST, ABHYAAS, PDP)

8 AIR

JIVANI KARTIK NAGJIBHAI
(GS FOUNDATION BATCH CLASSROOM STUDENT)

9 AIR

APALA MISHRA
(ABHYAAS TEST SERIES)

10 AIR

SATYAM GANDHI
(ALL INDIA TEST SERIES, EASSY TEST)

YOU CAN BE NEXT

HEAD OFFICE Apsara Arcade, 1/8-B, 1st Floor,
Near Gate 6, Karol Bagh Metro Station
+91 8468022022, +91 9019066066

Mukherjee Nagar Centre
635, Opp. Signature View Apartments,
Banda Bahadur Marg, Mukherjee Nagar

DELHI

JAIPUR 9001949244 | HYDERABAD 9000104133 | PUNE 8007500096 | AHMEDABAD 9909447040 | LUCKNOW 8468022022 | CHANDIGARH 8468022022 | GUWAHATI 8468022022

/c/VisionIASdelhi /vision_ias /visionias_upsc /VisionIAS_UPSC