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# TARGET 2022



**ENVIRONMENT  
& GEOGRAPHY**



**JUNE 2021 TO  
JANUARY 2022**



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# TARGET 2022

## ENVIRONMENT & GEOGRAPHY

⌚ June 2021 to January 2022

### ENVIRONMENT

#### 1. POLLUTION

##### 1.1 Fly Ash

*NTPC Ltd (formerly known as National Thermal Power Corporation Limited) has invited Expression of Interest for sale of fly ash from the designated ports of the Middle East and other regions.*

- Fly ash is a finely divided byproduct obtained from the burning of coal in electric power generating plants and steam generating plants.
- It results from the combustion of pulverized coal. It is called fly ash because it is transported from the combustion chamber by exhaust gases.
- It is collected from the exhaust gases by electrostatic precipitators or filter fabric bag filters.
- Fly ash has substantial amounts of silicon dioxide ( $\text{SiO}_2$ ), aluminium oxide ( $\text{Al}_2\text{O}_3$ ), ferric oxide ( $\text{Fe}_2\text{O}_3$ ) and calcium oxide ( $\text{CaO}$ ).
- **Uses of fly ash** - Typical highway engineering applications include: Portland Cement Concrete (PCC), soil and road base stabilization, flowable fills, grouts, structural fill and asphalt filler.
- Fly ash is most commonly used as a pozzolan in PCC applications.
- [Pozzolans are siliceous or siliceous and aluminous materials, which in a finely divided form and in the presence of water, react with calcium hydroxide to produce cementitious compounds.]
- It is used as good mineral filler in hot mix asphalt (HMA) applications and improves the fluidity of flowable fill and grout.

##### 1.2 Study on Air Pollutants

*A new study says that Black Carbon (BC) has adverse effect on human health and leads to premature mortality.*

- The Scientists from the Centre of Excellence in Climate Change Research who conducted the study were supported by the Climate Change programme of Department of Science and Technology (DST).
- The study explored the individual and cumulative impact of BC aerosol, fine (PM 2.5), and coarse (PM 10) particulates, and trace gases ( $\text{SO}_2$ ,  $\text{NO}_2$ ,  $\text{O}_3$ ) on premature mortality in Varanasi of Indo-Gangetic plain.
- The Scientists utilized daily all-cause mortality and ambient air quality from 2009 to 2016 to clearly establish a significant impact of BC aerosols,  $\text{NO}_2$  and, PM2.5 exposure on mortality.
- **Findings** - The inclusion of co-pollutants ( $\text{NO}_2$  & PM 2.5) in the multi-pollutant model increased the individual mortality risks for BC aerosols.
- The effect of pollutants was more prominent for males, age group 5-44 and, in winter. The adverse effect of pollutants wasn't limited to current day of exposure but can extend as high as up to 5 days (Lag effect).



Black carbon, commonly known as soot, is a solid particle or aerosol that is produced from incomplete combustion. It is a form of particulate air pollutant that contributes to the warming of the atmosphere.

- The mortality rises linearly with an increase in air pollutants level and shows adverse impact at higher levels.

### 1.3 Smog Tower

Delhi will get its 1<sup>st</sup> smog tower in Connaught Place that aims to help combat air pollution at hotspots.

- The smog tower is expected to **clean the air** around a 1-km radius.
- The structure is 24 m high with 40 fans in its base that emit purified air at 10 m above the ground.
- It can discharge up to 1,000 cubic metres per second of air from the tower, helping reduce PM 2.5 and PM 10 levels in the locality.
- The tower uses a ‘downdraft air cleaning system’ in which the polluted air is sucked from the top and filtered air is released at the bottom of the tower through fans fitted on sides.
- Inside the tower in two layers are 5,000 filters.
- The ‘macro’ layer in the filter traps particles of 10 microns and larger, while the ‘micro’ layer filters smaller particles of around 0.3 microns.
- A control room has been set up at the site to monitor the operations of the smog tower.
- Another 25-metre-tall smog tower is being built by the central government at Anand Vihar, Delhi.
- In China, the updraft system is deployed in which air is sucked in from near the ground and filtered air is released at the top by propelling upwards by heating and convection.

### 1.4 WHO’s Global Air Quality Guidelines 2021

Global Air Quality Guidelines (AQGs) 2021 released by the World Health Organization (WHO) would make India appear worse than it already looked under the existing 2005 norms.







- WHO’s new Global AQGs are an evidence-based and practical tool for improving the quality of the air on which all life depends.
- AQGs recommend air quality levels for 6 pollutants - Particulate Matter (PM2.5 and PM10), ozone (O<sub>3</sub>), nitrogen dioxide (NO<sub>2</sub>) sulphur dioxide (SO<sub>2</sub>) and carbon monoxide (CO).
- It also highlights good practices for the management of certain PM types (black/elemental carbon, ultrafine particles, particles from sand & dust storms).
- This is applicable to both outdoor and indoor environments globally.

### 1.5 Emission Control Measures By Thermal Plants

In 2020, the Government of India made rules for use of coal by thermal power plants, without stipulations of ash content or distance.

- Technology Solution for emission norms** - Compliance of specified emission norms for Particulate Matter, as per the notifications of Central Pollution Control Board, issued from time to time.
- In case of washeries, Middling and rejects to be utilized in Fluidised Bed Combustion (FBC) technology based thermal power plants.
- Ash Ponds** - Thermal plants must comply with the Fly Ash notification, without being entitled to extra power generation capacity of fly ash pond on ground of switching from washed to

### WHO’s Global Air Quality Guidelines 2021

Pollutants	Averaging Time	2005 AQGs	2021 AQGs
 PM <sub>2.5</sub> µg/m <sup>3</sup>	Annual	10	5
	24 hr <sup>a</sup>	25	15
 PM <sub>10</sub> µg/m <sup>3</sup>	Annual	20	15
	24 hr <sup>a</sup>	50	45
 O <sub>3</sub> µg/m <sup>3</sup>	Peak Season <sup>b</sup>	-	60
	8 hr <sup>a</sup>	100	100
 NO <sub>2</sub> µg/m <sup>3</sup>	Annual	40	10
	24 hr <sup>a</sup>	-	25
 SO <sub>2</sub> µg/m <sup>3</sup>	24 hr <sup>a</sup>	20	40
 CO mg/m <sup>3</sup>	24 hr <sup>a</sup>	-	4

µg = microgram  
a 99th percentile (i.e. 3-4 exceedance days per year).  
b Average of daily maximum 8-hour mean O<sub>3</sub> concentration in the six consecutive months with the highest six-month running- average O<sub>3</sub> concentration.  
Note: Annual and peak season is long-term exposure, while 24-hour and 8-hour are short-term exposure.

unwashed coal.

- Segregation of ash may be done at the Electro-Static Precipitator stage to ensure maximum utilization of fly ash.
- **Coal Transportation** may be undertaken by Railway wagon (covered by tarpaulin or other means) or covered conveyer beyond the mine area.
- However, road transportation may be undertaken in covered trucks, if Rail transport/conveyer infrastructure is not available.
- With advancement in pollution control technologies, thermal plants are better equipped to capture fly-ash generated in combustion process and unwashed coal can be used more efficiently and economically.

### Fluidised Bed Combustion Technology

- It is a combustion technology used to **burn solid fuels** (types of coal, coal waste and woody biomass) at high efficiency and without the necessity for expensive fuel preparation.
- Fuel particles are suspended in a hot, bubbling fluidity bed of ash and other particulate materials (sand, limestone etc).
- Through this suspension, jets of air are blown to provide the oxygen required for combustion or gasification.
- The resultant fast and intimate mixing of gas and solids promotes rapid heat transfer and chemical reactions within the bed.
- For any given thermal duty, FBCs are smaller than the conventional furnace, so they offer advantages in terms of cost and flexibility.
- **Reduced Emissions** - FBC reduces the amount of SO<sub>x</sub>, NO<sub>x</sub> emitted.

### Other Options

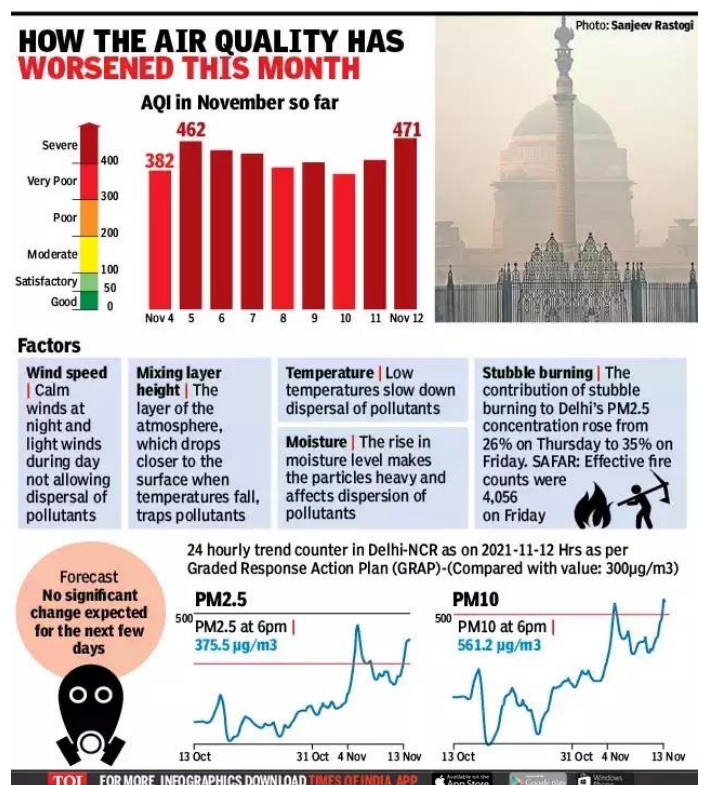
Various technology options for regulating the emission standards in coal-fired power plants include,

- Flue Gas Desulfurization System,
- Spray Dryer Absorber (SDA),
- Circulating Dry Scrubber (CDS),
- Limestone-based Wet FGD,
- Selective Non Catalytic Reduction,
- Electrostatic Precipitator,
- Bag House Dust Collector.

### 1.6 Getting to the Root of Delhi's Air Pollution

According to the latest data from SAFAR, the levels of PM<sub>10</sub> and PM<sub>2.5</sub> particles have reached 876 and 680 micrograms per cubic metres, against the safe limits of 100 and 60 micrograms per cubic metres, respectively.

- A study commissioned by the Delhi government (2016) highlights that road dust along with construction and demolition dust is the most prominent polluter of air.
- Vehicles are the second largest polluter, with 20 % of PM 2.5 load and approximately 9 % of PM 10.
- The per capita registration of high emission vehicles in Delhi is reportedly the highest in India.
- Then there are over 100 coal thermal plants in the immediate 300-km periphery of Delhi and Industrial point sources have an annual



contribution of about 11 % of PM 2.5 and 10 % of PM 10.

- Open burning of waste by neighbourhoods and municipalities, stubble burning, etc adds to this issue.
- Given the geographical nature of the region, Delhi ends up becoming a pollution trap with weather and wind speed playing a key role.
- Diwali crackers and stubble burning are the two most visible sources of pollution and every other sources of pollution are conveniently brushed under the carpet.
- **Relevance of neighbouring states** - Stubble burning takes place for maximum three-four weeks in the month of October-November contributing to 2- 38 % of Delhi's ambient air quality.
- Goyal (2014) of Centre for Atmospheric Sciences, IIT Delhi reported that the largest contributor of air pollutant emissions in Delhi is found to be vehicles followed by industries, power plants and domestic sources.
- If stubble burning in these States is the only cause for Delhi's severe air pollution, then the air quality in Lucknow, Chandigarh and Amritsar should be high as well but this is not the case.
- The satellite images by ISRO prove that the neighbouring States were responsible for only 20% of the pollution, whereas the 80% was strictly from Delhi and mainly due to its garbage problem.

### 1.7 Reduction in Stubble Burning

*The Centre-constituted Commission for Air Quality Management said that there could be reduced stubble burning in the coming seasons due to two main factors.*

- **Reduction in the area under paddy cultivation** - The total paddy area in Haryana, Punjab and the eight NCR (National Capital Region) districts of Uttar Pradesh has reduced by 7.72% during 2021 as compared to the previous year.
- **A shift away from paddy varieties that take long to mature** - PUSA-44 variety has the longest duration (145-150 days) of maturity and leaves a shorter window for wheat sowing after its harvest.
- Also, it's the non-basmati variety of rice, whose stalk remains, that is usually burnt off by farmers ahead of sowing wheat.
- So, crop diversification and moving away from PUSA-44 variety with short duration High Yielding Varieties are thus part of the action plan for control of stubble burning.
- With this, total paddy straw generation from the non-basmati variety of rice is likely to be reduced by 12.42%.

### 1.8 Stubble Burning & Reduced Lung Function

*A study, correlating the effect of air pollution on health, says that air pollution from stubble burning significantly reduced lung function and was particularly harmful to women in rural Punjab.*

- The study found that the PM<sub>2.5</sub> concentrations was found to increase more than twice between the two phases, from 100 g/m<sup>3</sup> to 250 g/m<sup>3</sup>.
- [PM<sub>2.5</sub> is the category of unburnt carbon particles considered most harmful to respiratory health.]
- These concentrations are around 10-15 times the WHO prescribed air quality standards though the permissible standards by India's Central Pollution Control Board (CPCB) are higher.
- **More symptoms** - During the crop residue burning period, a 2 to 3-fold increase was noted in most of the respiratory symptoms across all age groups (10-60 years).
  - The highest number of respiratory complaints were reported by the elderly population (>40-60)
  - The lowest number of respiratory complaints were reported in the younger age group (>10-18).
- There was decline in lung function with increase in PM<sub>2.5</sub> concentration across all age groups even after controlling for several other variables, such the influence of cooking fuel, ventilation, distance from road etc.
- The study reported a 10-14% decline in lung function in men and nearly 15-18% decline in women across all age categories.

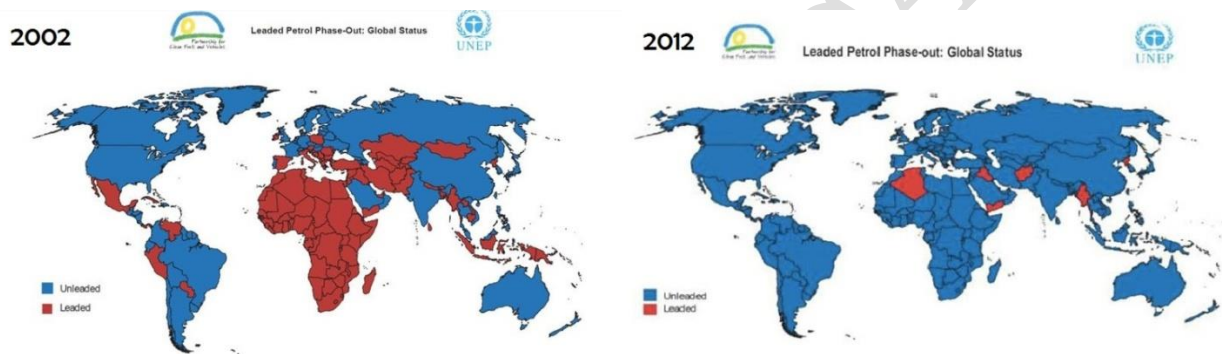
### 1.9 Leaded Petrol

*According to UNEP, World has completely eradicated the use of Leaded Petrol.*

- Globally, automotive fuel is completely lead-free now. Not a single fuel outlet sells leaded petrol anymore anywhere.
- Algeria was the last country to use the fuel.
- This feat is achieved after UNEP-led global Partnership for Clean Fuels and Vehicles (PCFV) began its campaign in 2002 to eliminate lead in petrol.
- Fumes from leaded petrol vehicles have been a significant source of lead exposure to humans.
- It affects emissions control systems of vehicles particularly catalytic converters.
- **India and Leaded Petrol** - It started its phase down in 1994 and completed in 2000.
- Initially, low-leaded petrol was introduced in Delhi, Mumbai, Calcutta and Chennai in 1994, followed by unleaded petrol in 1995.

### Partnership for Clean Fuels and Vehicles

- It was setup at the World Summit on Sustainable Development, 2002. UNEP hosted the Secretariat.
- Its aim is to eliminate leaded petrol globally and provided support to many countries and regional initiatives.
- At the time, 117 countries world-wide were still using leaded petrol with 86 countries supported to phase out leaded petrol.
- In 2006, the first major success was achieved – Sub-Saharan Africa went unleaded.



### 1.10 Flex-Fuel Vehicles

The government has advised carmakers to start making Flex Fuel Strong Hybrid Electric Vehicles (FFSHEV).

- Flex fuel vehicles (FFV) are capable of running on 100% petrol or 100% bio-ethanol or a combination of both.
- [Ethanol blends - E12 fuel is a blend of 12% ethanol in gasoline, while E 15 fuel is a blend of 15% ethanol in gasoline.]
- Flex Fuel Strong Hybrid Electric Vehicles (FFSHEV) essentially houses an electric motor which powers the vehicle alongside the traditional petrol engine.
- Such vehicles are yet to be made widely available in world markets.
- **Role in cutting emissions** - By hitting E20
  - Carbon monoxide emissions were 50% lower in two-wheelers and 30% lower in four-wheelers compared to petrol.
  - Hydrocarbons were lower by 20%.
- E20 blending will result in drop in fuel efficiency by nearly 6-7% in 4 wheelers designed for E0 and calibrated to E10.
- **Difference from existing vehicles** - Dual fuel vehicle means the engine uses two fuels (gas and diesel) at the same time
- Bi Fuel means the engine could run on either fuel separately.
- FFV is capable of running on either petrol or ethanol or a combination of both hence it is a synthesis of Dual fuel vehicle and Bi fuel vehicle.

- Both of the fuels are stored in same common tank. The fuel injection and spark timing are automatically adjusted in accordance with the actual blend detected by the fuel composition sensor.
- **Government Prescribed Standard for blending** - Bio-ethanol contains less energy per litre than petrol. However the calorific value will become on par with petrol with use of advanced technology.
- A litre of petrol sold in India has an average of 8% ethanol content even though oil marketing companies have clearance to do 10% (E10) blending.
- All vehicles manufactured in India are tuned for E10. They will not be able to run on higher ethanol content beyond 10%.
- **Need for pushing FFV** - In FY21 India's oil import bill stood at \$62.7 billion. To make matters worse, the rupee is at its weakest level in last three financial years.
- The government is desperate to bring down the oil import bill by creating fuel substitutes like ethanol, hydrogen and electricity.
- Even a push till the E20 level can result in savings of \$4 billion per annum.
- This is possible only if flex-fuel vehicles are made available in the market.
- Also, FFVs will also help the government meet its commitments when it comes to reducing emission.
- **Reaction of Auto Industries** - Auto parts that come in contact with higher ethanol content have to be replaced with a compatible product to avoid corrosion.
- So higher blending of ethanol increases manufacturing costs of vehicles.
- Automotive companies say that they are ready to move with E20 by 2025.

#### 1.11 Dust Mitigation Measures at C&D Sites

*Commission for Air Quality Management in NCR and Adjoining Areas (CAQM) has been taking up for strict compliance of dust mitigation measures at Construction & Demolition (C&D) sites.*

- *Dust emanating from C&D sites is a major consistent source of air pollution.*
- The statutory directions were issued by CAQM to the authorities of the NCR states and Delhi to reduce dust from C&D sites includes imposing and collecting Environmental Compensation (EC) from the
  1. Violators of dust mitigation norms at the C&D sites, and
  2. Vehicles found violating the prescribed dust abatement norms during transportation of materials relating to C&D waste.
- C&D activities generate enormous amounts of dust and contribute significantly to PM<sub>2.5</sub> and PM<sub>10</sub> adversely affecting the quality of air.
- To tackle the problem of dust resulting from construction, remodeling, repair and demolition, such activities need to be strictly monitored and inspected regularly for compliance of various dust control measures.

#### 1.12 Low-Carbon Bricks

*Researchers have developed energy-efficient low-carbon bricks using construction and demolition waste (CDW) and alkali-activated binders.*

- These low-carbon bricks were developed from CDW waste through an alkali activation process using fly ash and ground slag.
- Low-carbon bricks do not require high-temperature firing, and avoid the use of high-energy materials such as Portland cement.
- The technology will be a solution to,
  1. Disposal problems associated with C&D waste mitigation,
  2. Conservation of mined raw material resources,
  3. Reduction of emission.

## WATER POLLUTION

### 1.13 Sea Snot Outbreak

Turkey's Sea of Marmara, that connects the Black Sea to the Aegean Sea, has witnessed the largest outbreak of 'sea snot'. The sludge has also been spotted in the adjoining Black and Aegean seas.

- A 'sea snot' outbreak was first recorded in the country in 2007. It was also spotted in the Aegean Sea near Greece. But the current outbreak in the Sea of Marmara is by far the biggest in the country's history.
- **Sea snot** is a slimy layer of grey or green sludge that floats up on the surface of the seas, which can cause damage to the marine ecosystem.
- It is marine mucilage formed when algae are overloaded with nutrients due to water pollution combined with the effects of climate change.
- **Causes** - The nutrient overload occurs when algae feast on warm weather caused by global warming.
- Overproduction of phytoplankton caused by climate change and the uncontrolled dumping of waste into the seas has led to the present crisis.
- **Impact on Marine Ecosystem** - The growth of the mucilage is posing a severe threat to the marine ecosystem of the country.
- Over a period of time, it could end up poisoning all aquatic life, including fishes, crabs, oysters, mussels, corals, sponges and sea stars.
- If unchecked, this mucilage spread can collapse to the bottom and cover the sea floor, causing major damage to the marine ecosystem.
- Besides aquatic life, the 'sea snot' outbreak has also affected the livelihoods of fishermen.
- The 'sea snot' can also cause an outbreak of water-borne diseases such as cholera in cities like Istanbul.

### 1.14 Microplastics Pollution in the Ganga

An analysis of the stretches of the river Ganga by Delhi-based environment NGO Toxics Link has revealed pollution by microplastics.

- Microplastics are defined as synthetic solid particles sized ranging 1 micrometre ( $\mu\text{m}$ ) to 5 millimetre (mm).
- These are insoluble in water.
- Microplastics are recognised as a major source of marine pollution.
- The major sources of microplastics are:
  - i. untreated sewage from many cities along the river's course
  - ii. industrial waste
  - iii. religious offerings wrapped in non-degradable plastics
- The plastic products and waste materials released or dumped in the river are eventually broken down into micro particles.
- The river finally transports large quantities downstream into the ocean which gets to be the ultimate sink of all plastics being used by humans.
- The study is titled 'Quantitative analysis of Microplastics along River Ganga', which was based on an analysis of water samples at Haridwar, Kanpur and Varanasi.
- **Highlights of the study** - The highest concentration of microplastics was found at Varanasi. It comprised single-use and secondary broken-down plastics from articles of everyday use.
- These include tyres, clothing, food packaging, bags, cosmetics with microbeads, garland covers and other municipal waste.
- The sample test results show the presence of at least 40 different kinds of polymers as microplastics.
- The shapes and nature of the observed resins ranged from fibres to fragments, films and beads. Fragments were the predominant shape in all locations, followed by film and fibre.
- Microbeads were observed in Varanasi and Kanpur, while no beads were found in Haridwar.

#### DID YOU KNOW?

Ganga has India's largest river basin in terms of catchment area and constitutes about 26% of India's landmass spread across 11 states, which supports 43% of the population.

- The most frequent size range observed in all the samples was  $<300\mu\text{m}$ .
- Previous studies say that over 663 marine species are affected adversely due to marine debris. 11% of them are said to be affected due to microplastic ingestion alone.
- **Efforts** - Most of the efforts to clean Ganga have focussed on creating sewage treatment capacities in the major urban centres along the river.
- In 2015, the government approved the Namami Gange (100% funding from the central government) programme to clean and protect the river.
- Programmes launched before this include the Ganga Action Plan (1985), the IIT Consortium (2011) for water diversion and effective treatment, and the National Mission for Clean Ganga (2011).

### 1.15 Detergent Footprint

- Water pollution caused by detergents is a big global concern.
- The per capita detergent consumption in India is around 2.7 kg per year. It is around 10 kg in the United States of America.
- **Nonylphenol**, a hazardous chemical present in detergents, is known to enter water bodies and the food chains.
- It bio-accumulates and can pose serious environmental and health risks.
- It has been detected in human breast milk, blood and urine, and is associated with reproductive and developmental effects in rodents.
- Bureau of Indian Statistics (BIS) has set the standard of phenolic compounds in drinking water (0.001 mg/L) and surface water (5.0 mg/L).
- **Carcinogens and Non-biodegradables** - The detergents contain suspected carcinogens, and ingredients that do not fully biodegrade.
- Many laundry detergents contain approximately 35 to 75% phosphate salts. Phosphates can cause a variety of water pollution problems. Non-biodegradables can't be eliminated by wastewater treatment.
- **Eutrophication** - Some phosphate-based detergents can cause eutrophication. Phosphate-enrichment can cause the water body to become choked with algae and other plants.
- Eutrophication deprives the water of available oxygen, causing the death of other organisms.
- **Oxygen-Reducing Substances** - Detergents also contain oxygen-reducing substances that may cause severe damage to the fishes and other marine animals.
- [Oxygen-Reducing Substances are chemical compound that readily transfer oxygen atoms.]
- They are capable of destroying the external mucus layers that protect the fish from bacteria and parasites, causing severe damage to the gills.
  - Fish die when detergent concentrations are near 15 parts per million (ppm);
  - Fish eggs die when detergent concentrations as low as 5 ppm.
- **Anthropogenic components** like herbicides, pesticides and heavy metals present in the detergents can cause the water to grow murky.
  - This block out light and disrupting the growth of plants.
  - Turbidity clogs the respiratory system of some species of fishes.
- Pathogens from these toxic water bodies cause diseases, some fatal, in human or animal hosts diseases.
- Drinking water contaminated with detergents can be hazardous to human health.

### 1.16 Prevention of River Pollution

- Under **National Water Quality Monitoring Programme**, Central Pollution Control Board (CPCB) along with the PCBs/Committees in different States/UTs is monitoring water quality of water bodies.
- As per the latest CPCB report of September 2018, 351 polluted stretches were identified on 323 rivers.
- **Problems** - Rivers in the country are polluted mainly due to,

1. Discharge of untreated sewage from cities/towns and industrial effluents in their respective catchments,
  2. Problems in operation and maintenance of sewage treatment plants, lack of dilution and other non-point sources of pollution,
  3. Rapid urbanization and industrialization.
- **Cleaning of rivers** is an ongoing process. It is the duty of States/UTs and local bodies to ensure treatment of sewage and industrial effluents to the prescribed norms before discharging into water bodies or land.
  - National River Conservation Plan (explained below) provides financial and technical assistance for abatement of pollution in identified stretches of rivers, excluding River Ganga and its tributaries.
  - The Central Government has notified General Discharge Standards and also industry specific effluent discharge standards under **Environment (Protection) Rules, 1986**.
  - These standards should be complied by the industrial units, STPs and/or the CETPs for prevention and control of pollution in water bodies.

### 1.17 River Pollution in Africa

*A new report has found that some rivers in Africa are turning the color of ink, and fast fashion is behind it.*

- The report claimed that the untreated or partially treated effluent from textile factories (blue or indigo in colour) is killing the African rivers.
- Trade agreements, tax incentives and cheap labour have spurred rapid growth of the industry, mainly in Tanzania, Ethiopia, Lesotho and Madagascar.
- The report flagged two major problems,
  1. Production of cotton and leather as inputs - that extensively use chemical, insecticides and fertiliser - pose significant water risks.
  2. Lack of transparency on who sources and manages these raw materials.
- In 2015 alone, the global textiles and clothing industry was responsible for the consumption of 79 billion cu.m. of water.
- Producing cotton burdens water resources and leads to salinisation, soil erosion and degradation.
- Other stages of production entail many water-polluting activities like,
  1. Unsafe management of solid waste and sludge,
  2. Unsafe handling of chemicals used,
  3. Shipping of products causing water pollution on the waterways,
  4. Release of microplastic in water,
  5. Fast-fashion, which makes most of our collection disposable.

### 1.18 Tarballs

*Tarballs have resurfaced on Mumbai's beaches like Cuffe Parade shoreline and Juhu beach and Versova beaches.*

- Tarballs are dark-coloured, sticky black oil-emanating balls lying on the shore.
- **Formation** - Tarballs form when crude oil floats on the ocean surface. They are formed by weathering of crude oil in marine environments.
- They are transported from the open sea to the shores by sea currents and waves.
- Tarballs are usually coin-sized and are found strewn on the beaches. But, over the years, they have become as big as basketballs.
- They stick to the cleaning machinery and are very difficult to wash off. They give off a foul fuel smell.
- **Deposition** - All the oil spilt in the Arabian Sea gets deposited on the western coast in the form of tarballs in the monsoon season when wind speed and circulation pattern favour transportation of these tarballs.
- Tarballs are removed from the beaches post-high tide.
-

### 1.19 Yamuna River Frothing

*A layer of froth was seen floating over parts of the Yamuna River near Kalindi Kunj. This has become a repeat occurrence in the city.*

- **Froth formation** is a phenomenon that takes place on many lakes and streams. The froth is a sign of a polluted river.
- Foam bubbles are produced when organic matter decomposes.
  1. These foam-producing molecules have two ends to repel and attract water, which work to reduce the surface tension on the water surface.
- These foam bubbles are lighter than water, so they float on the surface as a thin film that gradually accumulates.
- **Causes** - Release of untreated or poorly treated effluents, which may contain soap-detergent particles could lead to frothing.
- Surfactants & phosphates from detergents in households and industrial laundry find their way into the river, as all the sewage is not treated.
  - These Phosphates persist in water, which leads to eutrophication. This lowers the oxygen content, killing off marine life that is essential to maintain the quality of water.
- Other sources are industrial effluents, organic matter from decomposing vegetation and presence of filamentous bacteria.
- The pollution from sugar and paper industries also causes pollution.
- The water falls from a height, so the untreated waste turns into foam.
- **Health hazards** - Short-term exposure can lead to skin irritation and allergies. If ingested, these chemicals may cause gastrointestinal problems and diseases like typhoid.
- Long term exposure to heavy metals in industrial pollutants can cause neurological issues and hormonal imbalances.

### 1.20 Vanishing Lakes of Bengaluru

*In order to protect Bengaluru lakes, the Karnataka High Court ordered the state government to issue necessary instructions to remove encroachments from the water bodies in accordance with the Land Revenue Act.*

- Terrain of Bengaluru with hills and valleys provide a natural drainage system with small streams originating from ridges to form major streams that flow into major and minor lakes. But these lakes are disappearing.
- **Reasons for decline** - Encroachment of the lakes by real estate developers, and also by the government agencies to set up bus stands, research centres, etc is a major reason that the lakes are disappearing.
- [In 2015, the Koliwad Committee stated that real estate developers and government bodies were major encroachers of lakes in Bengaluru.]
- During 2015-16 period, 98% lakes were encroached for illegal buildings, slums, etc and that sewage is flowing into 90% of the lakes in the city.
- **Consequences** - Lakes are contaminated due to the sustained inflow of untreated industrial effluents and domestic sewage.
- The groundwater in the vicinity of lakes is contaminated which is evident from the higher nitrate levels and heavy metal in the groundwater.
- Indiscriminate dumping of municipal solid waste has also led to the contamination of groundwater.

## PLASTIC POLLUTION

### 1.21 The Gaps in the Plan to tackle Plastic Waste

*The Environment Ministry published draft regulations on Extended Producer Responsibility (EPR) which denote a backslide, particularly with respect to integration of the informal sector.*

- **Extended Producer Responsibility (EPR)** is a policy approach under which producers are given a significant responsibility – financial/ physical for the treatment or disposal of post-consumer products.

- It helps advance the circular economy, decreases the environmental impact from a product and its packaging, and promotes the principle of “polluter pays” by holding the producer accountable for the entire lifecycle of the product.
- India first introduced EPR in 2011 under the **Plastic Waste (Management and Handling) Rules, 2011** and **E- Waste Management and Handling Rules, 2011**.
- The objectives of EPR are as follows
  - Integration of environmental costs
  - Improved waste management
  - Reduction of disposal
  - Reduction of burden on municipalities

“As of 2019, about 660,787.85 tonnes of plastic waste is produced in India annually, of which around 60% is reportedly recycled and most are single use plastic.”

### Draft rule

- **Aim-** to mandate producers of plastic packaging material to collect all of their produce by 2024 and ensure that a minimum percentage of it be recycled as well as used in subsequent supply.
- **Categories of plastic packaging-** Plastic packaging, as per the rules fall into three categories.
  1. **Rigid plastic packaging-** includes PET and HDPE that are effectively recycled.
  2. **Flexible plastic packaging-** includes single layer or multilayer plastic sheets and covers made of plastic sheet, carry bags plastic sachet or pouches that are expensive to recycle.
  3. **Multi-layered plastic packaging-** has at least one layer of plastic and at least one layer of material other than plastic which are difficult to recycle.
- **Declaration-** Producers of plastic will be obliged to declare to the government through the website how much plastic they produce annually.
- Companies will have to collect at least 35% of the target in 2021-22, 70% by 2022-23 and 100% by 2024.
- **Not fulfilling the objectives-** If entities cannot fulfil their obligations, they will on a case by case basis be permitted to buy certificates from organisations that have used recycled content in excess of their obligation.
- The CPCB will develop a mechanism for such exchanges on a centralised online portal.
- **Non-compliance-** An environmental compensation will be levied, though the rules do not specify how much this compensation will be.
- **Banning of a range of range of plastic products-** The manufacture of a range of plastic products such as plastic sticks, plastic flags, candy and ice-cream sticks, thermocol, plates, cups, glasses, plastic cutlery, wrapping or packing films, invitation cards, cigarette packets, plastic or PVC banners less than 100 microns, etc will be banned from July 2022.
- **Exceptions-** Only a fraction of plastic that cannot be recycled such as multi-layered multi-material plastics will be eligible to be sent for end-of-life disposal such as road construction, waste to energy, waste to oil and cement kilns
- The methods prescribed by the Central Pollution Control Board will only be permitted for their disposal.
- **Criticisms -** The draft rule fails to mention the waste pickers or mechanisms for their incorporation under EPR.
- The guidelines fall short in three areas - people, plastics and processing.
- **People-** Waste pickers form the base of a pyramid diverting waste towards recycling and reuse, waste pickers also subsidise local governments responsible for solid waste management.
- Most informal waste pickers in India work without social security, health insurance, minimum wages or basic protective gear.
- The guidelines don't involve them as stakeholders in formulating the guidelines and doesn't direct producers to set up a private, parallel plastic waste collection and recycling chain.
- **Plastics-** The EPR guidelines are limited to plastic packaging leaving out many multi-material plastic items like sanitary pads, chappals, and polyester that pose a huge waste management challenge today.
- Flexible plastics like LDPE and PP bags are recyclable, but due to their contamination with organic waste, light weight and high volume, the cost of recycling is very expensive compared to the market value of the output.

- Multi-layered and multi-material plastics are low weight and voluminous, making them expensive to handle and transport and recycling is technologically challenging as it is heterogeneous material.
- **Processing-** Processes like waste-to-energy, co-processing and incineration have been proven to release carbon dioxide, particulate matter, harmful dioxins and furans which have negative climate and health impacts.
- Technologies like chemical recycling and pyrolysis are capital-intensive, releases pollutants, yielding low returns and running into frequent breakdowns and technological problems.
- A number of gasification, pyrolysis and other chemical recycling projects have figured in accidents such as fires, explosions and financial losses.
- But the draft regulations legitimise them to justify the continued production of multi-layered plastics.

### 1.22 Plastic Waste Management Rules

*The Ministry of Environment, Forest and Climate Change (MoEFCC) has notified the Plastic Waste Management Amendment Rules, 2021, prohibiting identified single use plastic (SUP) items by 2022.*

- **Single use plastics** - Plastics that are used just once, as in disposable packaging and products.
- **SUP's Impact:**
  1. Low utility but high littering potential.
  2. Large and growing volume adds enormously to the total plastic waste.
  3. Adverse impacts on both terrestrial and aquatic ecosystems.
- **Larger Concerns:**
  1. 22 States have, in the past, announced a ban on SUP, but waste choking wetlands and waterways (and being transported to the oceans to turn into microplastic) still continue.
  2. Lack of proper waste segregation leading to difficulties in recycling:- 34 lakh tonnes of plastic waste generated in 2019-20 in India; only about 60% is recycled.
  3. Nearly 43% of India's plastics are used in packaging and much of it is SUP.

### Key provisions in the Amendment Rules

- **Prohibition** of manufacture, import, stocking, distribution, sale and use of SUP, including polystyrene and expanded polystyrene, commodities from the 1st July, 2022. This covers –
  - i. ear buds with plastic sticks, plastic sticks for balloons, plastic flags, candy sticks, ice-cream sticks, polystyrene [Thermocol] for decoration
  - ii. plates, cups, glasses, cutlery, wrapping or packing films around sweet boxes
  - iii. invitation cards, cigarette packets, plastic or PVC banners less than 100 micron, stirrers
- **Thickness** of plastic carry bags to be increased from 50 microns –
  - i. to 75 microns from 30th September, 2021
  - ii. to 120 microns from the 31st December, 2022
- This is to stop littering due to light weight plastic carry bags, and allow their reuse.
- **Guidelines for Extended Producer Responsibility/EPR** (as per Plastic Waste Management Rules, 2016) has been given legal force through the 2021 Rules, for effective implementation.
- EPR - Environmental policy approach in which a producer's responsibility for a product is extended to the post-consumer stage of a product's life cycle.
- Accordingly, collection and management of plastic packaging waste, which is not covered under the phase out of identified SUP items, through the EPR of the Producer, Importer and Brand owner (PIBO).
- **Other measures** for elimination of single use plastics and effective implementation of Plastic Waste Management Rules, 2016:
  1. A Special Task Force by States/UTs
  2. National Level Taskforce by the Union MoEFCC for taking coordinated efforts

3. Strengthening of waste management infrastructure in the States/UTs through the Swachh Bharat Mission.
  4. Comprehensive action plans by State/UT Governments and concerned Central Ministries/Departments
  5. Establishment of institutional mechanism in all States/UTs as per direction issued under Section 5 of Environment (Protection) Act, 1986
  6. Awareness generation
  7. India Plastic Challenge - Hackathon 2021 for Higher Educational Institutions' students and Startups for developing alternatives to identified SUP items and digital solutions to plastic waste management.
- Notably, in the 4th UN Environment Assembly held in 2019, India had piloted a resolution on addressing single-use plastic products pollution.

### 1.23 Algae to Biodegrade Plastic

*Researchers have isolated an alga species that shows promise as an agent of biodegradation of plastic sheets.*

- The usual means of disposal of plastic waste involves incineration, land-filling and recycling. These methods are hazardous to the environment.
- But, the new biodegradation method based on alga species is safe and environment friendly.
- In the recent study, the biodegradation of low-density polyethylene (polymer) sheet into monomers was done by the microalga *Uronema africanum* Borge.
- This microalga degrades the polymers by producing enzymes, hormones, toxins such as cyanotoxins, and some polysaccharides.
- This green photosynthetic microalgae is commonly found in Africa, Asia and Europe. It is an epiphyte, which attaches itself to other algae and plants.

#### CPCB Annual Report

- The plastic waste generated in a year amounted to 5.6 million metric tonnes.
- Only 60% of the plastic used in India was collected and recycled.
- The metros alone contributed some 21.2% of the total waste, led by Delhi, followed by Chennai, Kolkata and Mumbai.

## OTHERS

### 1.24 Netherlands' Nitrogen Crisis

*The Netherlands has proposed a plan to slash livestock numbers by 30% by forcing farmers to sell their emission rights and even their land to the state.*

- The Netherlands has been battling a "nitrogen crisis" caused by excess nitrogen emissions in the vulnerable natural areas.
- The concern with livestock is that livestock production leads to alarming nitrate pollution of groundwater.
- **Impacts** -The livestock produce manure which, when mixed with urine, releases ammonia (a nitrogen compound).
- This ammonia, via farm runoff, can get into water bodies, in which case the excessive nitrogen will damage sensitive natural habitats.
- Nitrogen can lead to algae that deplete oxygen at the surface of the water.
- Nitrogen in the soil, which is largely attributable to livestock production, leaches to groundwater mainly in the form of nitrate (NO<sub>3</sub><sup>-</sup>)
- Run-off and leaching of nutrients from soils and groundwater leads to eutrophication as a result of which nitrogen concentrations exceeds the standard level.
- Moreover, deposition of nitrogen compounds can also affect terrestrial ecosystems through acidification and eutrophication.

#### DID YOU KNOW?

The Netherlands is the biggest meat exporter of the European Union. It has also one of the largest livestock industries in Europe.

**1.25 Earthshot Prize**

- The Earthshot Prize, dubbed as the “Eco Oscars” was established in 2020.
- The Earthshot Prize’s name is a reference to the “Moonshot” ambition of the then US President John F. Kennedy in 1960s who pledged to get a man on the Moon within a decade.
- The award was set up by Prince William and Royal Foundation, the charity founded by the Duke and Duchess of Cambridge.
- It honours individuals/organisations with one million euros for their contributions towards the following five UN Sustainable Development Goals –
  1. Restoration and protection of nature,
  2. Air cleanliness,
  3. Ocean revival,
  4. Waste-free living and
  5. Climate action.

“According to a UN FAO report, the livestock sector contributes 18% of the global emission of greenhouse gases.  
It generates 65% of human related nitrous dioxide, whose global warming potential is 310 times that of CO2.”

2021 Winners	Category	Contribution
Indian Vidyut Mohan led Takachar	Clean Our Air	Cheap technology innovation to convert crop residues into sellable bio-products
Costa Rica	Protect and Restore Nature	Scheme paying local citizens to restore natural ecosystems that has led to a revival of the rainforest.
Coral Vita Project run by two individuals	Revive our oceans	Growing coral in the Bahamas designed to restore the world’s dying coral reefs.
City of Milan Food Waste Hubs, Italy	Build a waste-free world	A waste-busting initiative which dramatically cut fast while tackling hunger
AEM Electrolyser, Thailand/Germany/Italy	Fix our Climate	A renewable energy project to make hydrogen by splitting water into hydrogen and oxygen

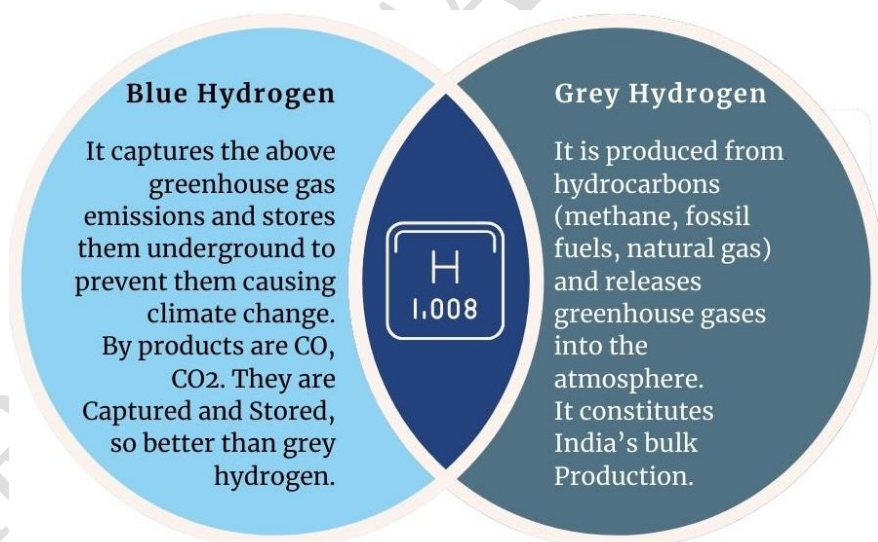
- Every year, 5 winners will be selected from 15 finalists (3 from each category) by the Earthshot Prize Council.
- The council comprises global spokespersons who are striving to bring impactful action in various capabilities.
- The historian David Attenborough will honour 5 finalists between 2021 and 2030.

## 2. RENEWABLE ENERGY

### 2.1 All about Green Hydrogen

As the green energy movement grows, Indian companies are on a mission to adopt green hydrogen, the cleanest form of energy in the world.

- **Green hydrogen** is produced using renewable energy and electrolysis.
- Electrolysis method uses an electrical current to separate the hydrogen from the oxygen in water.
- If this electricity is obtained from renewable sources we will, therefore, produce energy without emitting carbon dioxide into the atmosphere.
- This ensures no greenhouse gas emissions as the only by product of this process is oxygen, making it a great replacement for carbon emitting fuels.
- NTPC Ltd, India's largest energy integrated company under Ministry of Power is pioneering Green Hydrogen Initiatives in India.
- India's National Hydrogen Energy Mission focuses on generation of hydrogen from green power resources.
- **Green Hydrogen Mobility Project** - Renewable Energy Ltd (REL), a 100% subsidiary of NTPC, signed a MoU with Union Territory of Ladakh and LAHDC to setup the country's first Green Hydrogen Mobility project in the region.
- This Project will enable NTPC to help Ladakh develop a carbon free economy based on renewable sources and green hydrogen.
- With this Project, Leh is soon to become India's first city to implement a green hydrogen based mobility project with zero emission.
- NTPC has been promoting usage of green hydrogen based solutions in sectors like mobility, energy, chemical, fertilizer, steel etc. It has recently doubled its target to achieving 60GW renewables capacity by 2032.
- **Significance** - India's current grey hydrogen production is six million tonnes per annum, which is around 8.5% of global annual production.
- As of now, 75% of India's energy demand is met by coal and oil, including imports which is expected to increase.
- The green hydrogen, being a sunrise sector, must be tapped to tackle the dependence on fossil fuel and take greater advantage of India's solar capacity.
- Green hydrogen is a crucial weapon in India's arsenal to fight climate change as it improves the long-term energy storage capabilities of renewable energy.
- It is also the most promising solution to decarbonise sectors like cement, steel, and refineries.
- Hydrogen can provide the lowest-cost decarbonization solution for over a fifth of final energy demand by mid-century contributing a cumulated reduction of 80Gt of CO<sub>2</sub> and is thus an essential solution to reach the 1.5°C climate scenario.
- Since hydrogen is the cleanest fuel, it can help India in achieving the target of net-zero carbon emissions by 2070.
- **Steps taken to promote Green Hydrogen** - Ministry of New and Renewable Energy (MNRE) has been supporting a broad based R&D programme on Hydrogen Energy and Fuel.



- With respect to transportation, major work has been supported to Banaras Hindu University, IIT Delhi, and Mahindra & Mahindra resulting in the development of internal combustion engines and vehicles that run on hydrogen fuel.
- Two hydrogen refuelling stations have been established (one each at Indian Oil R&D Centre, Faridabad and National Institute of Solar Energy, Gurugram).
- India has already taken the first step with the Indian Oil Corporation floating a global tender to set up two green hydrogen generations units at the Mathura and Panipat refineries.
- **National Hydrogen Energy Mission** which was proposed in the Budget Speech 2021-22 aims to develop India into a global hub for manufacturing of hydrogen and fuel cells technologies across the value chain.
- A production linked incentive (PLI) scheme was announced in the budget 2021-22.
- National Hydrogen Energy Mission document was drafted by MNRE to scale up Green Hydrogen production and utilization across multiple sectors, including transportation.
- **Challenges** - The major challenge in the electrolysis of water using renewable energy is the cost, particularly, the cost of the electrolyser (the device that splits water).
- Only a handful of Indian companies manufacture electrolysers.
- According to The Energy and Resources Institute (TERI), the cost of green hydrogen production is \$5-\$6 per kg.
- Another challenge is the efficiency of the electrolysers i.e. how much electricity it consumes to produce a kg of hydrogen. Today, it is 55 kWhr per kg of hydrogen.
- Absence of dedicated government policy and lack of public awareness have been significant barriers in India's hydrogen economy.

## 2.2 National Hydrogen Mission

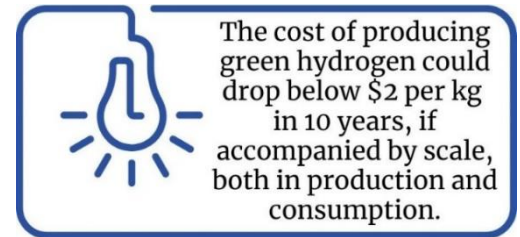
Indian Prime Minister recently announced the National Hydrogen Mission.

- Budget 2021 found mention of Hydrogen Energy Mission in 2021-22 for generating Hydrogen from green power sources.
- Accordingly, the Ministry of New and Renewable Energy (MNRE) has drafted a National Hydrogen Energy Mission.
- It aims to scale up Green Hydrogen production and utilization across multiple sectors.
- Hydrogen is emerging as an important source of energy since it has zero carbon content and is a non-polluting source of energy.

### Hydrogen colour palette

Colour code	Brown	Grey	Blue	Turquoise	Green
Energy source	Coal or lignite	Natural gas	Any non-renewable energy source	Methane	Any renewable energy source
Process of getting hydrogen	Gasification	Steam methane reformation	Steam methane reformation and carbon capture & storage	Pyrolysis	Electrolysis of water
Highest to lowest greenhouse gas emissions	←————→				
Lowest to highest acceptance level	←————→				

- But the current global production of hydrogen of about 80 million metric tonnes, is almost wholly produced **through fossil fuels**.
- It uses 6% of global natural gas and 2% of coal, and contributes 830 million tonnes of CO<sub>2</sub>.
- Green hydrogen is produced by splitting water into hydrogen and oxygen using an electrolyzer powered by electricity from green energy sources such as wind and solar.
- When burnt, it gives out water vapour, with no residue or climate-harming impact.
- Green hydrogen is aided by:
  1. Global energy transition toward renewables
  2. Declining costs
  3. Breakthroughs in technology - electrolyzer capacity projects
  4. High carbon taxes
- **Advantages** - Transform India from an energy-deficient to an energy-rich country.
- Make India a net exporter of energy.
- Play a key role in decarbonization efforts.
- Significantly reduce import dependence— India spends \$160 billion on imports of crude oil, liquified natural gas, coal and fertilizer.
- Solar-to-hydrogen also solves an intermittence problem, as hydrogen substitutes the need for battery storage.
- **Favourable factor** - All-year sunshine - Most parts of India receive 4-7 kilowatt-hour of solar energy/sq. m/day.



### Possible applications

- Transportation, including trucks, buses, cars and rail.
- Feedstock for fertilizers, chemicals and refineries.
- Decarbonizing buildings and decarbonizing high-heat industries such as steel-making.
- Hydrogen fuel cells – A key complement to batteries.
- Grid-scale storage solutions and feedstock for ammonia production (thus eliminating the need for natural gas).
- Blending hydrogen with natural gas in city gas pipelines reduces the import of natural gas.

### Interventions so far

- The cost of green hydrogen made by electrolysis is estimated to be around Rs.350 per kg. The Centre plans to bring it down to Rs.160 per kg by 2029-30.
- Plans for green hydrogen consumption obligation (GHCO) in fertilizer production and petroleum refining; similar to renewable purchase obligations (RPO).
- The draft Electricity Rules, 2021 have allowed green hydrogen purchase to help meet RPOs.
- Plans to call bids for 4 GW electrolyzer capacity.
- Extending the PLI (Production Linked Incentive) scheme for manufacturing electrolyzers.
- NTPC Renewable Energy is setting up India's largest solar park of 4.75 GW in Gujarat, with plans to make green hydrogen on a commercial scale.
- NTPC has also called bids for setting up a pilot project for mixing green hydrogen with natural gas for the city gas distribution network.
- Besides, Reliance Industries Ltd has recently announced plans to build large-scale, low-cost and high-efficiency electrolyzers as part of its \$10 billion renewables push.

### DID YOU KNOW?

Possibly, 22% of the global energy need by 2050 could be hydrogen-based.

### Challenges

- A lot of energy for the electrolysis of water is needed.

- Unless this electricity is produced with a zero-carbon footprint, it defeats the key aspect of 'green' hydrogen.

### 2.3 India's 1st Green Hydrogen Microgrid Project

*NTPC Ltd has awarded India's first green hydrogen microgrid project at its Simhadri plant in Andhra Pradesh.*

- This unique project configuration, designed in-house by NTPC, is in-line with the vision of India for becoming carbon neutral by 2070.
- **Production** - Green hydrogen is produced by splitting water into hydrogen and oxygen using the advanced 240 kW Solid Oxide electrolyzer powered by renewable energy sources like wind and solar.
- The hydrogen produced during sunshine hours would be stored at high pressure and would be electrified using a 50 kW Solid Oxide Fuel Cell.
- The system would work in standalone mode from 5PM in the evening to 7AM in the morning.
- **Significance** - This green hydrogen microgrid project is the precursor to large scale hydrogen energy storage projects.
- It would be useful for studying and deploying multiple microgrids in various off grid and strategic locations of the country.
- This unique project would open doors for decarbonising the far-off regions of the country like Ladakh, J&K etc., hitherto dependent on diesel generators.
- The Green Hydrogen fuel can be a game-changer for the energy security of India, which imports 85% of its oil and 53% of gas requirements.
- To promote clean fuels, India is considering making it mandatory for fertilizer plants and oil refineries to purchase green hydrogen.

#### Types of Hydrogen

- **Green hydrogen** is the one produced with no harmful greenhouse gas emissions.
- It is made by using clean electricity from surplus renewable energy sources, such as solar or wind power, to electrolyse water.
- Electrolysers use an electrochemical reaction to split water into its components of hydrogen and oxygen, emitting zero-carbon dioxide.
- As its production is expensive, green hydrogen currently makes up a small percentage of the overall hydrogen.
- **Blue hydrogen** is produced mainly from natural gas, using steam reforming process, which brings together natural gas and heated water in the form of steam.
- Blue hydrogen is sometimes described as 'low-carbon hydrogen' as the steam reforming process produces carbon dioxide as a by-product.
- That means carbon capture and storage (CCS) is essential to trap and store this carbon.
- **Grey hydrogen** is the most common form of hydrogen production.
- It is created from natural gas, or methane, using steam methane reformation but without capturing the greenhouse gases made in the process.
- **Black & brown hydrogen** are produced using black coal or lignite (brown coal) in the hydrogen-making process. They are also produced from other fossil fuels through the process of 'gasification'.
- They are the absolute opposite of green hydrogen. They are the most environmentally damaging hydrogen in the hydrogen spectrum.
- **Pink hydrogen** is generated through electrolysis powered by nuclear energy. Nuclear-produced hydrogen can also be referred to as purple hydrogen or red hydrogen.
- In addition, the very high temperatures from nuclear reactors could be used in other hydrogen productions by producing steam for more efficient electrolysis or fossil gas-based steam methane reforming.
- **Turquoise hydrogen** is made using a process called methane pyrolysis to produce hydrogen and solid carbon.
- In the future, turquoise hydrogen may be valued as a low-emission hydrogen, dependent on the thermal process being powered with renewable energy and the carbon being permanently stored or used.

- **Yellow hydrogen** is a relatively new phrase for hydrogen made through electrolysis using solar power.
- **White hydrogen** is naturally-occurring geological hydrogen found in underground deposits and created through fracking.
- There are no strategies to exploit this hydrogen at present.

## 2.4 Meeting Green Targets through Biomass

*Biomass can be an effective means to raise the green footprint but there are some issues that need to be resolved.*

- Green energy is not only about solar and wind, but about biomass too.
- Biomass today is an important fuel in many countries, especially for cooking and heating in developing countries
- Over the years, its use as fuel for transportation and electricity generation has been increasing.
- India's focus on this segment of green energy comes from the statements made by the Prime Minister at the recently held COP26 summit "India will reach its non-fossil energy capacity to 500 GW by 2030."

### Government policies

- **Old policy (2017)**- Earlier, the government had issued a policy on biomass utilization for power generation through co-firing in coal-based power plants.
- The government had advised coal-based thermal power plants, (except ball and tube mill, power generation) to endeavor to use a 5-10% blend of biomass pellets.
- Primarily the pellets are made of agro residue along with coal after assessing the technical feasibility and safety aspect.
- **Modified policy (2021)** – Earlier policy was revised because it was an advisory without any mandatory use of biomass.
- However the government now pushes for mandatory use of biomass co-firing.
- But concerns remain on successful implementation since it is a policy and not a regulation. Making it mandatory may not mean much.
- **Recommendation of the revised policy** - Mandating all thermal power plants to use 5% blend of biomass pellets made, primarily, of agro residue along with coal with effect from one year of the date of issue of this guideline.
- This will increase to 7% (except for those having Ball & Tube mill the use of biomass remain 5 percent) with effect from two years after the date of issue of this order and thereafter.
- Minimum contract period for procurement of biomass pellets by generating utilities shall be for 7 years
- This helps in avoiding delays in awarding contracts to generating companies every year and also to build up a long-term supply chain.
- Provisions related to tariff determination and scheduling:
  - For projects set up under Section 62 of the Electricity Act 2003, the increase in cost due to co-firing of biomass pellets shall be passed through in Energy Charge Rate (ECR).
  - **Energy Charge** means a charge levied on the consumer based on the quantity of electricity
  - For projects set up under Section 63 of the Electricity Act 2003, the increase in ECR due to biomass co-firing can be claimed under Change in Law provisions.
  - Such additional impact on ECR shall not be considered in deciding Merit Order Despatch (MOD) of the power plant.
  - Obligated Entities such as Discoms can meet their Renewable Purchase Obligations (RPO) by buying such generation of co-firing.

### Advantages

- **Curtail Stubble burning** – The Power Ministry has already set up the National Mission on the use of Biomass in coal-based thermal power plants, to address the issue of stubble burning and to reduce carbon footprints of thermal power generation.
- Around 53,000 tonnes of biomass was utilized as green fuel in power plants so far.

- This is expected to curtail air pollution in northwest India as well as prevent loss of fertility of agricultural land and provide a sustainable income source for farmers, suppliers, and biomass fuel manufacturers.
- The current availability of biomass in India is estimated at 750 million tonne annually. The estimated surplus biomass availability is at about 230 million tonne annually covering agricultural residues.

### Hindrances

- It will be successful only if it finds full acceptance among the stakeholders, particularly power generation companies and distributors.
- **Price of biomass** - Procurement of biomass, as well as right price and quality, are the most critical aspect.
- State power generation companies will be able to manage the increase in cost due to biomass pellet co-firing by claiming under Change in Law provisions.
- For Independent power producers a clarity on the regulatory mechanism of pass-through for open capacity is needed.
- **Supply chain** – There is a need to establish a proper supply chain and ensure the adequacy of stock to achieve the 5% requirement
- The requirement increases to 7% from the second year.
- **Cash flow** –The Independent power producers (IPPs) are already under stress due to distribution utilities defaulting on payments. Due to this transition, IPPs will face an additional cash flow burden
- **Legal backup** - Electricity is de-licensed and the Union Power Ministry without the backing of any Act may not have the necessary means to enforce mandatory use of biomass.
- Only the Central Pollution Control Board or the Bureau of Energy Efficiency have power/supporting acts that could enable them to put a mandatory condition.

## 2.5 India's Solar Energy Capacity

*India told the UN COP26 climate summit about its solar energy capacity.*

- India's solar energy capacity stands at about 45 gigawatts after it increased 17 times in the last 7 years.
- This asserts that although the country represents 17% of the global population, its historical cumulative emissions are only 4%, and its current annual greenhouse gas (GHG) emissions are only about 5%.
- India achieved 24% reduction in emission intensity of its Gross Domestic Product (GDP) over the period of 2005-2014.
- Also, India's 15% of total CO<sub>2</sub> emission in 2016 was removed from the atmosphere by the Land Use, Land-Use Change & Forestry (LULUCF).
- Between 2015 and 2019, the forest and tree cover increased by 13,031 sq. km. and mangrove cover increased by 235 sq. km.

## 3. CLIMATE CHANGE

### 3.1 IPCC Sixth Assessment Report (AR6) - 2021

*The Intergovernmental Panel on Climate Change (IPCC) recently released the 1<sup>st</sup> part of its Sixth Assessment Report (AR6) titled 'Climate Change 2021: The Physical Science Basis'.*

#### IPCC

- It is established by the UNEP and the World Meteorological Organization in 1988.
- It is a body of world's leading climate experts.
- It provides reports on the current state of knowledge in climate change and its potential environmental and socio-economic impacts.
- Its first report in 1990 on consequences of rising greenhouse gas (GHG) emissions led to the forming of UNFCCC in 1992.

- Since then, reports have been produced roughly every 7 years.

## Key factors behind Climate Change

### Human Activities

- The combined contribution to global warming by natural factors, such as the sun and volcanoes, is now estimated to be close to zero (negligible).
- 1.07°C out of the 1.09°C warming is due to GHG associated with human activities.
- Thus, almost 100% of global warming has been caused by humans.

### Emissions

- CO<sub>2</sub> levels were greater in 2019 than they had been in “at least 2 million years.”
- Methane and nitrous oxide (2<sup>nd</sup> and 3<sup>rd</sup> major contributors of warming respectively) levels are their highest in at least 800,000 years.
- CH<sub>4</sub> stays in the atmosphere only for a fraction of time compared to CO<sub>2</sub>, but is far more efficient at trapping heat.
- Human-induced sources of methane
  1. consuming fossil fuels
  2. leaks from natural gas production, coal mining and landfills
  3. livestock and manure handling

### PREVIOUS IPCC ASSESSMENT REPORTS: HIGHLIGHTS

**FIRST REPORT, 1990**

- Emissions resulting from human activities are increasing atmospheric concentrations of greenhouse gases
- Global temperatures have risen by 0.3°–0.6°C in 100 years. In business-as-usual scenario, likely to increase by 2°C compared to pre-industrial levels by 2025, and 4°C by 2100
- Sea-level likely to rise 65 cm by 2100
- Report formed basis for negotiation of UN Framework Convention on Climate Change in 1992

**SECOND REPORT, 1995**

- Revises projected rise in global temperatures to 3°C by 2100, and sea-level rise to 50 cm
- The scientific underpinning for Kyoto Protocol in 1997

**THIRD REPORT, 2001**

- Revises predicted temperature rise to 1.4°–5.8°C by 2100 compared to 1990
- Rainfall to increase; sea-level likely to rise by 80 cm from 1990 by 2100.
- Frequency, intensity and duration of extreme weather events to increase
- Presents new and stronger evidence

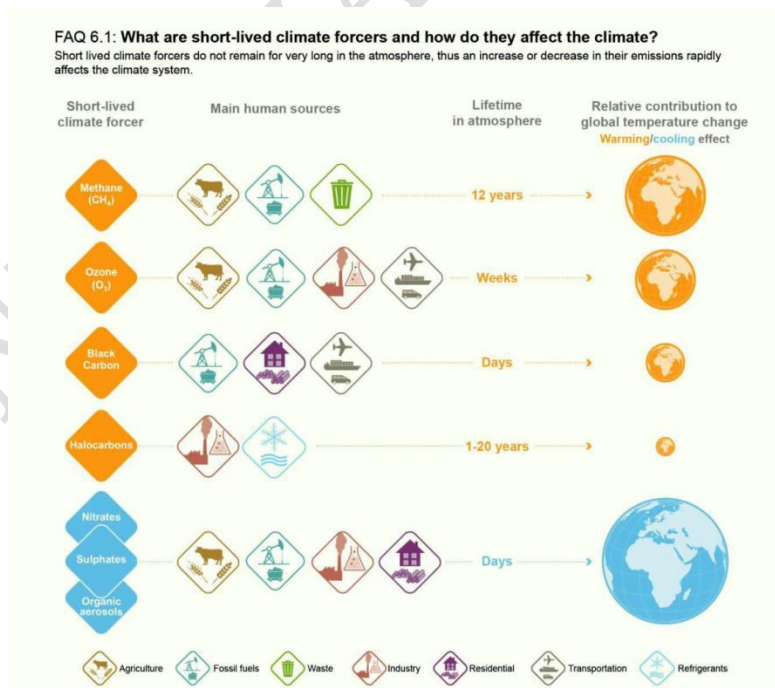
to suggest most of warming attributable to human activities

**FOURTH REPORT, 2007**

- Greenhouse gas emissions rose by 70% between 1970 and 2004
- Atmospheric concentrations of CO<sub>2</sub> in 2005 (379 ppm) the highest in 650,000 years
- In worst-case scenario, global temperatures could rise 4.5°C by 2100 from pre-industrial levels; sea-levels could be 60 cm higher than in 1990
- Wins 2007 Peace Nobel for IPCC
- Report is the scientific input for the 2009 Copenhagen climate meeting

**FIFTH REPORT, 2014**

- Temperature rise by 2100 could be 4.8°C from pre-industrial times
- Atmospheric concentrations of CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O “unprecedented” in last 800,000 years
- More frequent and longer heat waves “virtually certain”
- “Large fraction of species” face extinction
- Forms scientific basis for negotiations of Paris Agreement in 2015



- Aerosols contribute to reducing the impact of warming therefore drastic reduction of aerosols actually leads to an increase in warming.

### Weakened Natural allies

- The CO<sub>2</sub> emissions notably increased by half since 1960.

- In the same period, forests, soil and oceans have absorbed 56% of all the CO<sub>2</sub> humanity has released into the atmosphere.
- But these carbon sinks which are natural allies in the fight against global heating are showing signs of saturation.
- The percentage of human-induced carbon they soak up is likely to decline as the century unfolds.

### Temperature Rise

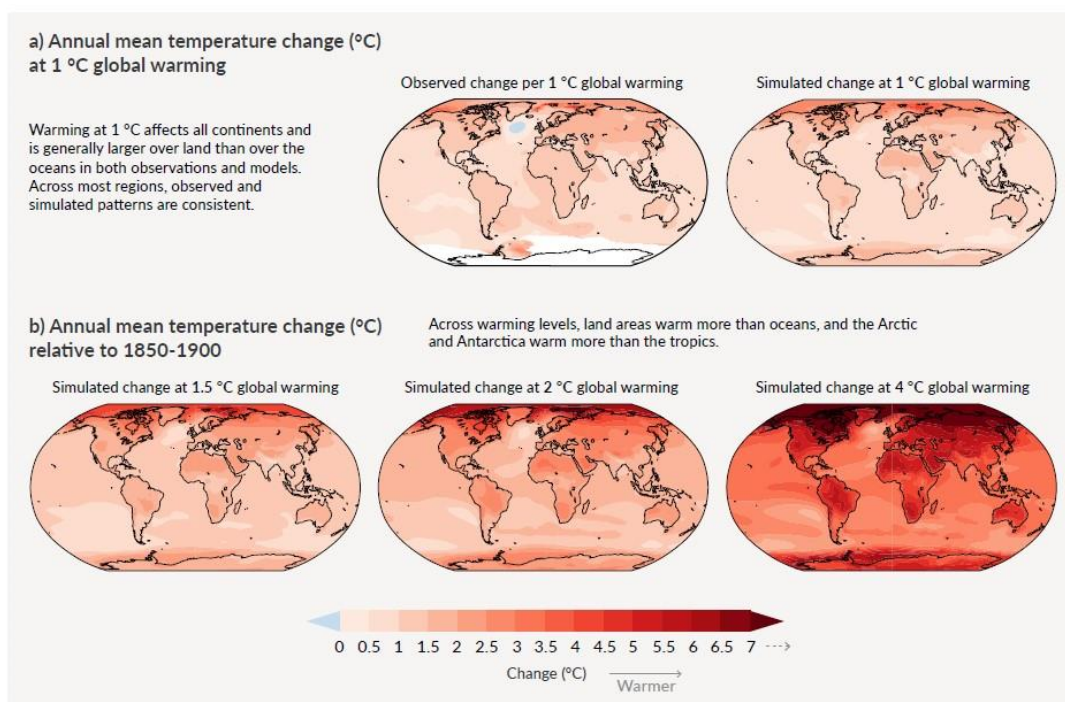
- 2011-20 was hotter than any period of time in the past 1.25 lakh years.
- Global surface temperature was 1.09°C higher in 2011-20 than between 1850-1900.

### Impending Threats

#### Global Warming

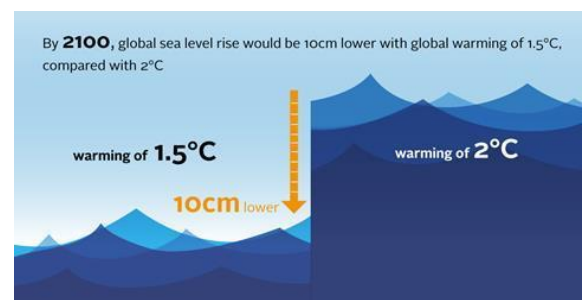
- Within the next two decades, temperatures are likely to rise by more than 1.5 °C above pre-industrial levels.
- Additional warming will weaken the Earth's carbon sinks present in plants, soils, and the ocean.
- Air pollution reduction and steep climate change mitigation are not complementary goals but require independent efforts over the short and medium term.
- Human-induced global warming has been more rapid in Africa than the rest of the world.

**With every increment of global warming, changes get larger in regional mean temperature, precipitation and soil moisture**



### Sea level rise

- Sea-level rise has tripled compared with 1901-1971 in the last decade.
- Global oceans have risen about 20 cm since 1900.
- The Arctic Sea ice is the lowest it has been in 1,000 years.
- Crumbling and melting ice sheets atop Antarctica have replaced glacier melt as the main drivers of sea level rise.
- If global warming is capped at 2°C, the ocean watermark will go up about half a metre over the 21<sup>st</sup> century.



### Impact on Cities

- Floods and sea-level rise in coastal areas & Ice sheet collapse or rapid changes in ocean circulations

- **Least developed countries** will increasingly bear the brunt of global warming
- **Other common threats** - increased heatwaves, more intense storms, and more serious droughts and floods etc
- With every 1°C rise in temperature, there will be a 7% increase in the intensification of extreme rain events.

### Impact on India

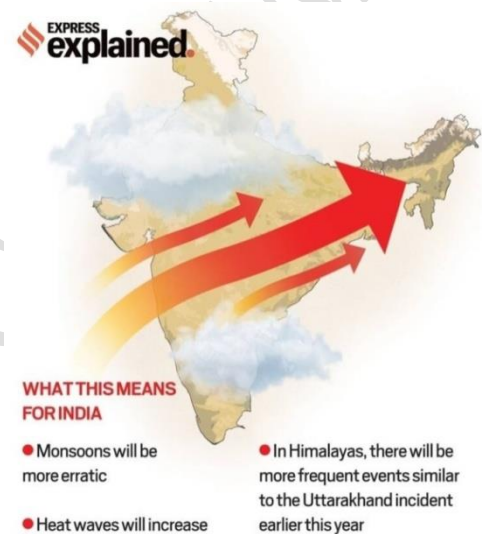
- With a 7,517 km coastline, India will face significant threats from rising seas
- Across 6 Indian port cities - Chennai, Kochi, Kolkata, Mumbai, Surat and Visakhapatnam - 28.6 million people will be exposed to coastal flooding.

### IPCC advocates 1.5°C mark

The 2015 Paris Agreement set the goal to limit global warming to well below 2°C, compared to pre-industrial levels, in this century.

It also sets 1.5°C as an **aspirational target** to channelize countries' efforts.

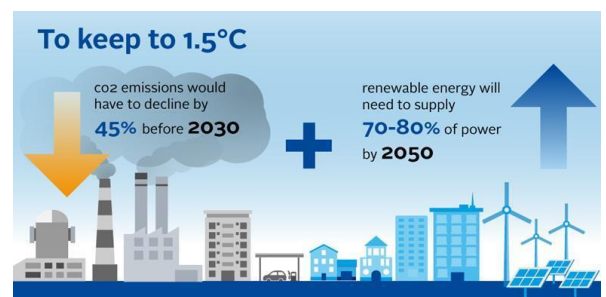
- Temperatures have now risen by about 1.1°C since the period 1850 to 1900.
- Even if we start reducing emissions now, we will still overshoot the 1.5°C mark by 2030. But we will see a drop in temperatures to around 1.4°C.
- It will take a lot of time for nature to heal; 20-30 years to see global temperatures stabilise.
- So, some long-term impacts of warming that are already in line are likely to be witnessed - Sea level rises, Melting of Arctic ice, Warming and acidification of the oceans.
- Nevertheless, the 1.5°C level will represent a much smaller risk than 2°C.
- And notably, this report is likely to be the last from the IPCC while there is still time to stay below 1.5°C.



### IPCC Recommendation

#### Emission Control

- IPCC has recommended that countries strive to achieve **net zero emissions** i.e no additional greenhouse gases were emitted by 2050.
- Drastic cuts in GHG emissions are needed this very decade (2021-2030).
- End to new coal plants and new fossil fuel exploration and development.
- Efforts of governments, investors and businesses towards a low-carbon future.



#### Cumulative Emissions

- Reaching net zero alone is not enough to reach the 1.5°C target.
- Historical cumulative emission i.e total emission by each country throughout the industrial phase is the cause of the climate crisis that the world faces today.
- They cannot be mitigated by promises of net zero 30 years from now.
- Therefore cumulative emissions should be factored in while calculating net zero.

#### Negative emissions

- Warming could be brought back down via “negative emissions” i.e., to cool down the planet by -
  1. sucking out or sequestering the carbon from the atmosphere

2. stopping the use of fossil fuels and stopping deforestation

- But the technology at this end is not yet evolved and perfect, and need attention.

### Peak by 2025

- Earth could exceed 1.5°C of global warming as soon as the early 2030s.
- So, staying below 2°C this century will happen only if emissions reach [net zero by 2050](#).
- For this to happen, global emissions must peak sometime in the middle of this decade itself (by 2025).
- **Indigenous and Traditional knowledge** had played an increasing role in historical climatology.
  1. Peruvian fishermen had first thought of the name 'El Niño' for the now well-known climate phenomenon in the tropical eastern Pacific Ocean, that scientists link with the Southern Oscillation.
  2. Inuit communities had contributed to community-based monitoring across the Arctic.
  3. Indigenous Australian knowledge of climatic patterns has been offered as a complement to observational records, such as those of sea-level rise.
- Such traditional knowledge must be assessed and integrated with scientific literature.

### Major Highlights

- **Temperature** - The report said that the 1.5 degree Celsius warming was inevitable even in the best case scenario, and has been shown to be closer than thought.
- This is the 1<sup>st</sup> time that IPCC said that the rise in global temperatures was a direct result of human activities.
- The most ambitious emission pathways would lead to the 1.5 degree C warming be achieved in the 2030s, overshoot to 1.6 degree C, before the temperatures drop back again to 1.4 degree C by the end of the century.
- **NDCs** - The IPCC report could also lead to renewed demands that all countries update their climate action plans called nationally-determined contributions (NDCs) of the Paris Agreement.
- Every country has submitted an NDC by listing the climate actions they would take by 2025 or 2030 - To be updated every 5 years from 2025.
- 110 countries have updated their NDCs, but not China, India or South Africa.
- **Impacts** projected at 2°C of warming would be present at 1.5°C as well, and are being witnessed even now.
  - a. Every additional half degree of warming will increase the intensity and frequency of hot extremes, heavy precipitation and drought.
  - b. At 2 degree C of global warming, heat extremes would reach critical tolerance thresholds for agriculture and human health.
  - c. For each additional degree C of global warming, extreme daily rainfall events would intensify by about 7%.
- The 6<sup>th</sup> Assessment Report suggested that the results of emission reductions might begin to show over time scales of 10 to 20 years.

### Effect of Oceans Warming on Fishes

- The IPCC report has warned that ocean warming will continue over the 21<sup>st</sup> century and is likely to continue until at least the year 2300 even if we minimise carbon emissions.
- This warming can help create both anoxic (waters that have no dissolved oxygen) and hypoxic (low oxygen concentration) zones.
- These oxygen-deficient areas are expected to persist for thousands of years.
- Warming oceans can cause stress, decrease the range, increase diseases and even wipe out many commonly eaten fish.
- A recent study found that the total number of open-water species in tropical marine zones declined by about 50% in the 40 years up to 2010.
- Several species might migrate poleward or to deeper waters to stay in their ideal temperature range.
- Fishes like sardines, pilchards and herring will become smaller in size and not be able to move to better environments.

- Studies found that the sharks reared in the warm waters weighed less and had low metabolic performance than those raised in lower temperatures.
- With sea temperatures rising faster than ever, fish will very quickly get left behind in evolutionary terms and struggle to survive.
- This also has serious implications on our food security.
- As temperature increases, the demand for oxygen of many fish species will exceed their capacity to extract oxygen from the environment through their gills.
- This will decrease the aerobic capacity of fish and this reduction would be more important in larger fishes, impairing their physiological performance in the future.”

### Compound Events

It is a new element of discussion in the IPCC's sixth Assessment report.

- It is defined as two or more climate change-induced events happening back to back, triggering each other, or occurring simultaneously.
  - Example - Glacial lake bursts, a familiar occurrence in the Himalayan region, accompanied with heavy rainfall and flooding.
- If occurring together, they feed into each other, aggravating each other's impacts.
- If occurring one after the other, they give little time for communities to recover, thus making them much more vulnerable.

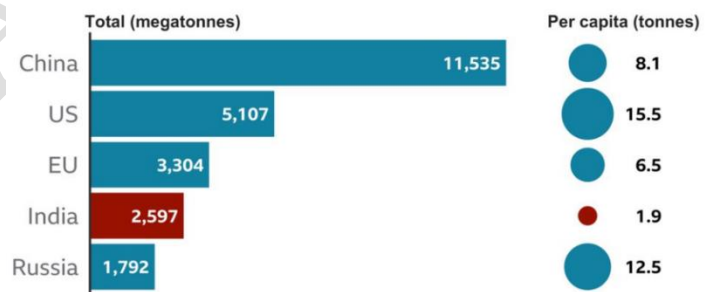
### 3.2 India's five-point Climate Action Plan

Indian Prime Minister announced as part of a five-point Climate Action plan at the COP26 summit in Glasgow.

- By 2070, India will achieve the target of net zero emissions. (India's first commitment towards net-zero emissions.)
- [Going 'Net Zero' indicates a situation where all the carbon dioxide or greenhouse gases produced by a country is completely absorbed via natural solutions or through the use of advanced technology.]
- By 2030, India will increase its non-fossil fuel power capacity to 500 gigawatts (GW) up from 450GW.
- By 2030, India will ensure 50% of its energy will be sourced from renewable energy sources.
- India will reduce its carbon emissions by 1 billion tonnes from business as usual by 2030.
- By 2030, India will reduce its carbon intensity goal - measured as carbon dioxide emissions per unit of GDP - by less than 45% (increased from 35% to 45%).
- **Related Links** - [Net-zero Targets of Countries](#)

### India is the world's fourth biggest emitter of carbon dioxide

Total and per capita emissions of CO2 per year



2019 data, EU includes UK  
One megatonne = 1,000,000 tonnes

Source: EC, Emissions Database for Global Atmospheric Research

BBC

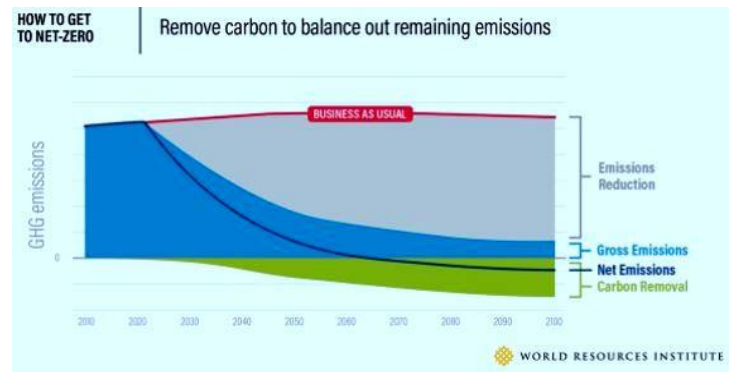
### 3.3 Net Zero Targets

With a lot of debate on India's dependence on coal, the Government of India has for the first time made a commitment to achieve the net zero target by 2070.

#### Net-zero

- It is also referred to as carbon-neutrality.
- It does not mean that a country would bring down its emissions to zero. That would be **gross-zero**, which means reaching a state where there are no emissions at all.
- Rather, net-zero is a state in which a country's emissions are compensated by absorption and removal of greenhouse gases from the atmosphere.

- It is achieved by creating more carbon sinks such as forests, while removal of gases from the atmosphere requires futuristic technologies such as carbon capture and storage.
- It is even possible for a country to have negative emissions, if the absorption and removal exceed the actual emissions.
- IPCC report finds that if the world reaches net-zero emissions by 2040, the chance of limiting warming to 1.5°C is considerably higher.



- Until recently, the South America's Amazon Rainforests (world's largest tropical forests), were carbon sinks. But eastern parts of the forests have started emitting CO<sub>2</sub> instead of absorbing them due to deforestation.
- But, it is possible for a country to have negative emissions, if the absorption and removal exceed the actual emissions. (e.g.): Bhutan.

### Countries with Net Zero targets

- IPCC AR6 emphasised that to keep temperature rise within 1.5°C, global emissions should be reduced by 45% from 2010 levels by 2030, on the way to net zero 2050.
- **Developed countries** – Countries such as the U.S., UK and Australia have committed to to achieve the goal of net zero GHG emissions by 2050.
- In 2019, the US launched a bipartisan organisation called World War Zero to reach net-zero carbon emissions in the country by 2050.
- **Developing countries** – Countries such as China have pledged to achieve net zero emissions by 2060.
- In 2020, China announced that it would become net-zero by 2060 and it would not allow its emissions to peak beyond what they are in 2030.
- Non state actors - Race To Zero is a UN-led campaign is asking cities, businesses, universities, and more to hit net zero emissions.
- The European Commission has asked all of its members to cut emissions by 55% below 1990 levels by 2030, through the EU's "Fit for 55" plan.

### Net zero emission and target of 1.5°C

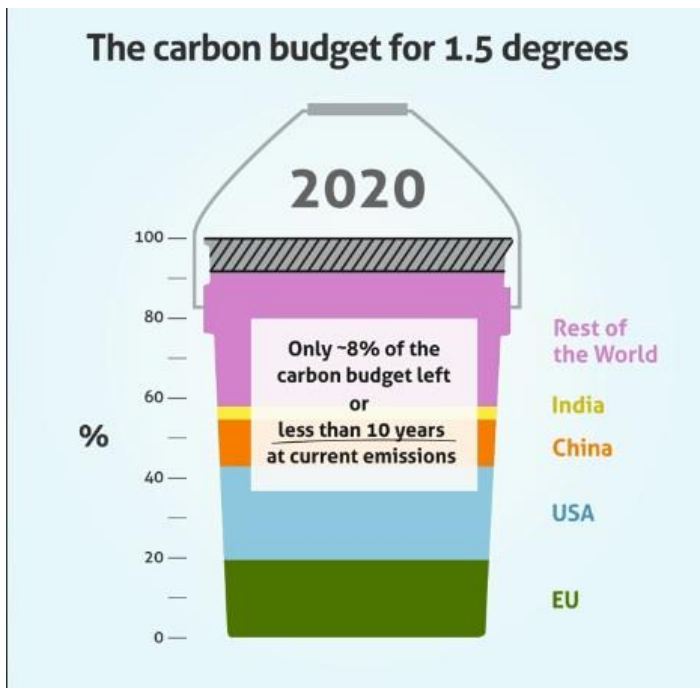
- The stringent limits on future cumulative emissions post 2020, amounts to less than a fifth of the total global carbon budget.
- The top three emitters of the world – China, the U.S. and the European Union – even after taking account of their net zero commitments will emit more than 500 billion tonnes of CO<sub>2</sub> before net zero.
- These committed emissions will undermine the basic purpose of net zero.
- The failure of the developed world to meet its pre-2020 obligations provides little confidence.
- Neither the Paris Agreement nor climate science requires that net zero be reached individually by countries by 2050.
- Less than a fifth of the world has been responsible for three-fifths of all past cumulative emissions.
- But the current net zero campaign pushes the developing countries for emission reduction despite their already low emissions.

### Reason for India's earlier hesistance

- India has neither historically emitted nor currently emits carbon anywhere close to what the global North has or does in per capita terms.
- India's per capita emissions is lower than the global average.
- It stressed for a higher and fairer share in the global carbon budget.
- There were arguments that since India was colonised, it has a right to burn and stopping the country from doing that is injustice.

## Injustice - Carbon Budget

- Carbon Budget is the estimated amount of carbon dioxide the world can emit still having a likely chance of limiting global temperature rise to 2°C above pre-industrial levels.
- The budget is estimated to be around 1 trillion tonnes of carbon. The Global Carbon Budget is produced under the umbrella of Global Carbon Project (GCP).
- Global injustice in terms of a carbon budget happens at the level of the nation-states, between the rich and the poor within nations and between humans and non-human species.
- The Global South is not only made primarily responsible for climate change, but also has to bear the effect of climate change because of its tropical climate and high population density along the coastal lines.
- For development, the countries in the global South need not increase their share in the global carbon budget.



## Areas to be focussed

- **Cleaner forms of energy** - The economic development requires energy and coal is favoured on account of its cost, reliability and domestic availability.
- But recent data show that the levelised cost of electricity from renewable energy sources like solar, hydro and onshore wind is already less than fossil fuel-based electricity generation.
- The frontier renewable energy technologies have managed to address the question of variability of sources with technological progress.
- Also, India is among the largest importers of coal in the world, whereas it has no scarcity of solar energy.
- **Development model** – The two significant issues under discussion in the post-colonial development were control over technology and choice of techniques to address the issue of surplus labour.
- The abundance of renewable natural resources in the tropical climate can give India a head start in this competitive world of technology.
- South-South collaborations can help India avoid the usual patterns of trade between the North and the South, where the former controls technology and the latter merely provides inputs.
- The high-employment path that the green energy provides may help address the issue of surplus labour while providing decentralised access to clean energy to the poor and the marginalized.
- It simultaneously addresses the issues of employment, technology, energy poverty and self-reliance.

## Path Ahead

- Global North needs to pay for the energy transition in the South.
- Creating an independent, greener path to development may give the South the moral high ground to force the North to come to the table, like South Africa did at Glasgow.
- The need of the hour is a global progressive agenda that wants working people of the world as a whole against the global ruling elite in its aggressive and dangerous model of competitive emissions.
- The transition to economic growth coupled with increased efficiency of renewable resources can aid India in achieving its goal of inclusive growth and sustainable development.

## 3.4 Reaching 'Net Zero' isn't enough

Environment Minister said that reaching 'net zero' alone is not enough to deal with climate change.

- **Initiatives by the Government** - India's renewable power capacity is currently the 4th largest in the world.

- India has an aspirational target of increasing the renewable energy capacity to 450 GW.
- It has announced Hydrogen Energy Mission 2021-22 for generation of hydrogen from green power sources.
- **Partnerships** - India has bilateral engagements with Germany, UK, and Denmark in the energy sector in the European Region.
- India and US have a joint climate and clean energy initiative called India-US Climate & Clean Energy Agenda 2030 Partnership.
- **Suggestions** - Developed Countries should provide lead markets for products of green technologies and drive down costs, such that these can be deployed in developing economies at scale.
- Private sector companies should be encouraged to develop voluntary roadmaps for the transition towards low carbon pathways.
- Indian companies especially in the hard to abate sectors like steel, cement, shipping, etc. must join “Leadership Group for Industry Transition”, a global initiative spearheaded by India and Sweden.

### 3.5 Impact of Climate Change

- People around the world have been doubly hit by the pandemic and extreme weather events which have been fuelled by climate change.
- **2021 is a Year of Extreme Weather Events** - Among the extreme weather events across the world this year are,
  1. Unprecedented heat wave that drove temperatures across Canada and parts of the US to a record high,
  2. Extreme floods in Germany that killed over 180 people;
  3. Cyclones Tauktae and Yaas that hit India’s west and east coasts;
  4. New South Wales (Australia) floods were the worst flooding on the mid-north coast since 1929.
- Extreme weather events like more powerful heat waves, extreme rainfall, droughts, etc., are likely to become more frequent or more intense with rising anthropogenic climate change.
- Rising temperatures will have far-reaching consequences, like impact on food security, health, the environment and sustainable development.

### Reports

- Carbon dioxide in the atmosphere at 419 parts per million (ppm) in May 2021 was the highest level in 63 years. This was recorded in the NOAA’s Mauna Loa Atmospheric Baseline Observatory using Keeling Curve.
- According to the NOAA’s Climate Extremes Index, the area in the Southwest are experiencing extremely high temperatures in summer over the last 20 years, with very little relief in the last six years.
- According to the Climate Science Special Report, global temperatures are likely to continue to increase due to the release of greenhouse gases.
- According to a report, temperatures at the Earth’s poles are rising at two to three times the temperature at the equator. This weakens the jet stream of the mid-latitudes, situated over Europe.
- During summer and autumn, the weakening of the jet stream has a causal effect resulting in slower-moving storms. This can result in more severe and longer-lasting storms with increased intensity.
- A 2016 study stated that human-induced global warming has contributed to the increased frequency and intensity of cyclonic storms over the Arabian Sea.
  - Indian Ocean is heating up at a faster pace in comparison to the Pacific or the Atlantic.
  - Western parts of the Indian Ocean are warming up even more.
- Many studies have found that a rise in the temperature of the sea surface is related to the changes in the intensity and frequency of cyclones.

### Keeling Curve

- The amount of carbon in Earth's atmosphere in May 2021 reached its highest level in modern history, a global indicator showed.
- The Keeling Curve, named after its creator Dr. Charles David Keeling, is a global benchmark for carbon levels in the atmosphere.

- It is a graph that represents the concentration of carbon dioxide (CO<sub>2</sub>) in Earth's atmosphere since 1958 at the Mauna Loa Observatory in Hawaii.
- It is the longest uninterrupted instrumental record of atmospheric CO<sub>2</sub> in the world, and it is commonly regarded as one of the best and most recognizable products of a long-term scientific study.
- It is considered by many scientists to be a trustworthy measure of CO<sub>2</sub> in the middle layers of the troposphere.
- At Mauna Loa Observatory, Keeling discovered global atmospheric CO<sub>2</sub> levels were rising nearly every year. By analyzing the CO<sub>2</sub> in his samples, he was able to attribute this rise to the use of fossil fuels.

### Keeling's Discoveries

- Keeling found that the air samples taken at night contained a higher concentration of CO<sub>2</sub> compared to samples taken during the day.
- He drew on his understanding of photosynthesis and plant respiration to explain this observation:
  1. During the day, plants take in CO<sub>2</sub> to photosynthesize, and
  2. At night, the plants release CO
- By studying his measurements over the course of a few years, Keeling also noticed a larger seasonal pattern.
  1. CO<sub>2</sub> levels are highest in the spring, when decomposing plant matter releases CO<sub>2</sub> into the air, and
  2. CO<sub>2</sub> levels are lowest in autumn when plants stop taking in CO<sub>2</sub> for photosynthesis.

### 3.6 Impact of Climate Change on Food Prices

*The Food and Agricultural Organization (FAO) has said that the average food prices (after adjusting for inflation) in the 11 months of 2021 are the highest in 46 years due to climate change.*

- **Findings** - Due to disasters, the world is losing up to 4% of potential crop and livestock production.
- It converts into a loss of some 6.9 trillion kilocalories per year, or annual calorie intake of 7 million adults.
- In the context of poor-, lower- and middle-income countries, it is a loss of 22% calorie intake daily due to disasters.
- **Reasons** - Climate change is fuelling **extreme and erratic weather** events and prolonging drought and heat waves. These lead to widespread crop damage and also affect crop yields in the long term.
- Climate change has two impacts on agriculture: It immediately leads to reduction in production and in consumption. Both affect the availability of food and its price, resulting mostly in steep increases.
- Global food price rise was **driven predominantly by wheat**, which reported an increase in price due to drought and high temperature in major producing countries, including the US and Canada.
- Russia, the world's largest exporter of wheat, is estimated to harvest less due to unfavourable weather conditions this season.
- **Impacts** - The price rise impacts the world's poor even more because the pandemic has already pushed millions into the poverty trap.
- Every third person in the world is not able to have adequate food.
- In 2008-18, as agriculture absorbed 26% of medium- to large-scale disasters, the poor-, low- and middle-income countries lost \$108.5 billion in disaster-induced decline in crop and livestock production.

### 3.7 Impacts of Thawing Permafrost

*The latest IPCC report has warned that increasing global warming will result in reductions in Arctic permafrost.*

- Permafrost thawing will very rapidly impact the countries where **roads/ buildings were constructed on permafrost**.
- E.g.: Russian railways, roads in northwest Canada, etc
- If thawing begins, the **organic material** that is now entombed and frozen in the ground will become available for microbiota to break down.
- In some environments, the biota will **release carbon dioxide**, and in others **release methane** which is about 25 to 30 times more potent as a greenhouse gas than carbon dioxide.

1. Total quantity of carbon buried in permafrost is about 1500 billion tonnes and the top 3 meters of the ground has 1000 billion tonnes.
2. Currently, the world emits into the atmosphere approximately 10 billion tonnes of carbon a year.
3. So, if the permafrost thaws and releases even only 1% of the frozen carbon in any one year, it can nullify anything that we do about industrial emissions.

- **New diseases** - It is not sure whether thawing permafrost can release new bacteria or viruses, or even cause another pandemic.
- When the permafrost was formed thousands of years ago, there weren't many humans who lived in that region which was necessarily very cold.
- The environment now is so much more suitable than during the Ice Age for not just human life, but also for microbes.

## PERMAFROST



It is defined as Ground (Soil, rock and any included ice or organic material) that remained at or below zero degree Celsius for at least 2 consecutive years. It is spread across an area of over 23 million square kms, covering about 15% of the land area of the globe.

### 3.8 Impacts of Shrinking Summer Sea Ice

A new study has found that if carbon emissions continue at current levels, summer ice in the Arctic will disappear by 2100, along with it, creatures such as seals and polar bears.

#### General Happening

- In winter, most of the Arctic Ocean surface freezes and scientists expect this to continue for the foreseeable future, even as climate warms.
- In summer, when some of the ice melts, winds and currents carry it for great distances - some into the North Atlantic, most into the Arctic's farthest-north coasts, along Greenland and the Canadian islands.
- It results in a **rich marine ecosystem**. On the Arctic ice, algae bloom.
- These feed tiny animals, which in turn feed fish, which in turn feed seals, which feed polar bears at the top of the chain.
- The irregular topography also helps create lairs for seals, and ice caves for polar bears during the winter.
- But with a warming climate, summer sea ice has been shrinking fast, and now consistently spans less than half the area it did in the early 1980s.

#### Pyramid of Marine Ecosystem



#### Findings

- The study covered the region north of Greenland and the coasts of the Canadian Archipelago, where sea ice has traditionally been thickest round the year, and thus likely to be most resilient.
- **Two Scenarios** - The study looked into two scenarios
  1. Under the optimistic scenario (if carbon emissions are brought in check), some summer ice could persist indefinitely.
  2. Under the pessimistic scenario (if emissions continue as they are), summer ice would disappear by the end of the century.
- **Low & High Emission Scenarios** - Under the low-emissions scenario, summer ice from even the central Arctic will wane by 2050.
- This ice will no longer endure through the year. Locally formed summer ice will persist in the [Last Ice Area](#), but will now be only a metre thick.

- The study forecasts that under the low-emissions scenario, at least some seals, bears and other creatures may survive. They currently exist under similar summer conditions along western Alaska and Hudson Bay.
- However, under the higher-emissions scenario, by 2100, even the locally formed ice will disappear in summer.
- **Implications** - With no summer ice anywhere, there will be no ice-dependent ecosystems. This may not mean the end of all life.
- New things will emerge from other areas, but it may take some time for new creatures to invade.
- Earth may be getting warmer, but the planet's rotation around the sun will not change, and any new occupants including photosynthetic organisms would have to deal with the long, sunless Arctic winter.

### 3.9 US Heat Wave

*The Northwestern US and Pacific Canada are in the grips of a heat wave that the National Weather Service called "historic and dangerous". A weather anomaly called a "heat dome" is partially to blame.*

- According to the US National Weather Service, in most parts of the country, temperatures must be above the historical average in an area for two or more days before the label "heat wave" is applied to a hot spell.
- **Causes of heat wave** - Heat waves begin when high pressure in the atmosphere moves in and pushes warm air toward the ground.
- That air warms up further as it is compressed, and we begin to feel a lot hotter. The high-pressure system pressing down on the ground expands vertically, forcing other weather systems to change course.
- It even minimizes wind and cloud cover, making the air more stifling. This is why a heat wave parks itself over an area for several days.

### Omega Block

- A dangerous 'Omega block' is trapping scorching hot air over the US and Canada.
- **Heat Dome** - Even though the average summer temperatures are steadily increasing every year due to global warming, a weather anomaly called 'Heat dome' is partly to blame for the Pacific Northwest heat.
- As the ground warms, it loses moisture, which makes it easier to heat even more. As that trapped heat continues to warm, the system acts like a lid on a pot - earning the name "heat dome."
- Conflating high- pressure and low-pressure systems have trapped the region in a heat dome locked in place by undulations in the jet stream. [Jet Stream is a river of strong wind in the upper atmosphere.]
- In this case, the jet stream has trapped a ridge of high pressure (heat dome) over the Pacific Northwest, creating a block in the atmosphere that prevents the weather system from moving on.
- Instead, the hot air in the high-pressure system pushes down over the region, creating a suffocating blanket of heat.
- As the wind patterns swirl around the heat block in the shape of the Greek letter Omega, the systems like these got the name "Omega blocks".

### 3.10 Heat Dome

- The temperatures being reported from the Pacific Northwest and some parts of Canada are part of a "historic" heat wave that lasted over a week, a result of a phenomenon referred to as a "heat dome".
- Temperatures of the western Pacific Ocean have increased in the past few decades and are relatively more than the temperature in the eastern Pacific.
- This strong change in ocean temperature from the west to the east is the reason for the heat dome, which is when the atmosphere traps heat at the surface, which encourages the formation of a heat wave.
- To compare, the reason that the planet Venus is the hottest in the Solar System is because its thick, dense cloud cover traps the heat at the surface, leading to temperatures as high as 471 degree Celsius.
- A heat wave is a period of unusually hot weather that lasts for more than two days. It can occur with or without high humidity and have the potential to cover a large area, exposing many people to hazardous heat.

### 3.11 Last Ice Area

*A new study has found that the "Last Ice Area" may be more vulnerable to climate change than suspected.*

- The Last Ice Area, an Arctic region known for its thick ice cover, spans more than 2,000 kms, reaching from Greenland's northern coast to the western part of the Canadian Arctic Archipelago.
- It earned its dramatic name because though its ice grows and shrinks seasonally, much of the sea ice was thought to be thick enough to persist through summer's warmth.
- But during the summer of 2020, the Wandel Sea in the eastern part of the Last Ice Area lost 50% of its overlying ice, bringing coverage there to its lowest since record-keeping began.
- **New study** - The study looked at the Wandel Sea north of Greenland, which is inside what's known as the "last ice area" of the Arctic Ocean.
- Researchers found that weather conditions were driving the decline, but climate change made that possible by gradually thinning the area's long-standing ice year after year.
- This hints that global warming may threaten the region more than prior climate models suggested.
- If the area is changing faster than expected, the Last Ice Area may not be the refuge for ice-dependent species in a future ice-free summer Arctic.
- **Anomaly 1** - In recent decades, ocean currents have bolstered ice cover in the Last Ice Area with chunks of floating sea ice.
- But, northward winds transported ice away from Greenland and created stretches of open water that were warmed by the sun.
- The heated water then circulated under sea ice to drive even more melting.
- Scientists first suspected something might be amiss in the Last Ice Area in 2018, when a stretch of ice-ringed open water, known as a polynya.
- **Anomaly 2** - In 2020, another sea ice anomaly in the Wandel Sea was gathered from an Arctic research expedition called The Multidisciplinary drifting Observatory for the Study of Arctic Climate (MOSAiC).
- The research vessel was taking "a strange-looking route" through areas that normally were covered in thick ice.
- Satellite observations and climate models revealed that in 2020, unusual northward-moving winds broke up sea ice and pushed it away from the Wandel Sea.
- Approximately 20% of the 2020 ice loss could be directly attributed to climate change, while 80% was linked to the wind and ocean-current anomalies, the researchers wrote.

### 3.12 Insights of Indigenous People

*The Food and Agricultural Organization (FAO) studied the indigenous people living on the frontline of climate change.*

- Indigenous people worldwide are self-reliant and resilient, living sustainably and in harmony with their ecosystems.
- They play a vital role in countering global threats like destruction of nature, climate change, biodiversity loss and risk of future pandemics.
- There are some 478 million indigenous peoples in the world, according to FAO, whose research also explored 11 indigenous communities.
  1. Reindeer herding by the Inari Sámi people in Nellim, Finland,
  2. The forest-based food system of the Baka indigenous people in South-eastern Cameroon and
  3. The Milpa food system of the Maya Ch'orti' people or "the maize people" in Chiquimula, Guatemala.
- **Threats** - Indigenous peoples' traditional ways of life are at high risk from climate change and the expansion of various industrial and commercial activities.
- Despite surviving for centuries, Indigenous Peoples' agri-food systems may disappear in the next years due to a number of drivers threatening their future.
- Being adaptive is the main resilient element of these food systems.

- Indigenous peoples adapt their food generation and consumption to the seasonality and natural cycles observed in their surrounding ecosystems, not in the opposite way as most other societies do.

### 3.13 Rain at Greenland Summit

*For the 1<sup>st</sup> time on record, the summit of Greenland received rain and not snow, just as temperatures at the spot went above freezing for the 3<sup>rd</sup> time in less than 10 years.*

- As per the US National Snow and Ice Data Center, this was the heaviest rainfall that the Greenland received since record keeping began in 1950.
- The US's National Science Foundation maintains a Summit Station at the highest point on Greenland's ice sheet.
- [Summit Station is a research facility that observes changes occurring over the island as well as in Arctic weather.]
- Summit Station observed rain at the normally frigid summit, with the precipitation extending up to Greenland's southeast coast.
- Not only is water warmer than the usual snow, it's also darker - so it absorbs more sunlight rather than reflecting it away.
- Rain & high temperatures triggered extensive melting here, which is 7 times more than daily average observed at this time (August) of the year.
- Rapid ice melting will be running off into the ocean in volumes, thus accelerating global sea level rise.
- **Concern** - The UN's "code red" climate report concluded that the burning of fossil fuels led to Greenland melting in the last 20 years.
- Arctic Ocean may witness ice-free summers by 2050 due to extreme climate interventions.
- If that happens, sea levels could rise by 20 feet, threatening low-lying cities around the world such as Mumbai, New York, etc.
- Rapid melting is also threatening polar bears, which have to make their way towards Greenland's interior from the coasts, where they usually find enough food.



### 3.14 July 2021 - Hottest Month Ever

*The US National Oceanic and Atmospheric Administration's (NOAA's) National Centers for Environmental Information has released a report on global climate.*

- This report has said that July 2021 was the hottest month on Earth since 1880.
- It says that the global land-only surface temperature for July 2021 was 1.40 degrees Celsius above the 20th-century average.
- The previous record was held by Julys in 2017 and 2020.
- The warmth across the global land surfaces was driven by higher than normal temperatures across much of the Northern Hemisphere land.
- In July 2021, Arctic sea ice extent was 18.8% below the 1981-2010 average levels.
  - NOAA said that 2021 will be in the list of the 10 warmest years on record.

### 3.15 ICMR Policy on Climate Change

*Indian Council of Medical Research (ICMR) has suggested India to 'urgently wean away from coal as its main source of energy' and 'shift from traditional animal husbandry practices' to combat the challenges of climate change.*

- The ICMR's policy brief accompanies the 2021 Global Lancet Countdown Report focusing on,
  1. Premature mortality due to ambient air pollution by sector;
  2. Emissions from agricultural production and consumption; and
  3. Detection, preparedness and response to health emergencies.

- The combustion of coal, mainly in power plants followed by industrial and household settings, has increased the premature mortality.
- Therefore, India needs to urgently wean away from coal as its main source of energy and needs to invest more on renewable, cleaner and sustainable sources such as solar, wind or hydro energy.
- Since 46% of all agricultural emissions in India are contributed by ruminants such as goats, sheep and cattle, India needs to move away from the traditional animal husbandry practices.
- India must invest in newer technologies that will improve,
  1. Animal breeding and rearing practices,
  2. Use of good livestock feeds and
  3. Implement proper manure management.
- All of these practices will contribute to the reduction of the GHG emissions.

### 3.16 Infrastructure for Resilient Island States

India and UK will together launch the initiative for the Resilient Island States (IRIS) for developing infrastructure of small island nations in COP26.

- IRIS aims to **strengthen critical infrastructure in small island states against disasters** induced by climate change.
- IRIS is the first major initiative by India under the Coalition for Disaster Resilient Infrastructure (CDRI) started in 2019.
- IRIS seeks to operationalize the CDRI initiative, as Small Island states are the most vulnerable to the impacts of climate change.
- Major threats to Small Island states - Rising seas, and major weather events such as large storms triggered by climate change.

#### DID YOU KNOW?

According to CDRI estimates, every one dollar invested in making infrastructure more resilient in low- and middle-income countries can potentially save losses of over \$4 when a disaster strikes.

### Coalition for Disaster Resilient Infrastructure

- CDRI is India's second international climate initiative by India in 2019; the first was the International Solar Alliance, launched in 2015.
- CDRI was launched as a global partnership to promote **resilient climate-proof critical infrastructure** in member countries.
  - 26 countries, including US, Germany, UK, Australia, Brazil, Bangladesh, Afghanistan, Nepal, Bhutan, and Sri Lanka are already part of the coalition.
- The coalition will not create any new infrastructure - rather, it will serve as a '**knowledge centre**' for member countries to share and learn best practices with respect to disaster-proofing of infra.
- It will work towards making existing and upcoming infrastructure in member countries more robust and resilient against climate disasters such as floods, heat, cyclones, forest fires, and rain.
- The aim of CDRI is to minimise the damage and disruptions.

### 3.17 Climate Equity Monitor

Climate Equity Monitor is an online dashboard that went live recently.

- India's Climate Equity Monitor (CEM) will assess equity in climate action, inequalities in emissions, energy & resource consumption across the world, and ongoing climate policies of several countries.
- Its focus on **equity and climate action from a data and evidence-based perspective** will encourage a vigorous discussion on this crucial issue and engage experts from all countries.
- The website has been conceptualized and developed by independent researchers from India, not only but also,
  1. Climate Change Group, at the M.S Swaminathan Research Foundation (MSSRF), Chennai, and
  2. Natural Sciences and Engineering department at the National Institute of Advanced Studies (NIAS) Bengaluru.
- **Principles** - CEM is aimed at monitoring the performance of Annex-I Parties under the UNFCCC (developed countries) based on the foundational principles of the Climate Convention, namely

1. Principle of Equity (Equitable sharing of the global carbon budget) and
  2. Principle of common but differentiated responsibilities and respective capabilities (CBDR-RC).
- The performance and policies of the Non Annex-I Parties (developing countries) will be also provided for comparison.
  - **Focus** - Existing “tracking” websites on climate policies are based in the global North and routinely do not address the crucial aspects of equity and differentiation.
  - The developers of this dashboard have taken this initiative to build awareness, especially among the public of the **global South**, that climate action is a global collective action problem.
  - The website is intended to debunk the narrative that focuses attention continually on what developing countries must do, constantly demanding greater commitment and action from them.

### 3.18 Climate Change & Locust Infestations

*Experts said that the infestation of desert locusts is closely linked to climate change, as a hotter climate is linked to more damaging locust swarms.*

- Therefore, plans to mitigate climate change must include action against pests and diseases.
- **Bane** - Locusts have been a bane especially to farmers in several countries, including India, Pakistan and Iran.
- Locust infestations can also harm livelihoods and be a threat to regional investments in ensuring food security.
- **Reasons** - Change in cyclonic patterns over the Arabian Sea is behind the locust invasions in east Africa, west and south Asia.
- Unusual rainfall in Iran helped in their breeding.
- **Control** - Locusts can be controlled using broad-spectrum pesticides.
- But these pesticides may be highly toxic to environment, humans and animals. They are a threat to pollinators and wildlife.
- **Measures** - The following measures could be taken to control locust infestation:
  1. A well-functioning early warning system,
  2. Counting the environmental and human costs through True Cost Accounting,
  3. Developing an efficient governance model,
  4. Governing the locusts crisis may also provide useful lessons for the agri-food system,
  5. Research on the biopesticide sector must be funded and
  6. Satellite and weather data, along with field observations, can be used for building powerful predictive models on breeding sites.

### 3.19 Black Box of the Earth

*A steel vault that will record the Earth's warming weather patterns is being built in Tasmania Australia, an Australian island state off the south coast.*

- This vault is dubbed as the ‘Black Box of the Earth’, is a 33-foot-long box made of 3-inch-thick steel.
- The Earth's Black Box will operate much like a plane's [Black Box](#), which records an aircraft's final moments before crashing.
- It will listen to what we say and do.
- It will create an archive that could be critical to piecing together the missteps that should humanity be destroyed by climate change.
- **Data** - The box will record leaders' actions (or inaction) by scraping the internet for keywords relating to climate change from newspapers, social media and peer-reviewed journals.
- It will collect daily metrics - average oceanic and land temperatures, atmospheric carbon dioxide concentration and biodiversity loss.

- Eventually, the data will be stored on a giant, automated, solar-powered hard drive with a capacity to collect information for about 50 years.
- **Tasmania was chosen** for its relative geopolitical and environmental safety.
- The vault will be designed to be resilient against threats including cyclones, earthquakes and, with its sloped walls, attacks by vandals.

### 3.20 Burden of Climate Change on Children

*A study found that children born today will be hit much harder by extreme climate events than today's adults.*

- A child born in 2021 is likely to experience on average twice as many wildfires, 2 to 3 times more droughts, 3 times more river floods and crop failures and 7 times more heat waves compared to today's adult.
- **Data** - The study is based on data from the Inter-sectoral Impact Model Intercomparison Project (ISIMIP).
- This is a community-driven climate-impacts modelling initiative that assess the differential impacts of climate change.
- ISIMIP data were used alongside country-scale, life-expectancy data, population data and temperature trajectories from the IPCC.
- **Solution** - The study said that the climate burden from our children's shoulders could be reduced on average by 24% globally by
  1. Limiting warming to 5 degrees Celsius,
  2. Phasing out fossil fuel use, and
  3. Increase climate protection from current emission reduction pledges.

## 4. ENVIRONMENTAL ORGANISATIONS, CONVENTIONS & TREATIES

### 4.1 Glasgow Climate Pact: Achievements and Disappointments

*The COP 26 UN Climate Change Conference, hosted by the UK in partnership with Italy, had taken place from 31 October to 12 November 2021 in the Scottish Event Campus in Glasgow, UK and the Glasgow Climate Pact was adopted recently.*

#### Goals of the Summit

- According to the UNFCCC, COP26 will work towards four goals:
- **Secure global net-zero by mid-century & keep 1.5 degrees within reach**
  - To meet this goal, the countries must accelerate the phase-out of coal, curtail deforestation, speed up the switch to EVs and encourage investment in renewables'.
- Countries to work together to **protect communities and natural habitats**, and build defences, warning systems and resilient infrastructure and agriculture to avoid losses.
- The UNFCCC notes that to deliver on the first two goals, developed countries must make good on their promise to **mobilise at least \$100 billion in climate finance** per year by 2020.
- Leaders will work together to 'finalize the **Paris Rulebook**', which are a list of detailed rules that will help fulfil the Paris Agreement.

#### Modest achievements of the Summit

- **Average global temperature** - The achievements include a clear consensus on a target of keeping global temperature rise down to 1.5 degrees Celsius.
- The notional target of 2 degrees of the Paris Agreement remains but the international discourse is now set in the more ambitious target.
- **Transition from fossil fuels** - It is the first clear recognition of the need to transition away from fossil fuels by phasing down the use of coal.
- **Importance of Adaptation** – Adaptation attained greater significance and there is a commitment to double the current finance available for this to developing countries.

- A start is being made in formulating an adaptation plan and this puts the issue firmly on the Climate agenda.
- **Global Methane Pledge** - Methane is a significant greenhouse gas with 28 to 34 times higher temperature forcing quality than carbon but stays in the atmosphere for a shorter duration.
- An agreement is signed among 100 countries to cut methane emissions by 30 % by 2030.
- **Ending deforestation** - A group of 100 countries has agreed to begin to reverse deforestation by 2030.
- Since the group includes Brazil and Indonesia where large areas of forests are being ravaged by legal and illegal logging, there will be progress in expanding these carbon sinks on the planet.
- **US-China Joint Declaration on Climate Change** - It implies that both the countries are moving towards a less confrontational and more cooperative relationship overall.
- **India's commitments** – The commitment to achieve net-zero carbon by 2070 and of enhanced targets for renewable energy were welcomed.
- **Clarity on Article 6 of Paris agreement**- There is greater clarity on how bilateral carbon trades can proceed and the creation of a centralised hub that replaces Kyoto Protocol's Clean Development Mechanism.
- Criteria have been set out for countries to use CERs from projects registered after January 1, 2013 to meet their first NDC or first adjusted NDC.
- It also designates a 12-member Supervisory Body to oversee the emerging hub and to review the baselines of recognised credits.
- Article 6 of the Paris Agreement introduces provisions for using international carbon markets to facilitate fulfilment of Nationally Determined Contributions (NDCs) by countries.

### Major disappointments of the Summit

- **Phasing out the coal** - India introduced an amendment to the original draft to replace the phrase “phase out” with “phase down” playing negatively with both the advanced as well as a large constituency of developing countries.
- India had earlier said that principles of equity meant all fossil sources: coal, oil and gas be reduced but the US and other countries refused as they were critical to their own economies.
- **Inadequate funding for adaptation** - Doubling the current finance available for adaptation to developing countries will be around \$ 30 billion which is grossly inadequate.
- According to UNEP, adaptation costs for developing countries are currently estimated at \$70 billion annually and will rise to an estimated \$130-300 billion annually by 2030.
- **Shortfall in Paris Agreement target** - The Paris Agreement target of \$100 billion per annum between 2005-2020 has a shortfall of more than half.
- The renewed commitment to deliver on this pledge in the 2020-2025 period is unlikely especially in this post-pandemic global economic slowdown.
- **Issue of compensation for loss and damage** – The compensation for loss and damage for developing countries who have suffered as a result of climate change for which they have not been responsible has not met.
- **Global Methane Pledge** - India did not join the Global Methane Pledge despite methane being the second-most abundant greenhouse gas in the atmosphere after carbon dioxide.
- **Ending deforestation** - India refused to join the group due to concerns over a clause on possible trade measures related to forest products.

### Assessment of the Outcome

- There is more ambition in the intent to tackle climate change but little to show in terms of concrete actions as there are no compliance procedures.
- The UK Presidency noted that as on 2019, only 30% of the world was covered by net zero targets and this had now moved close to 90%.
- Enhanced Nationally Determined Contributions (NDCs) are expected to be announced next year and further deliberations are planned on the other pledges related to Adaptation and Finance.
- However the text of the agreement indicates that all countries should deliver climate plans to the UN on 5-year cycles starting from 2025 (submitting 2035 NDCs in 2025, 2040 NDCs in 2030).

## Conference of Parties

- The Conference of Parties (COP) is a pivotal movement for the world to come together and accelerate the climate action plan.
- Formation of COP** - The COP comes under the United Nations Climate Change Framework Convention (UNFCCC) set up in 1994.
- It laid out a list of responsibilities for the member states which included:
  - Formulating measures to mitigate climate change,
  - Cooperating in preparing for adaptation to the impact of climate change, and
  - Promoting education, training and public awareness related to climate change.
- COP members have been meeting every year since 1995. The UNFCCC has 198 parties including India, China and the USA.
- COP26 is the 26th iteration of the Conference of the Parties to the UN Framework Convention on Climate Change (UNFCCC).
- This year, the meeting will be held in Glasgow, UK. The UK will share the presidency with Italy.
- This year's COP is the most significant climate meeting since 2015, when the Paris Agreement was launched.
- A first version of the guidelines known as the 'rulebook' was worked out in past meetings, but so far countries have been unable to agree on important points.
- At the meeting, countries will also be expected to raise their climate ambitions, updating the Nationally Determined Contributions (NDCs).

COP	Place	Specialty
COP1 (1995)	Berlin, Germany	First conference
COP3 (1997)	Kyoto, Japan	Adoption of Kyoto Protocol
COP8 (2002)	New Delhi, India	Hosted by India
COP21 (2015)	Paris, France	Paris Agreement or Paris Climate Accords

## 4.2 Global Methane Pledge

The Global Methane Pledge launched at the UN COP26 climate conference in Glasgow has been signed by over 90 countries so far.

- This pledge is an effort led jointly by the US and the European Union.
- It is essentially an agreement to stop deforestation and cut down global methane emissions by up to 30% from 2020 levels by 2030.
- Significance** - Rapidly reducing methane emissions is complementary to action on carbon dioxide and other greenhouse gases.
- This is regarded as the single most effective strategy to keep the goal of limiting global warming to 1.5 degrees Celsius within reach.
- Signatories** - Among the signatories is Brazil - one of the five biggest emitters of methane.
- China, Russia and India have not signed up, while Australia has said it will not back the pledge.

### DID YOU KNOW?

The latest IPCC report reveals that the methane accounts for about half of the 1.0 degrees Celsius net rise in global average temperature since the pre-industrial era.

## Methane

- Methane is the second-most abundant greenhouse gas in the atmosphere, after carbon dioxide.
- Methane is more short-lived in the atmosphere than carbon dioxide but 80 times more potent in warming the earth.
- Methane accounts for about 20% of the heating effects by all of the greenhouse gases combined.
- The UN says that 25% of the global warming is because of methane.
- Sources of methane** include natural sources (40% of global methane emissions) and human sources (60% of global methane emissions).

- Natural sources - Emissions from wetlands and oceans, cows' digestive systems, and from the digestive processes of termites.
- Human sources - Oil and natural gas systems (largest contributors to human sources), landfills, agricultural activities, coal mining, wastewater treatment, and certain industrial processes.
- **Uses** - Methane is flammable, and is used as a fuel worldwide. It is a principal component of natural gas.

### 4.3 India's Ratification of Kigali Amendment

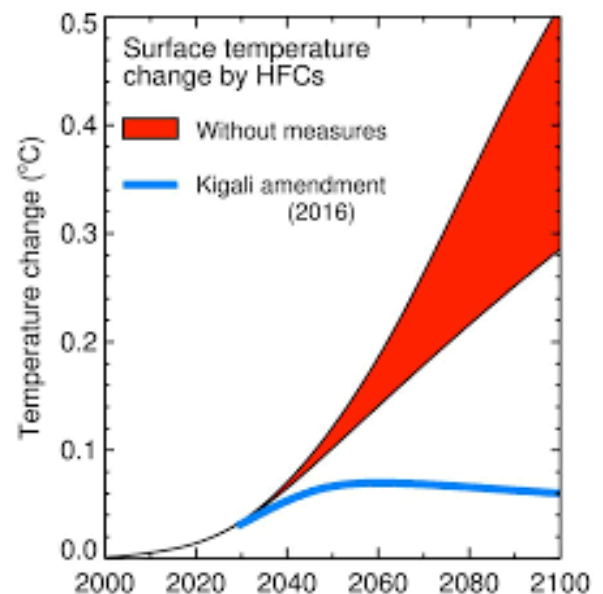
Recently, India has ratified the Kigali Amendment to the 1989 Montreal Protocol for protection of the ozone layer.

- **Montreal Protocol (1989)** - It is an international treaty that regulates the production and consumption of nearly 100 man-made chemicals referred to as ozone depleting substances (ODS).
- It aims to protect the ozone layer by taking measures to control total global production and consumption of substances that deplete it.
- The protocol's objective is to eliminate Ozone Depleting Substances (ODS) on the basis of developments in scientific knowledge and technological information.
- It mandated the complete phase-out of CFCs and other ODSs, which it has successfully did in the last 3 decades.
- The ODS, when released to the atmosphere, damage the 'stratospheric ozone layer' that protects the earth against the harmful levels of UV radiation from the sun.
- It mandated the complete phase-out of chlorofluorocarbons or CFCs and other ODS.
- CFCs were gradually replaced, first by **hydrochlorofluorocarbons (HCFCs)**.
- Eventually, **hydrofluorocarbons (HFCs)** were introduced as non-ozone depleting alternatives to support the timely phase out of CFCs and HCFCs.
- **Hydrofluorocarbons** - HFCs are a family of chemicals used extensively in the air-conditioning, refrigeration and furnishing foam industry.
- HFCs, though benign to the ozone layer, were powerful greenhouse gases.
- They are known to be much worse than CO<sub>2</sub> in causing global warming.
- UNEP says that the average global warming potential of 22 of the most used HFCs is 2,500 times that of CO<sub>2</sub>
- CFCs were gradually replaced, first by hydrochlorofluorocarbons (HCFCs), and eventually by HFCs.
- The transition from HCFCs to HFCs is still happening, particularly in the developing world.
- **Problem with HFCs** - It do not deplete the ozone but are **powerful greenhouse gases (GHGs)** with high Global Warming Potential (GWP).
- It is essential to phase out HFCs as-
  1. Global warming is emerging as one of the biggest global challenges.
  2. Air-conditioning demand is showing a significant increase, especially in countries like India.
- The average GWP of 22 of the most used HFCs is about 2,500 times that of CO<sub>2</sub>. If left unabated, HFCs might contribute to annual GHG emissions up to 19% by 2050.
- Being non-ozone-depleting, HFCs reduction was under the 1997 Kyoto Protocol and 2015 Paris Agreement that addressed GHG emissions and climate change.
- But the Montreal Protocol has –

**?**

**OZONE HOLE**

CFCs are a set of chemicals mainly used in the air-conditioning and refrigeration industry earlier. Extensive use led to depletion of the ozone layer, and formation of an "ozone hole" over the Antarctic region.



1. far more effective and successful than the climate change instruments
2. already resulted in the phase-out of 98.6% of ODS.
3. to date, the only UN treaty ever that has been ratified by every country - all 198 UN Member States

• So, it was decided to use the Montreal Protocol to phase out HFCs.

• **Kigali amendment** - It was negotiated in Rwanda (2016) to amend the Montreal Protocol (9<sup>th</sup> time) mainly to phase out hydrofluorocarbons (HFCs) - A greenhouse gas.

• Under this amendment, countries agreed to include HFCs in the list of controlled substances under Montreal Protocol.

• It essentially enables the **gradual phase-down of hydrofluorocarbons**, or HFCs.

• The terms entered into force in 2019, and have been signed by more than 122 countries so far.

Category	Targets
Group I	Rich & developed economies like USA and EU; Started phase down HFCs by 2019 and reduce it to 15% of 2012 levels by 2036
Group II	Emerging economies like China, Brazil start phase down by 2024 and reduce it to 20% of 2021 levels by 2045
Group III	Developing economies & some of the hottest climatic countries like India, Pakistan, Iran, Saudi Arabia starts phasing down by 2028 and reduce it to 15% of 2024-2026 levels till 2047
HFCs reduction as per the countries' commitments is estimated to reduce Earth's average surface warming by 0.5 degree celcius over pre-industrial era levels.	

• **Target** - Under the Kigali Amendment, current HFC use has to be curtailed by 85% before 2050.

• India has to achieve this target by 2047 while the developed countries have to do it by 2036. China has a target of 2045.

• While the reductions for the rich countries have to begin immediately, India has to begin cutting their HFC use only from 2031.

• **Significance** - If implemented successfully, the Kigali Amendment may prevent about 0.5°C rise in global warming by 2100.

• It is crucial to achieve Paris Agreement target of restricting temperature rise to within 2°C from pre-industrial times.

• Despite being one of the main architects of the Kigali Amendment, India was the last major country to announce its decision to ratify it.

### India's performance

• According to Climate Action Tracker, India is one of the few countries whose actions are compatible with keeping warming below 2°C.

• The climate actions of different countries are rated as below:

1. Australia, Brazil, Canada, the UK and all of Europe - 'Insufficient'
2. China, Japan and South Africa - 'Highly insufficient'
3. Argentina, Russia, Saudi Arabia and Turkey - 'Critically insufficient'

• India recently crossed the milestone of 100 GW of installed renewable energy capacity.

• India will also draw up a national strategy for phase-down of HFCs by the year 2023 in 'consultation with all industry stakeholders.'

• Amendments to the Ozone Depleting Substances (Regulation and Control) Rules will be done by mid-2024.

• **Concerns**- Overall energy policy pushes for both renewable and fossil-fuel-based energy production.

• E.g., Draft National Electricity Policy 2021 said India would build more **coal power plants** given its cost-effectiveness.

• Centre's attempts to allow violators to 'pay and pollute' undermines the other efforts.

• Fossil fuel producers, mostly from Russia, US and the Middle East, have begun entering India, seeing it as one of the last big markets for fossil fuels.

- These realities suggest that India's energy transition will see a delay.

#### 4.4 UN High-Level Dialogue on Desertification, Land degradation and Drought

- The United Nations High-Level Dialogue on Desertification, Land Degradation and Drought (DLDD) was convened with the support of the United Nations Convention to Combat Desertification (UNCCD).
- It assessed the progress made in fighting land degradation, and map the way forward on global efforts to revive and restore healthy land.
- It encourages all the member states to adopt and implement UNCCD's Land Degradation Neutrality (LDN) targets and National Drought Plans.
- [LDN is a state whereby the amount and quality of land resources, necessary to support ecosystem functions and services and enhance food security, remains stable or increases within specified temporal and spatial scales and ecosystems.]

#### Terminologies

- **Land degradation** can be considered in terms of the loss of actual or potential productivity or utility as a result of natural or anthropic factors; it is the decline in land quality or reduction in its productivity.
- The UN says that desertification is a process, which is a consequence of severe land degradation in typically dry areas resulting from various factors, including climatic variations and human activities.
- **Desertification** creates arid, semi-arid and dry sub-humid areas.
- The Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES) estimates that over 70% of all natural, ice-free land has been transformed by human activity, devastating global biodiversity.

- **Challenges** - Globally, one fifth of land area (more than 2 billion hectares) is degraded, including more than half of agricultural land.

- Each year, more than 12 million hectares of land are lost to DLDD. Annually, 24 billion tons of fertile soil is lost due to dryland degradation.
- Land degradation currently undermines well-being of 3.2 billion people, more than 40% of the entire world population. Unless we change how we manage soil, 90% could become degraded by 2050.

#### Steps Taken by India

- India is on track to achieve its national commitment on Land Degradation Neutrality (LDN) (SDG target 15.3).
- It is working to restore 26 million hectares of degraded land by 2030.
- India is assisting fellow developing countries to develop land restoration strategies.
- Over the last 10 years, around 3 million hectares of forest cover has been added.
- A Centre of Excellence is being set up at Indian Council of Forestry Research and Education (ICFRE) to promote a scientific approach towards land degradation issues.
- Based in Dehradun, ICFRE is an autonomous body of the Ministry of Environment, Forest and Climate Change.

#### United Nations Convention to Combat Desertification

- Established in 1994, the United Nations Convention to Combat Desertification (UNCCD) is the sole legally binding international agreement linking environment and development to sustainable land management.
- It is the only convention stemming from a direct recommendation of the Rio Conference's Agenda 21.
- Focus Areas: The Convention addresses specifically the arid, semi-arid and dry sub-humid areas, known as the drylands, where some of the most vulnerable ecosystems and peoples can be found.
- From India, the Ministry of Environment, Forest and Climate Change is the nodal Ministry for this Convention.

#### 4.5 India votes against U.N. draft resolution on climate change

India voted against a draft resolution at UNSC linking climate to security.

- UNSC organised a debate titled 'Maintenance of international peace and security: security in the context of terrorism and climate change.'

- One of the objectives of the debate was to examine how terrorism and security risks could be linked to climate change.
- It seeks to transfer the decision making for climate issues under the ambit of UNSC.
- The resolution was sponsored by Ireland and Niger
- It did not pass as India and Russia voted against it and China abstained.
- Supporters of the resolution argue that climate is creating security risks in the world, which will exacerbate in the future with water shortage, migration and a destruction of livelihoods.
- **Reason for India's voting** - India feels that it was an attempt to shift climate talks from UNFCCC to UNSC and a “step backward” for collective action on the issue.
- India's position is that the UNSC's primary responsibility is “maintenance of international peace and security” and climate change-related issues are outside its ambit.
- For India bringing climate talks under UNSC was an attempt to take decisions without consensus or the involvement of most developing countries.
- This will give more powers to the world's industrialised countries, which hold a veto power, to decide on future action on climate-related security issues.
- For India this is neither desirable nor acceptable.
- **Implications** - This would undermine progress made during COP26 at Glasgow.
- ‘Developing’ and ‘least developed’ countries had worked, over the last two decades, to make “common but differentiated” responsibilities as a fundamental tenet of climate action
- Linking climate with security tries to obscure the lack of progress on critical issues under the UNFCCC process
- Developed countries had not met their promises of providing \$1 trillion in climate finance with regard to climate action
- The attempt to discuss climate action and climate justice issues at the UNSC was “motivated by a desire to evade responsibility in the appropriate forum.”
- **India's stand** - Currently, all matters related to climate change are being discussed in the UN Framework Convention on Climate Change (UNFCCC), a specialised agency.
- With over 190 members, its framework has made progress in tackling climate change.
- It is this process that led to the Kyoto Protocol, the Paris Agreement and the recent COP26 summit
- It has put in place an international approach to combat global climate change.
- Criticising that decision making at UNFCCC conferences is slow.
- But the solution is not outsourcing decision making to the five permanent members of the UNSC.
- The least developed and developing countries should be encouraged to keep the promises they made with financial assistance.
- There needs to be a collective process and the best way is through the UNFCCC, where decisions made are by consensus.
- The UNFCCC should not only make sure that the promises made by member countries, especially the powerful ones, in previous conferences are kept but also expand the scope of discussions to include climate-related security issues.
- India is of the view that climate change may have exacerbated conflicts in the Sahel region and across Africa.
- But viewing conflicts through the prism of climate change was misleading and an oversimplification that could worsen conflicts rather than resolving them.
- India remained committed to peace and development in those regions.

#### 4.6 International Nitrogen Initiative

- The United Nations (UN) Sustainable Development Goals (SDGs) are the main focus of the eighth triennial conference of the International Nitrogen Initiative (INI).

- The International Nitrogen Initiative (INI) was set up in 2003 under the sponsorship of Scientific Committee on Problems of the Environment (SCOPE) and the International Geosphere-Biosphere Program (IGBP).
- The key aims of the INI are to:
  1. Optimize nitrogen's beneficial role in sustainable food production,
  2. Minimize nitrogen's negative effects on human health and the environment resulting from food and energy production.
- The program is currently a sustained partner of Future Earth.
- INI is coordinated by a **Steering Committee**, led by a chair and six regional centre directors representing, Africa, Europe, Latin America, North America, South Asia and East Asia.
- Steering Committee members serve a ~four year term.

#### 4.7 Post-2020 Global Biodiversity Framework

- The UN Convention on Biological Diversity (CBD) has demanded an additional \$200 billion fund flow to developing countries from various sources to manage nature through 2030.
- It is one of many demands and targets that have been set through 2030 in the official draft of a new Global Biodiversity Framework.
- The post-2020 global biodiversity framework builds on the Strategic Plan for Biodiversity 2011-2020.
- This new framework will be the global guiding force to protect nature and to retain its essential services for humans from 2020 to 2030.
- **Goals** - The new frameworks have four goals to achieve by 2050.
  - To halt the extinction and decline of biodiversity,
    - The rate of extinctions has been reduced at least tenfold and
    - The risk of species extinctions across all taxonomic and functional groups is halved and
    - Genetic diversity of wild and domesticated species is safeguarded, with at least 90% of genetic diversity within all species maintained.
  - To enhance and retain nature's services to humans by conserving.
  - To ensure fair and equitable benefits to all from use of genetic resources.
  - To close the gap between available financial and other means of implementation and those necessary to achieve the 2050 Vision.
- The framework document says that the adequate financial resources to implement the framework are available and deployed, progressively closing the financing gap up to at least \$700 billion per year by 2030.
- **Targets** - The new framework has the same 21 lofty targets agreed earlier to meet by 2030.
  - To bring at least 30% of land and sea under the world's protected areas,
  - To redirect, repurpose, reform or eliminate incentives harmful for biodiversity, in a just and equitable way, reducing them by at least \$500 billion per year.
- This framework ensures the right capacity building of the communities /governments to take up conservation measures to meet the goals.
- These include the contentious technology transfer to countries that don't have it currently and also a wide scientific cooperation among countries.

#### 4.8 Tiger Reserves Recognized by Global CA/TS

- The 14 Tiger Reserves in India received the accreditation of the Global Conservation Assured | Tiger Standards (CA|TS).
- **14 tiger reserves** - Manas, Kaziranga, Orang (Assam), Satpura, Kanha, Panna (MP), Pench (Maharashtra), Valmiki (Bihar), Dudhwa (UP), Sunderbans (West Bengal), Parambikulam (Kerala), Bandipur (Karnataka) and Mudumalai and Anamalai (Tamil Nadu).
- CA|TS has been agreed upon as accreditation tool by the global coalition of Tiger Range Countries (TRCs). Officially launched in 2013, it has been developed by tiger and protected area experts.

- It is a set of criteria which allows tiger sites to check if their management will lead to successful tiger conservation. It sets minimum standards for effective management of target species and encourages assessment of these standards in relevant conservation areas.

#### 4.9 Climate Action & Finance Mobilization Dialogue

India and the USA launched the “Climate Action and Finance Mobilization Dialogue (CAFMD)”.

- CAFMD was launched under India-US Climate and Clean Energy Agenda 2030 Partnership launched at the Leaders' Summit on Climate.
- It aims to advance inclusive and resilient economic development.

#### India-US Climate & Clean Energy Agenda 2030 Partnership

- It is a joint climate and clean energy initiative by India with the US.
- It will demonstrate how the world can align towards swift climate action with inclusive & resilient economic development by taking into account the national circumstances as well as sustainable development priorities.
- The objectives of the initiative are,
  1. To mobilize investments and speed clean energy deployment,
  2. To demonstrate & scale clean technologies needed to decarbonize sectors including industry, transportation, power, and buildings,
  3. Build capacity to measure, manage, and adapt to the risks of climate-related impacts,
  4. Enabling green collaborations in India in order to create templates of sustainable development for other developing countries.
- The Partnership will proceed along two main tracks:
  1. Strategic Clean Energy Partnership and
  2. Climate Action and Finance Mobilization Dialogue.

#### 4.10 Clean, Healthy and Sustainable Environment - A Universal Right

The UN Human Rights Council unanimously voted for recognizing a clean, healthy and sustainable environment as a universal human right.

- If formally recognised by all, this right would be the first of its kind in more than 70 years since the Universal Declaration of Human Rights was adopted by the UN General Assembly in 1948.
- The resolution emphasises the rights to life, liberty and security of Environmental Human Rights Defenders (EHRDs).
- This resolution was adopted by a vote of 43 in favour, none against and 4 abstentions.
  - China, **India**, Japan and Russian Federation, abstained from voting on the resolution.

#### DID YOU KNOW?

Right to a clean environment was rooted in the 1972 Stockholm Declaration

#### Environmental Human Rights Defenders

- EHRDs are the human rights defenders working in environmental matters.
- Environmental defenders across the globe are subject to constant physical attacks, detentions, arrests, legal action and smear campaigns.
- Some 200 environmental defenders have been murdered in 2020 alone.

## 5. GOVERNMENT INTERVENTIONS

### 5.1 National Policy on Bio-fuels 2018

*The Ministry of New and Renewable Energy envisages the creation of a National Biomass Repository through its National Policy on Bio-Fuels 2018.*

- This would be done by conducting appraisal of biomass across the Country.
- The policy is aimed at taking forward the indicative target of achieving 20% blending of biofuels with fossil-based fuels by 2030.
  - a. Target of 20% blending of ethanol in petrol and
  - b. Target of 5% blending of biodiesel in diesel.
- [The percentage of the same currently stands at around 2% for petrol and less than 0.1% for diesel.]
- It categorises biofuels as following to enable extension of appropriate financial and fiscal incentives under each category,
  - a. **Basic Biofuels** - First Generation (1G) bio-ethanol & biodiesel
  - b. **Advanced Biofuels** - Second Generation (2G) ethanol, Municipal Solid Waste (MSW) to drop-in fuels, Third Generation (3G) biofuels, bio-CNG etc.
- The Policy expands the scope of raw material for ethanol production by allowing use of the following for ethanol production,
  - a. Sugar-containing materials like B grade molasses, sugarcane juice, sugar beet, sweet sorghum,
  - b. Starch-containing materials like corn, cassava,
  - c. Damaged food grains like wheat, broken rice, rotten potatoes, unfit for human consumption.
- The Policy allows use of surplus food grains for production of ethanol for blending with the approval of National Biofuel Coordination Committee.
- One of the expected benefits is that the Used Cooking Oil can be used as potential feedstock for biodiesel and its use for making biodiesel will prevent diversion of used cooking oil in the food industry.

### 5.2 Forest Rights & Forest Conservation

*Recently, at the UN High-Level Dialogue on Desertification, Land Degradation and Drought, Indian PM reiterated India's target of land degradation neutrality by 2030, citing the Banni grassland in Gujarat.*

#### Various Land Restoration Aspects

- One of Asia's largest tropical grasslands, Banni is home to great biological diversity.
- It is the lifeline of its pastoralist communities.
- However, climate change and the invasion by *Prosopis juliflora* have severely impacted its unique ecology.
- It was found that unless action was taken, Banni grassland was headed for severe fodder scarcity.
- The region's highly degraded lands were being restored.
- The livelihoods of pastoralists were supported using a "novel approach."
- The Banni's pastoralist communities (Maldharis) uproot *Prosopis* in the pre-monsoon period.
- When it rains, the native grass species regenerate from their rootstock.
- This is precisely what the pastoralist communities have been doing for the past few years.
- Their endeavour needs to be supported.
- **Significance** - Local communities applying their deep knowledge of the local ecology to become "decision-makers" in restoring their commons is indeed novel in India.
- However, the mandate for them to do so is not new. The Forest Rights Act (FRA), 2006 provides for this.
- Adivasis and other traditional forest-dwelling communities, including pastoralists, are legally empowered.

- They can decide on the management and restoration of their community forest resources (CFR).
- They can stop any activity that adversely impacts biodiversity or the local ecology.
- Similar to the Banni grasslands, India's forests are grappling with degradation, an important contributor to GHG emissions.
- More than 40% of the forest cover is open, often degraded.
- India has committed to restore 26 million hectares of degraded forests and lands by 2030 under the Bonn pledge.
- It has also targeted creating an additional carbon sink of 2.5 to 3 billion tonnes by 2030 through additional forest and tree cover.
- This is committed as part of its Nationally Determined Contribution under the Paris Agreement.

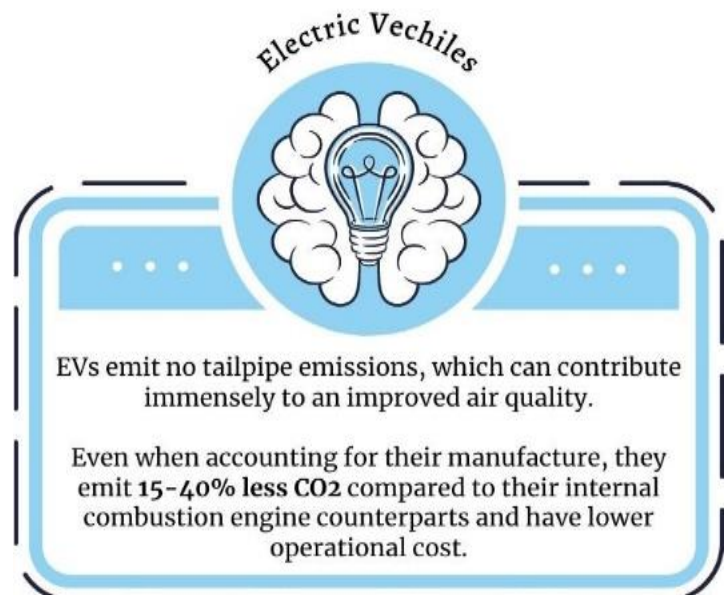
### Forest restoration efforts

- Initiatives to restore degraded landscapes include:
  - i. social forestry in the 1970s
  - ii. tree growers' cooperative societies in the 1980s
  - iii. Joint Forest Management in the 1990s
  - iv. National Afforestation Programme and Green India Mission in the last two decades
- Studies have found these to have limited restoration benefits.
- These initiatives have drawn criticism for paying little attention to the land and forest tenure of local communities.
- They fail to incorporate traditional ecological knowledge.
- The CFR rights under FRA tackle these issues.
- It assigns rights to protect, manage and restore around 40 million hectare of forests to village-level democratic institutions.
- The recognition of these rights, however, has happened at an extremely slow pace.
- Less than 5 % of the total potential area has been brought under CFR.
- In Banni too, title deeds formally recognising the CFR rights of the pastoralists are yet to be issued.
- Institutional support for CFR remains minimal.

### 5.3 Shoonya Campaign

With Rocky Mountain Institute (RMI) and RMI India's support, NITI Aayog has launched Shoonya Campaign.

- The Shoonya campaign aims to
  1. Accelerate adoption of **electric vehicles** (EVs) in the urban deliveries segment and
  2. Create consumer awareness about the health, environmental and economic benefits of **zero-pollution delivery**.
- As part of the campaign, a corporate branding & certification programme is being launched to promote industry's efforts towards transitioning to EVs for final-mile deliveries.
- An **online tracking platform** will share the campaign's impact through data such as vehicle kilometers electrified, carbon savings, criteria pollutant savings and other benefits from clean delivery vehicles.



#### 5.4 India Cooling Action Plan

- The 20-year India Cooling Action Plan (ICAP) was released by Ozone Cell of the Environment Ministry in 2019. It aims to bring down the refrigerant demand by 25 to 30% in the next 20 years.
- It aims to recognize “cooling and related areas” as a thrust area of research under the National S&T Programme.
- It describes cooling as a “developmental need” and seeks to address the rising demand in cooling, from buildings to transport to cold-chains, through sustainable actions.
- The plan estimates that the national cooling demand would grow 8 times in the next 20 years, which would result in a corresponding 5 to 8-fold rise in the demand for refrigerants that involve the use of HFCs.
- As part of the ICAP, the government has also announced targeted R&D efforts aimed at developing low-cost alternatives to HFCs.
- Other objectives** - It will assess the cooling requirements across sectors and the associated refrigerant demand and energy use.
- The goals emerging from the suggested interventions stated in ICAP are,

Goals	Targets
Reduction of cooling demand across sectors	20% to 25% by 2037-38
Reduction of refrigerant demand	25% to 30% by 2037-38
Reduction of cooling energy requirements	25% to 40% by 2037-38
Skilling and certifying 100,000 Refrigeration and AC servicing sector technicians, in synergy with Skill India Mission	2022-23

#### 5.5 National River Conservation Plan

- It is a **Centrally Sponsored Scheme** of the Jal Shakti Ministry. Aim of the plan is to prevent pollution of rivers and improving water quality.
- The activities under National River Conservation Plan include,
  - Sewage treatment plants for treating the diverted sewage,
  - Low cost sanitation works to prevent the open defecation on riverbanks,
  - Public awareness and public participation,
  - Electric crematoria to ensure proper cremation of the bodies brought to burning Ghats.
- It is implemented by National River Conservation Directorate (NRCD).
- NRCD only provides financial assistance to the States/ local bodies to set up infrastructure for pollution abatement of rivers in identified polluted river stretches based on proposals received from the States/ local bodies.

#### 5.6 The NITI Aayog Draft Report on Prospects of coal

The NITI Aayog has drawn up an important ‘draft’ report on the prospects of coal in the coming decade.

- The report bases its projections on eight major studies.
- In India coal cannot be phased out owing to urgency in moderating coal use.
- The report suggests a modest growth in coal-fired power by 2030, despite its share in electricity generated is projected to fall from 72% now to just 50% by then.
- Battery storage and Grid integration remains as areas of uncertainty in case of renewable energy.
- So, there can be no get away from an increase in demand for thermal-based power over the next decade.
- Recommendation** - Producing clean electricity means low sulphur and carbon emissions.
- Experts feel that coal power should be drawn largely from new plants in order to meet these parameters, thereby scrapping old ones.

- However, there is also a broad consensus that no further projects should be planned.
- The extra electricity demand can be met from a coal-fired generation capacity of about 250 GW by 2030 (renewable accounting for the rest), against 210 GW at present, to be met from thermal projects in the pipeline.
- Conceiving further thermal capacities will create a problem of stranded assets.
- **Phasing out of Old Plants** - The views of experts advising NITI Aayog on energy policy appear to diverge.
- **The National Institute of Advanced Studies** has suggested the progressive retirement of 36 GW of total capacity.
- **The Council on Environment, Energy and Water (CEEW)** recommends decommissioning 30 GW coal-based capacities and temporarily mothballing 20 GW of relatively new capacity
- Mothballing indicates stop using equipment but keeping it in good condition so that it can readily be used again.
- According to CEEW all old plants are not decrepit. Scrapping plants aged over 25 years will yield a one-time savings of over Rs10,000 crore in terms of avoided pollution retrofits.
- Scrapping old plants - Closing down plants brings with it a political risk in the event of outages
- A call to set up new thermal plants will increase, introducing further environmental and financial risks.
- A measured approach to the issue is the need of the hour.

## 5.7 Glacial Lake Atlas

*The Department of Water Resources, River Development and Ganga Rejuvenation (DoWR, RD & GR) under the Ministry of Jal Shakti have released the updated Glacial Lake Atlas of Ganga Basin.*

- For the present study, glacial lakes with water spread area greater than 0.25 ha were mapped using Resourcesat-2 (RS-2) Linear Imaging Self Scanning Sensor-IV (LISS-IV) satellite data.
- Based on its process of lake formation, location, and type of damming material, glacial lakes are identified in 9 types, grouped into 4 categories.
- The present glacial lake atlas is based on the inventoried glacial lakes in part of Ganga River basin from its origin to foothills of Himalayas. The study portion of the basin covers part of India and transboundary region.
- This Atlas is available on Bhuvan portal of National Remote Sensing Centre (NRSC), India WRIS Portal and National Hydrology Project (NHP) website.
- **Role of NRSC** - NRSC under the NHP is carrying out hydrological studies using satellite data and geospatial techniques.
- It is responsible for forming a detailed glacial lake inventory, prioritization for GLOF risk, and simulation of GLOF for selected lakes has been taken up for all the catchments of Indian Himalayan Rivers.
- Under this activity, an updated inventory of glacial lakes using high resolution satellite data was prepared for the Indus River basin in 2020.
- **Uses** - The Glacial Lake Atlas can be used for managing the glacial lakes, and to mitigate the possible impacts of Glacial Lake Outburst Floods (GLOF) and climate change.
- It provides database for regular or periodic monitoring changes in spatial extent (expansion/shrinkage), and formation of new lakes.
- Central and State Disaster Management Authorities can make use of the atlas for disaster mitigation planning and related program.

## National Hydrology Project

- National Hydrology Project is a Central Sector Scheme with 100% grant to implementing agencies on pan India basis that was started in 2016.

### ● ● NHP-Bhuvan Portal

- The Secretary, Department of Space & Chairman of ISRO launched the National Hydrology Projector NHP-Bhuvan portal of NRSC.
- This portal is a repository of information on the initiatives undertaken by NRSC under NHP with a facility to download the reports and knowledge products being developed by NRSC.
- This initiative under NHP is a step towards facilitating acquiring reliable information and putting the same in public domain which would pave the way for an effective water resource development and management.

- It is implemented by the Department of Water Resources, River Development & Ganga Rejuvenation (DOWR, RD & GR). It is supported by the World Bank.
- **Objective** - To improve the extent, quality and accessibility of water resources information and to strengthen the capacity of targeted water resources management institutions in India.
- **Project Components** - Water Resource Monitoring System (WRMS), Water Resources Information System (WRIS), Water Resources Operation and Planning System (WROPS) and Water Resources Institutions Capacity Enhancement (WRICE).
- **Groups of direct beneficiaries**
  - Central and state implementing agencies (IAs) responsible for surface and/or groundwater planning and management, including river basin organizations; and
  - Users of the WRIS across various sectors and around the World.
- **Key Results Indicators**
  - Improving the extent, quality, and accessibility of water resources data: Number of new or upgraded Water Resources monitoring stations providing validated data online.
  - Improving the accessibility of water resources information.
  - Strengthening the capacity: Number of Water Resources institutions achieving benchmark performance levels.

## 5.8 Deep Ocean Mission

The Cabinet Committee on Economic Affairs has approved the proposal of Ministry of Earth Sciences (MoES) on "Deep Ocean Mission".

- Deep Ocean Mission aims to explore the Deep Ocean for resources and develop deep sea technologies for sustainable use of ocean resources.
- It will be a mission mode project to support the Blue Economy Initiatives of the Government of India. Ministry of Earth Sciences (MoES) will be the nodal Ministry implementing this multi-institutional mission.
- The Deep Ocean Mission consists of the following six major components:
  1. Development of Technologies for Deep Sea Mining, and Manned Submersible,
  2. Development of Ocean Climate Change Advisory Services,
  3. Technological innovations for exploration and conservation of deep-sea biodiversity,
  4. Deep Ocean Survey and Exploration to explore and identify potential sites of multi-metal Hydrothermal Sulphides mineralization along the Indian Ocean mid-oceanic ridges,
  5. Energy and freshwater from the Ocean - Studies and engineering design for offshore Ocean Thermal Energy Conversion (OTEC) powered desalination plant are envisaged in this proof of concept proposal.
  6. Advanced Marine Station for Ocean Biology.
- The Government of India's Vision of New India by 2030 enunciated in 2019 highlighted the Blue Economy as one of the ten core dimensions of growth.

## 5.9 First-ever GM Rubber

Kerala-based Rubber Research Institute of India (RRII), under the Rubber Board, had developed the world's first genetically modified (GM) rubber plant tailored for the climatic conditions in the Northeast.

- This is the first time any GM crop has been developed exclusively for this region after years of research in RRII's biotechnology laboratory.
- The GM rubber has additional copies of the gene MnSOD, or manganese-containing superoxide dismutase, inserted in the plant.

### ● ● Rubber Board

- The Rubber Board is a statutory body under the administration of the Ministry of Commerce and Industry.
- It was constituted as per the Rubber Act, 1947 and Rubber Rules 1955 for the overall development of the rubber industry in the country.
- Head Office – Kottayam, Kerala.
- It is responsible for the development of the rubber industry in the country by assisting and encouraging research, development, extension and training activities related to rubber.

- MnSOD may tide over the severe cold conditions during winter - a major factor affecting the growth of young rubber plants in the region.
- Natural rubber is a native of warm humid Amazon forests and is not naturally suited for the colder conditions in the Northeast.
- Growth of young rubber plants remains suspended during the winter months, which are also characterised by progressive drying of the soil.
- This is the reason for the long immaturity period of this crop in the region. With the MnSOD gene in the GM crop, the plants will be protected from adverse effects of severe environmental stresses.

### 5.10 LiDAR Survey

- Environment Minister released the Detailed Project Reports (DPRs) of LiDAR based survey of forest areas in ten states.
- [Ten states - Assam, Bihar, Chhatisgarh, Goa, Jharkhand, Madhya Pradesh, Maharashtra, Manipur, Nagaland, and Tripura.]
- The project, which was awarded to WAPCOS in 2020 for implementation in 26 states, is a first of its kind experiment using LiDAR technology.
- WAPCOS has prepared these DPR's using LiDAR technology in which the 3-D (three dimensional) DEM (Digital Elevation Model), imagery and layers of the project areas are used.
- This LiDAR Survey will,
  - Help augment water and fodder in jungles areas thereby reducing human-animal conflict,
  - Help in groundwater recharge,
  - Recommend different types of Soil & Water conservation structures such as Anicut, Gabion, etc.,
- State forest departments must use CAMPA funds towards implementation of these projects in accordance with the 'Ridge to Valley' approach of watershed management.
- WAPCOS with the participation of State Forest Departments identified one major ridge inside a forest block in these states with average area of 10,000 ha selected in each State for preparation of DPRs.
- States/UTs identified one major ridge inside a forest block with the criteria that
  1. Area selected should have average rainfall of the state, and
  2. Area requires assisted natural generation which means the density of forests should be less than 0.4 or below, but should have reasonable potential to regenerate with the ANR interventions.

#### LiDAR

- Light Detection and Ranging (LiDAR) is a remote sensing method that uses light in the form of a pulsed laser to measure ranges (variable distances) to the Earth.
- A LiDAR instrument has a laser, scanner & a specialized GPS receiver.
- It determines the ranges by targeting an object with a laser and measuring the time for the reflected light to return to the receiver.
- Airplanes and helicopters are the most commonly used platforms for acquiring LiDAR data over broad areas.
- Types - Two types of lidar are topographic and bathymetric.
  1. Topographic lidar uses a near-infrared laser to map the land,
  2. Bathymetric lidar uses water-penetrating green light to also measure seafloor and riverbed elevations.
- Uses - It is used for agriculture, hydrology and water management systems and geology-related applications.
- It is also used in archaeology.

### 5.11 Project BOLD

The project "Bamboo Oasis on Lands in Drought" (BOLD) is an initiative of the Khadi and Village Industries Commission (KVIC) that seeks to create bamboo-based green patches in arid and semi-arid land zones.

- It has been launched as part of KVIC's "Khadi Bamboo Festival" to celebrate 75 years of independence "Azadi ka Amrit Mahotsav".
- It is the first of its kind exercise in India which was launched from the tribal village NichlaMandwa in Udaipur, Rajasthan.
- The saplings of special bamboo species – Bambusa Tulda and Bambusa Polymorpha specially brought from Assam – have been planted over 16 acres of vacant arid Gram Panchayat land.
- KVIC is set to replicate the Project at Village Dholera in Ahmedabad district in Gujarat and Leh-Ladakh region by August 2021.

- **Significance** - It is a scientific exercise that will reduce desertification and provide livelihood and multi-disciplinary rural industry support. It will be havens of sustainable development and food security.
- **Reasons for selecting Bamboos** - Bamboos grow very fast and in about three years' time, they could be harvested.
- They conserve water and reduce evaporation of water from the land surface - An important feature in arid and drought-prone regions.

## 5.12 Heritage Trees

- The Maharashtra government will make amendments to the Maharashtra (Urban Areas) Protection and Preservation of Trees Act of 1975, to introduce provisions for the protection of 'heritage trees'.
- **Heritage trees** - Under the proposed amendment, a tree with an estimated age of 50 years or more shall be defined as a heritage tree. It may belong to specific species, which will be notified from time to time.
- The environment department, in consultation with the forest department, will issue guidelines to determine the age of the tree.
- **Protection** - According to the current Compensatory Plantation in the state, one sapling has to be planted for each tree that is cut.
- Under the proposed amendment, anyone cutting a heritage tree must plant compensatory trees in the same numbers as the cut tree's age.
- **Maintenance** - The organization planting these trees will have to ensure the survival of the plantation for 7 years and geo-tag the trees.
- Such plantations can be carried out either in the same plot or a common amenity plot.
- The amendment also has the fine for illegal felling of trees from a maximum of Rs 5,000 to Rs 1 lakh per tree.

### Determining a Tree's Age

- The most common method of determining the age of the tree is Dendrochronology – or tree-ring dating also called growth rings.
- Each year, roughly a tree adds to its girth, the new growth is called a tree ring. By counting the rings of a tree, the age can be determined.
- To analyse the rings, core samples are extracted using a borer that's screwed into the tree and pulled out, bringing with it a straw-size sample of wood. The hole in the tree is then sealed to prevent disease.

## Maharashtra Tree Authority

- Maharashtra will form the Tree Authority in local civic bodies and councils which will take all decisions regarding the protection of trees.
- Tree Authority (TA) is tasked with increasing the tree cover in urban areas and protecting the existing ones.
- The knowledge of the experts, who are part of the local TA, will form the basis of decisions taken up by the authority.
- A proposal to cut more than 200 trees of age 5 years or more, will be referred to the state tree authority.
- The local TA will have to ensure that the project is not sub-divided into smaller parts to keep the number of trees below the defined threshold.
- Ensure preparation of a tree plan and should aspire over the years to have 33% green belt in their area.
- The local Tree Authority will have to ensure tree census to be carried out every five years along with counting of heritage trees.

## 5.13 Sariska Relocation

*For the first time in the history of tiger conservation, the wild cats were translocated from Ranthambhore to Sariska.*

- The Rajasthan government took up the challenge to reintroduce tigers in Sariska and set up a task force in June 2008.
- The Wildlife Institute of India and World Wide Fund were approached.
- This was to plan and organize a population estimation exercise in Ranthambhore & Sariska.

- The genetic studies were undertaken to identify tigers suitable for translocation.
- After the relocation, the tiger population increased at a rapid speed from 1,411, as per the tiger census in 2006, to 2,226 in 2015 and 2,967 in 2018.
- **Need for relocation** - Due to the loss of the forest corridors, tigers were surviving only in pockets like Sariska, Panna and Ranthambhore Tiger Projects.
- As these pockets were not connected, there was inbreeding of tigers.
- This, in the long run, would have affected their biological fitness, among other issues.
- Another factor important for tiger reserves is to have the right male and female ratio.
- These issues could only be corrected/addressed by relocation.

#### NTCA

- At the beginning of the 21st century, the tiger population again started declining.
- The main Protected Area which was left without tigers due to hunting and poaching activities was the Sariska Tiger Reserve (Rajasthan) in 2004-2005.
- Subsequently, the Panna Tiger Reserve (M.P) faced the same in 2007-2008.
- This led to several inquiry commissions, at national and state levels to find out the reason behind it.
- Subsequently, the government reconstituted 'Project Tiger' and converted it into the National Tiger Conservation Authority (NTCA) in 2005.
- It was constituted under enabling provisions of the Wildlife (Protection) Act, 1972, as amended in 2006, for strengthening tiger conservation, as per powers and functions assigned to it.
- The NTCA had more power to check poaching and preserve the tiger population.
- Its mandate included setting up Tiger Protection Force and funding the relocation of villages from the protected areas.

#### 5.14 Tracking of Tigers

- Major ways of tracking a tiger are radio collars and camera traps. GSM camera traps can also be used, though they are dependent on internet connectivity.
- **Radio collars** are put on tigers for long-term studies of their behaviour, their feeding and movement patterns, etc. For this, a tiger is tranquilised and the collar put around its neck.
- Using the highly sophisticated technology of radio telemetry, officials can get real-time information about its movement.
- **Camera traps** can be used to capture a non-collared tiger. These traps are laid at locations which the tiger is most likely to move past.
- But apart from these places, it keeps moving to scores of other areas where there are no cameras. Thus, only a few locations can be received.
- Also, the cameras are checked only after a gap of 2-12 hours.
- While camera traps do help in identifying the animal, but if more than one tiger is moving around in a given location, this can get tricky.
- **Areas** - Tiger tracking is done both in protected areas (PAs) and non-PAs (generally human-dominated landscapes).
- This is further distinguished into tracking in established and non-established territories.
- Generally, tigers have big territories and hence when they move from one end to the other, another male could even trespass into their territory.
- But there are also tigers that don't have established territories. Their movement is difficult to track.
- Tigresses have small territories, which they guard by continuously patrolling it. So they spend more energy and thus require more food.
- Females in PAs require 10-12% more food than males. The food requirement of females over males goes up by about 24% in human dominated landscapes. So, more tigresses than tigers come in conflict with humans.

### 5.15 Catch the Rain Project

- Recently, the Ministry of Jal Shakti launched a campaign “Jal Shakti Abhiyan: Catch the Rain” (JSA:CTR) with the tag line “Catch the rain, where it falls, when it falls”.
- This campaign was aimed at giving a nudge to the states and all stakeholders to create Rain Water Harvesting Structures (RWHS) suitable to the climatic conditions and sub-soil strata.
- The Ministry has taken up the campaign to cover all the blocks of all districts across the country during the pre-monsoon and monsoon period (22<sup>nd</sup> March 2021 and 30<sup>th</sup> November 2021).
- As a part of the campaign, the following activities will be taken up,
  1. Creation of new and maintenance of old Rainwater harvesting structures;
  2. Revival of traditional rainwater harvesting structures;
  3. Enumeration, geo-tagging, making inventory of water bodies, reuse and recharge of bore wells;
  4. Watershed development, intensive afforestation preparation of scientific water conservation plans and
  5. Setting up of Jal Shakti Kendras.

### 5.16 Decarbonisation of Indian Economy

India's announcement of achieving net-zero emissions by 2070 has highlighted the importance of decarbonising the economy but the road ahead will be challenging.

Decarbonisation is the process of reducing the amount of carbon, mainly carbon dioxide (CO<sub>2</sub>), sent into the atmosphere.

Figure 1: Industrial decarbonization challenges



- Industrial decarbonization will propel India towards a sustainable future and further towards deep decarbonisation but it also causes loss to several players.
- People working in fossil fuels and energy production, heavy industry and the vehicle manufacturing sectors are expected to be significantly impacted in the coming decades.
- Steel, petrochemicals, aluminum, cement, and fertilizer sectors are hard to abate sectors and cleaner pathways are yet to prove themselves economically.
- Besides maintaining global competitiveness, heavy industries due to their longer lifespan they cannot retire their existing machinery and switch to green fuels due to associated costs very quickly.
- Another problem with heavy industries is the requirement of high temperature heat (>500 Degree Celsius), which can only be provided by burning fossil fuels.

#### Approach Needed

- **Breaking up into shorter periods** - By 2070, there will be many changes in technology, environmental conditions and the economy.
- The planning horizon of about 50 years will need to be broken up into shorter periods so that new knowledge about emerging technologies can be incorporated into plans.
- Five years, as the UK has used seems reasonable.
- **Setting up an autonomous agency** – A technically credible agency like the Climate Change Committee (CCC) in the UK should be set up.
- Its members should be recognised experts in their fields to provide independent advice to the government regarding long-term and interim (five-year) targets.

- It would also monitor progress and annually report and suggest mid-course corrections.
- **Targeting the power sector** - The power sector has to be focussed because it is the biggest source of GHG emissions and also the easiest one to decarbonise.
- It would be best to have a single emissions-related objective so that an optimal strategy can be developed at the lowest cost.
- Setting permissible emission intensity in terms of grams of carbon dioxide equivalent per kWh of electricity sold would be a good option for targets in the power sector.
- India is anticipating that 80-85% of the country's electricity demand will be met from renewable sources by 2050.

**Figure 2: Possible pathways for decarbonizing India's industrial sector**



**Clear road map with sector-specific targets**

Including industry-specific targets and strategies in the Nationally Determined Contributions



**Expanding the decarbonization umbrella**

Including MSMEs under the decarbonizing umbrella through policy intervention such as PAT scheme



**Technology transfer**

Platform for facilitating knowledge and technology transfer through innovative partnerships with European countries such as UK



**Promoting circular economy**

To ensure sustainability in terms of reducing process emissions and waste management

- **Need for a Coordinated Approach** - There are separate targets for almost every resource such as solar, non-solar renewable energy, hydropower, etc.
- It reduces the flexibility of distribution companies to select resources to meet their loads resulting in a non-optimal resource mix and a higher cost of electricity.
- India needs a coordinated approach for decarbonisation of economy.

### 5.17 CRISP-M for MGNREGA

*Ministry of Rural Development reaches an important milestone with the completion of Geographical Information System (GIS) plans for around 75% Gram Panchayats (GPs) under Mahatma Gandhi NREGA.*

- Climate Resilience Information System and Planning (CRISP-M) tool will integrate this GIS-based planning data with the climate data.
- This tool was developed jointly by the Ministry of Rural Development and the British Government.
- CRISP-M will enable the local communities to understand the impact of changing climate in terms of various geophysical parameters and make smart decisions on them.
- This is initially proposed to be taken up in 7 states and will be expanded later to all other states as well.

### 5.18 Elephant Collaring

*A wild elephant was radio-collared in Assam by the state's Forest Department, in collaboration with NGO World Wildlife Fund (WWF)-India.*

- This initiative is seen as a step to study & mitigate human-elephant conflict in the state. But experts say that the exercise is challenging, and even runs the risk of having a low success rate.
- **Radio-collars** are GPS-enabled collars. They can be fitted around the elephant's neck to relay information about an elephants' whereabouts.
- Collaring includes,
  1. Identifying a suitable candidate (generally an adult elephant),
  2. Darting the candidate with a sedative, and
  3. Fitting a collar around its neck, before the animal is revived.
- The objectives of this joint initiative are twofold.
  1. GPS information from the collar would help us track and study the movement patterns of the herd, across regions and habitats. This would help in understanding what is driving the conflict.

2. The collars would serve as an early warning system. If people know in which direction an elephant is moving, they can be prepared.

- These collars are a tried-and-tested tool for wildlife monitoring and will give rangers a leg up on poachers, allowing them to identify and respond to threats in real-time through mobile devices.
- **Challenges** – As we don't have helicopters and other sophisticated equipment to approach elephants to tranquillise them, we go by foot. There is life risk.
- All components for radio collaring are not available in India. These have to be imported and are quite expensive.
- As the elephants grow in size, collars may become tight. So, we usually have to identify a senior elephant to avoid the chance of growth.
- Each geographical area has its own peculiar problems. Also, we have elephants that are long ranging, and have a diverse topography.
- Many times elephants are not able to keep the collar on. They will have it on for maximum 6 months, before it falls off. Also, there may be technical glitches with the device too.
- Apart from Assam, collaring has been attempted in Chhattisgarh, Odisha and Tamil Nadu too.

### 5.19 Kerala Revoked Order to Fell Trees by TN

*A fresh controversy over felling of trees downstream the baby dam, which is part of the 126-year-old Mullaperiyar dam has erupted*

- Mullaperiyar dam comprises the main dam, a baby dam, an earthen dam and the spillway.
- **Baby dam** was constructed to increase the water level.
- As per a 2014 Supreme Court directive, the water level at the dam can be maintained at 142 ft.
- Pointing out the age of the dam and raising safety concerns, Kerala has been demanding that the water level be reduced to 136 ft.
- For Tamil Nadu, strengthening of the baby dam is crucial for increasing the water level from 142 ft to 152ft.
- This is the reason why Tamil Nadu is seeking the permission from Kerala to cut the trees.
- Recently, Kerala granted TN permission to cut down trees. But it froze its decision in the wake of fears that the move would impair the interests of Kerala in the long-pending inter-state dispute.
  - By strengthening the baby dam and other structures, TN can play to hilt its demand that water level has to be raised to 152 ft.
- The forest department froze the order, pointing out that cutting of trees from the Periyar Tiger Reserve is subject to the clearance by the Union Ministry of Environmental and Forests and other statutory bodies.
- So, Tamil Nadu has to obtain approval from the Standing Committee of the National Board of Wild Life.
- Apart from that, permission is required as per the Forest Conservation Act of 1980. However, Tamil Nadu has not completed these mandatory steps before seeking permission to cut the trees.

#### DID YOU KNOW?

Mullaperiyar dam is situated in Kerala, and Tamil Nadu, the custodian of the dam. Although the dam is controlled by Tamil Nadu, the permission for felling trees has to be granted by Kerala, where the dam is situated

### 5.20 Looking Beyond the Forest Rights Act

*The Forest Rights Act (FRA) has been in existence for 15 years but many forest dwellers across India are in vulnerable condition due to improper implementation of FRA.*

- The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006 or FRA was a landmark legislation that sought to restore the rights of forest dwellers over land, community forest resources and habitats, and the governance and management of forests.
- It concerns the rights of forest-dwelling communities to land and other resources, denied to them over decades as a result of the continuance of colonial forest laws in India.
- The Act grants legal recognition to the rights of traditional forest dwelling communities, partially correcting the injustice caused by the forest laws.

- **Significance** - The community forest titles enable all the villagers, including landless people, to access, use and sell minor forest produce and use other forest resources contributing to their livelihood.
- The FRA has the potential to restore the rights of forest dwellers over at least 100 million acres of forest land in one-fourth of the villages across the country.
- There are evidences that after recognition of community forest rights, the household incomes from bamboo harvesting have increased.
- There are possibilities of reverse migration and reduced forest fires due to regular patrolling and monitoring by the villagers and promotes sustainable management of forests.
- **Implementation status of FRA** - The Supreme Court ordered the eviction of Scheduled Tribes (STs) and Other Traditional Forest Dwellers (OTFDs) across 16 States, whose claim as forest-dwellers has been rejected under the Forest Rights Act.
- The court directed that the eviction be carried out by July 24, 2019.
- The forest land claims of these tribes and forest-dwellers are mostly rejected by the States.
- Being poor and illiterate, living in remote areas, they do not know the appropriate procedure for filing claims and the rejection orders are not even communicated to these communities.
- The order was stayed by the Supreme court after the Centre moved the apex court to modify the former order
- **The Ministry of Tribal Affairs** is the implementing agency whereas the role of the Forest Department in granting titles is crucial because the lands claimed are under its jurisdiction.
- As on April 30, 2020, the Ministry of Tribal Affairs had received 42,50,602 claims (individual and community), of which titles were distributed to 46% of the applicants.

### Issues in Implementation

- **Non-compliance of the procedure**- The process of constitution of a Forest Rights Committee comprising members from within the village by conducting a Gram Sabha with two-thirds of the members present is not followed in many places.
- These committees were mostly constituted by the Panchayat Secretaries upon the directives received from District Magistrates at short notice.
- **Lack of Transparency**- The nominations for members for the taluk-level and district-level committees were not transparent.
- **Women rights**- The FRA provides for equal rights in titles issued under the Act for women but on the ground level, women were hardly visible in this regard.
- **Proofs of evidence** - In the initial stages of implementation, there was insistence on satellite images as evidence while other admissible proofs were ignored, as happened in Gujarat resulting in mass rejections of claims.
- **Issues in confirmation of the award**- In some villages around Bastar, Chhattisgarh, the plots claimed and the documents confirming the award did not match.
- Besides, the extent of land that was awarded was far smaller than what was claimed.
- **Non- expansion of other welfare schemes**- Various welfare and developmental schemes of the Rural Department were not extended to the tribal people who received documents of land possession under the FRA despite the directives issued by the Ministry.
- **Poor awareness**- Poor awareness levels among the tribal people proved to be a drawback especially in the scheduled areas which are remotely located.
- **Decline in the quality of forest produce**- The tribals possess lands (including the lands recognised under the FRA) that are small, of poor quality, infertile without irrigation facilities thus forcing them to look for other sources of livelihood.
- In Chhattisgarh, earnings from activities such as collection of tendu leaves for rolling local cigars were affected when there was an influx of labourers from Bihar who were willing to work for low wages.
- **Lack of coordination**- The biggest challenge throughout the country has been a lack of coordination between tribal, forest and revenue departments at the local level.
- **Myths of disappearance of tigers**- The number of tigers has only gone up after the FRA came into the picture.

- For example, after giving forest titles to the **Soliga tribal community** in the BRT Hills of Karnataka, a 2013 government estimate shows tiger density to be 11.3 tiger/100 sq km, making it second only to Kaziranga.

### 5.21 Ethanol 20 Programme

The government has launched the Ethanol 20 (E20) programme under which it aims to achieve 20% ethanol blending in petrol by 2025.

- Earlier, the central government had released an expert committee report on the 'Roadmap for Ethanol Blending in India by 2025' that proposes,
  1. A gradual rollout of ethanol-blended fuel to achieve E10 fuel supply by April 2022 and
  2. A phased rollout of E20 from April 2023 to April 2025.
- The committee also recommends roll out of E20 material-compliant and E10 engine-tuned vehicles from April 2023 and production of E20-tuned engine vehicles from April 2025.
- **Significance** - E20 programme is aimed at reducing the country's oil import bill, and it will also decrease the emissions of carbon monoxide, hydrocarbons and nitrogen oxides by 40%.
- This new initiative is also part of measures to improve energy security and self-sufficiency measures.
- With 100% use of 20% blend of bio ethanol, India will be able to save Rs. 30,000 crore on import of fossil fuel.

### Other Initiatives

- The government is planning to introduce Flex Fuel Vehicles soon, which would be able to operate on 100% bio ethanol or 100% petrol.
- The government has allowed the production of ethanol from surplus and damaged food grains in addition to sugar cane.

### 5.22 Gross Environment Product

The Uttarakhand government announced that it will initiate valuation of its natural resources in the form of 'Gross Environment Product' (GEP), said to be along the lines of Gross Domestic Product (GDP).

- Gross Environment Product (GEP) is an assessment system to measure the ecosystem services of any area.
- It reflects the aggregated annual value of goods and services provided by ecosystems (forests, water bodies, oceans, etc.) to people in a given region, such as at district levels, state, and country.
- It entails the establishment of a natural capital accounting framework by integrating ecological benefits into common measures of economic growth such as GDP.
- It summarizes the value of ecosystem services in a single monetary metric.

### 5.23 Forest Restoration

- Forests cover nearly 30% land surface of the earth. But, there is a decline in global forest cover, and requires restoration.
- **Restoration** is bringing back the degraded or deforested landscape to its original state by various interventions to enable them to deliver all the benefits.
  - Active restoration includes planting, and
  - Passive restoration includes halting environmental stressors.
- **Challenges** - Out of 21.9% population of India living under the poverty line, nearly 275 million people including tribes **depend on the forest for subsistence**.
- As 18% of the global human population depends on forests, there is a degradation of 41% of India's forests
- To combat this, India joined the Bonn Challenge with a

#### FACTS

- State of the World's Forests report 2020 says that between 1990 & 2020, 420 million hectares of forest have been lost through deforestation, conversion & land degradation.
- India lost 4.69 MHA of its forests for various land uses between 1951 and 1995.
- Decade 2021-2030 is declared as the UN Decade on Ecosystem Restoration for improving environmental conditions and enhancing human communities.

pledge to restore 21 MHA of degraded and deforested land by 2030.

- This pledge was later revised to 26 MHA to be restored by 2030.
- **Solution - Research on the local ecology** before putting restoration interventions into practice is needed.
- **Alternate financing ways** such as involving corporates and dovetailing restoration activities with ongoing land-based programmes of various departments can help to make it easy for operation.
- An **inclusive approach** involving active engagement of stakeholders, awareness and capacity building of stakeholders can help India achieve its MHA restoration objectives.
- In forest restoration, the **participation of local communities** and adequate financing and incentives are essential.

## 5.24 Tight Oil

*Cairn Oil & Gas has partnered with US-based Halliburton to start shale exploration in the Lower Barmer Hill formation, Western Rajasthan.*

- Tight oil (also known as shale oil, shale-hosted oil or light tight oil) is **light-gravity crude oil** found in petroleum-bearing shale or tight sandstone formations of low permeability.
  - Tight oil is different from oil shale, which contains kerogen.
- Tight oil is found in **smaller batches**, and **deeper** than conventional crude deposits.
- Its extraction requires creation of fractures in oil and gas rich shale to release hydrocarbons through a process called **hydraulic fracking**.
  - Hydraulic fracking requires massive amount of water.
  - As the shale fluid from fracking may penetrate aquifers leading to methane poisoning of groundwater, the groundwater in the areas adjacent to shale production sites would be contaminated.
- Also, the construction of horizontal wells with multi-fracturing completions is one of the most effective methods for recovering tight oil.
- Tight oil is processed into gasoline, diesel, and jet fuels.
- Russia and the US are among the largest shale oil producers of the world, with a surge in shale oil production in the US having turned the country from an importer of crude to a net exporter in 2019.

### Shale Oil Exploration in India

- Currently, there is no large-scale commercial production of shale oil and gas in India.
- In 2013, state-owned ONGC had started exploration and, by the end of FY21, ONGC's assessment found prospects of shale oil at the Cambay basin (Gujarat) and Krishna Godavari basin (Andhra Pradesh).
- But, the quantity of oil flow observed in these basins did not indicate 'commerciality'.

## 5.25 Web-building Algorithm

*Researchers have created a web-building playbook or algorithm by discovering how spiders build webs in the dark.*

- The creation of a web-building algorithm brings new understanding of how creatures with brains a fraction of the size of a human's are able to create structures of such elegance, complexity and geometric precision.
- Web-weaving spiders build blindly using only the sense of touch.
- To understand how the relatively small brains of these animal architects support their high-level construction projects, is to systematically document and analyze the behaviours and motor skills involved.
- They found that web-making behaviors are quite similar across spiders, so much so that the researchers were able to predict the part of a web a spider was working on just from seeing the position of a leg.
- Even if the final structure is a little different, the rules they use to build the web are the same. This confirms that the rules are encoded in their brains.
- This work could give us hints on how we can understand larger brain systems, including humans.

## 6. PROTECTED AREAS

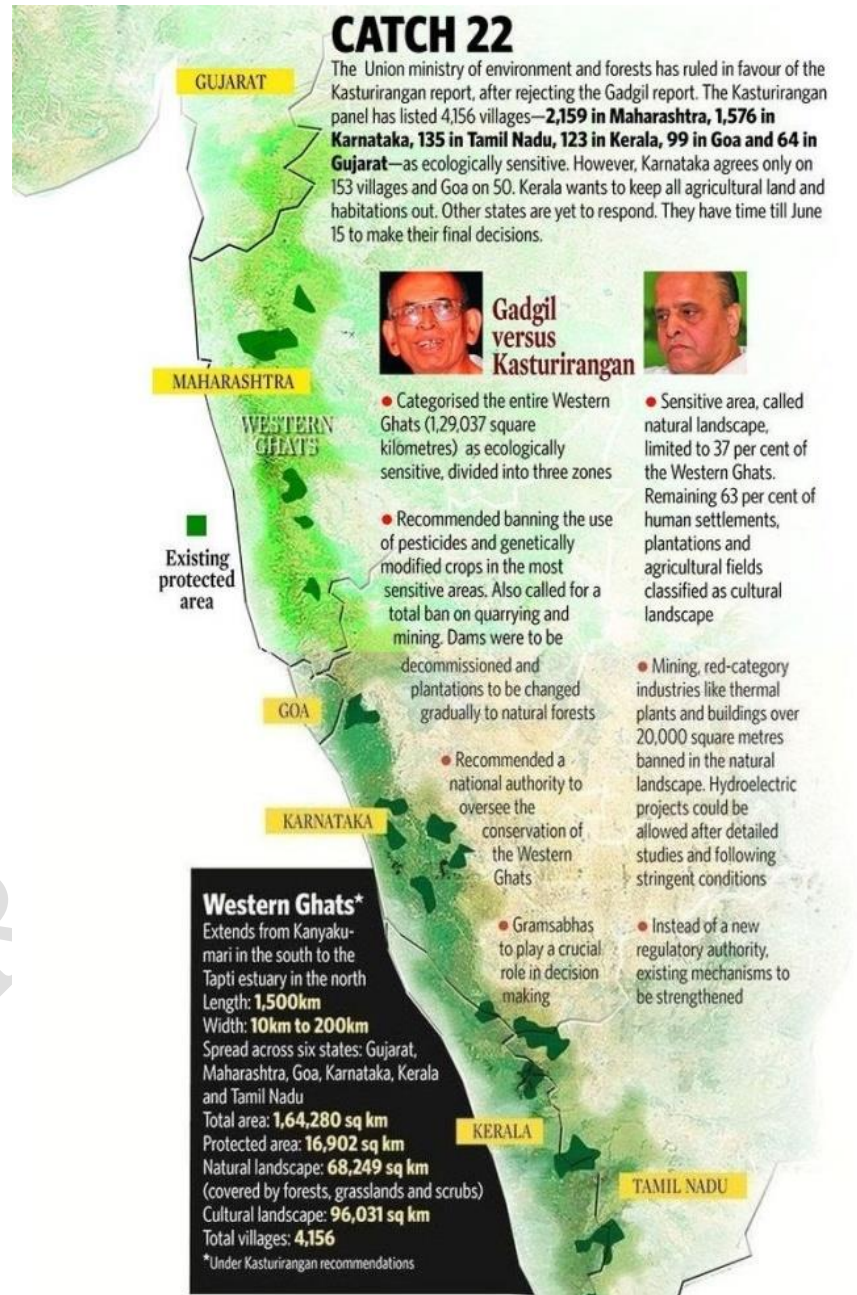
### 6.1 Western Ghats

Karnataka Chief Minister Basavaraj Bommai informed the Centre that the state is opposed to the Kasturirangan Committee report on Western Ghats.

- The Western Ghats is spread across the states of Kerala, Tamil Nadu, Karnataka, Goa, Maharashtra and Gujarat.
- It is a UNESCO World Heritage Site and is one of the eight "**hottest hot-spots**" of biological diversity in the world.
- It hosts properties including national parks, wildlife sanctuaries, world heritage sites, etc.
- It has over 7,402 species of flowering plants, 1,814 species of non-flowering plants, 139 mammal species, 508 bird species, 179 amphibian species, 6,000 insects species and 290 freshwater fish species.
- Thus, the demarcation of an ESA is an **effort to protect the fragile eco-system** from indiscriminate industrialisation, mining and unregulated development.
- Two committees – Gadgil and Kasturirangan – were appointed in the last eight years to identify the areas that needed to be kept out from such activities.

#### Kasturirangan committee report

- The Western Ghats Ecology Expert Panel (WGEEP), also known as the **Gadgil Commission** has designated the **entire hill range** as an Ecologically Sensitive Area and classified the 142 taluks in the Western Ghats boundary into Ecologically Sensitive Zones (ESZ) 1, 2 and 3.
- It suggested the formation of a **Western Ghats Ecology Authority (WGEA)**, a statutory authority which enjoys the powers under the Environment (Protection) Act.
- The Kasturirangan committee report proposes **37% of the total area of Western Ghats**, which is roughly 60,000 square kilometres, to be declared as eco-sensitive area (ESA).
- Out of this, 20,668 sq km of the area falls in Karnataka covering 1,576 villages.
- The report recommended a blanket ban on mining, quarrying, setting up of red category industries and thermal power projects.
- It stated that the impact of infrastructural projects on the forest and wildlife should be studied before permission is given for these activities.



- It also stated that the boundary of the 39 UNESCO Heritage sites are in most cases, boundaries of the legally demarcated national parks, wildlife sanctuaries, tiger reserves and forest divisions which are already accorded with high level of protection.
- The state of Karnataka has the highest percentage of the ESA- 46.50 %.

### Karnataka Government Rejection

- **Environment vs Development-** The state government believes that implementation of the report will halt the developmental activities in the region.
- Bommai said that declaring Western Ghats as ecologically sensitive zone would adversely affect the livelihood of people in the region.
- **Ground reality-** The Kasturirangan report has been prepared based on the satellite images, but the ground reality is different.
- People of the region have adopted agriculture and horticultural activities in an eco-friendly manner prioritising the environment protection as per the Forest Protection Act.

### Present status of the deemed forest land in Karnataka

- As per the Supreme Court, in *Godavarman Thirumulpad Vs Union of India & others*, the term forest as per dictionary meaning and the forests recorded in government records were to be included in the broad definition of 'forests' along with notified forests for consideration of any diversion proposal under the Forest (Conservation) Act, 1980.
- The expert committee appointed by the Government of Karnataka identified 10 lakh hectares of land in the State as deemed forest.
- The state expert committee in 1997 had identified 10 lakh hectares of deemed forest area which over the years were shrunk by the successive governments.
- The Karnataka government has planned to further shrink the deemed forest area from 3,30,186.938 hectares to 2 lakh hectares.
- There have been massive encroachments across the state forest areas and these have been done at the behest of political leaders.
- Considering the changes in climate which would affect the people's livelihood and the nation's economy, it is essential to conserve the fragile ecosystems that costs less compared to spending money on restoration and rejuvenation.

### 6.2 Ramsar Sites

*Four wetlands are recognised from the Ramsar Secretariat as Ramsar sites - Sultanpur & Bhindawas (Haryana) and Thol & Wadhvana (Gujarat).*

- With this, the number of Ramsar sites in India is 46 and the surface area covered by these sites is now 1,083,322 hectares.
- **Bhindawas Wildlife Sanctuary** is the largest wetland in Haryana.
- It is a human-made freshwater wetland.
- Over 250 bird species use the sanctuary throughout the year as a resting and roosting site.
- Globally threatened species found here are endangered Egyptian Vulture, Steppe Eagle, Pallas's Fish Eagle, and Black-bellied Tern.
- **Sultanpur National Park** supports more than 220 species of resident, winter migratory and local migratory water birds at critical stages of their life cycles.
- Species found here are,
  1. Critically endangered sociable lapwing, and
  2. Endangered Egyptian Vulture, Saker Falcon, Pallas's Fish Eagle and Black-bellied Tern.
- **Thol Lake Wildlife Sanctuary** lies on the Central Asian Flyway.
- It supports the threatened waterbird species,
  1. Critically endangered White-rumped Vulture, Sociable Lapwing,

2. Vulnerable Sarus Crane, Common Pochard and Lesser White-fronted Goose.

- **Wadhvana Wetland** provides wintering ground to migratory waterbirds, including the species that migrate on the Central Asian Flyway.
- Threatened or near-threatened species found here are,
  1. Endangered Pallas's fish-Eagle,
  2. Vulnerable Common Pochard, and
  3. Near-threatened Dalmatian Pelican, Grey-headed Fish-eagle and Ferruginous Duck.

### 6.3 Eco Sensitive Zone

*Government of India has recognised the reserve forest area on the fringes of Nagarjunasagar Srisailam Tiger Reserve (NSTR) as an Eco-Sensitive Zone (ESZs).*

- Also known as Ecologically Fragile Areas (EFAs), ESZs are areas notified around the Protected Areas, National Parks and Wildlife Sanctuaries by the MoEFCC under the Environment (Protection) Act, 1986.
  - But the word "Eco-Sensitive Zones" was not mentioned in this Act.
- **Coverage** - An ESZ could go up to 10 kms around a protected area as provided in the Wildlife Conservation Strategy, 2002.
- In the case of where sensitive corridors, connectivity and ecologically important patches are crucial for landscape linkage are beyond 10 km width, they should be included in the ESZs.
- **Permitted activities** - Ongoing agricultural or horticultural practices, rainwater harvesting, organic farming, use of renewable energy sources, adoption of green technology for all activities.
- **Regulated activities** - Felling of trees, establishment of hotels and resorts, commercial use of natural water, erection of electrical cables, drastic change of agriculture system, widening of roads.
- **Prohibited activities** - Commercial mining, saw mills, industries causing pollution, establishment of major hydroelectric projects (HEP).
- It also prohibits commercial use of wood, Tourism activities, discharge of effluents or any solid waste or production of hazardous substances.
- **Benefits** - ESZs are created to prevent ecological damage caused due to developmental activities around the Protected Areas.
- They act as a transition zone from areas of high protection to that of lesser protection.

### 6.4 Nagarjunasagar Srisailam Tiger Reserve

- **Location** - NSTR is India's largest tiger reserve that is present in the Nallamala ranges of the southern Eastern Ghats (AP and Telangana).
- River Krishna cuts the basin of this reserve.
- Most area is hilly terrain with plateaus, ridges, gorges and deep valleys that support the tropical mixed dry and moist deciduous forests.
- **History** - NSTR was notified in 1978 and became a tiger reserve under the protection of Project Tiger in 1983.
- In 1992, it was retitled as Rajiv Gandhi Wildlife Sanctuary.
- Two wildlife sanctuaries constitute the reserve's core area,
  1. Rajiv Gandhi Wildlife Sanctuary and
  2. Gundla Brahmeswaram Wildlife Sanctuary (GBM).
- Multipurpose reservoirs in the reserve - Srisailam and Nagarjunasagar.

### 6.5 Guru Ghasidas & Tamor Pingla Tiger Reserve

*National Tiger Conservation Authority (NTCA) approved the Chhattisgarh's proposal to declare the combined areas of the Guru Ghasidas National Park & Tamor Pingla Wildlife Sanctuary as a Tiger Reserve.*

- **Approval** - The 11th Technical Committee of the NTCA approved the proposal under the Section 38V (1) of the Wildlife (Protection) Act, 1972.
- [Section 38V (1) of WPA, 1972 (Tiger Conservation Plan) - The State Government shall, on the recommendation of the NTCA, notify an area as a tiger reserve.]
- **About the New Reserve** - The new Reserve is located in the northern part of Chhattisgarh, bordering Madhya Pradesh and Jharkhand.
- Both Tamor Pingla Wildlife Sanctuary and Guru Ghasidas National Park were identified as **reserve forests**.
- Turning Guru Ghasidas into a Tiger Reserve is important as it provides a corridor for tigers to move between Bandhavgarh Tiger Reserve (Madhya Pradesh) and Palamau Tiger Reserve (Jharkhand).

### Tamor Pingla Wildlife Sanctuary

- It is located in the Surajpur district of Chhattisgarh, and
  1. Moran River surrounds the northern boundary,
  2. BongaNalla guards the eastern boundary and
  3. Rihand River flows in the western boundary.
- The sanctuary experiences a warm and temperate type of climate.
- It is a part of the Sarguja Jashpur Elephant Reserve since 2011.
- **Fauna** - Asian elephants, Bengal tigers, Indian leopards, bears

### Guru Ghasidas National Park

- It is located in the Narmada Valley dry deciduous forests eco-region of Chhattisgarh.
- It was the last known habitat of the Asiatic cheetah in the country.
- Originally a part of the Sanjay Dubri National Park in undivided Madhya Pradesh, it was created as a separate entity in Chhattisgarh's Sarguja region after the formation of the state in 2001.
- **Fauna** - Bengal tiger, Indian leopard, Spotted deer, Sambar deer, wild boar, Nilgai, Chinkara, Civet, Porcupine, Monitor lizard, etc

## 6.6 Ramgarh Vishdhari Tiger Reserve

- National Tiger Conservation Authority (NTCA)'s technical committee has given a nod for the Ramgarh Vishdhari wildlife sanctuary to become Rajasthan's fourth tiger reserve.
- The area that has been identified as the reserve area comprises of two forest blocks of Bhilwara, territorial forest block of Bundi and Indargarh, which falls under buffer zone of Ranthambore Tiger Reserve (RTR).
- Prior to the formation of the state of Rajasthan, these forests were a part of the erstwhile Bundi princely states and were hunting reserves.
- In 1982, a part of the forest was declared as Ramgarh Vishdhari Wildlife Sanctuary under the Rajasthan Wild Animals and Birds Protection Act, 1951. The core area of the Ramgarh Vishdhari has eight villages.
- The sanctuary has leopards, sambhars, chitals, wildboars, smaller cats, caracals, chinkaras and nilgai.
- Other Tiger Reserves in Rajasthan,
  - Ranthambore Tiger Reserve (RTR) in Sawai Madhopur,
  - Sariska Tiger Reserve (STR) in Alwar, and
  - Mukundra Hills Tiger Reserve (MHTR) in Kota.

## 6.7 Dihing Patkai National Park

- Recently, the Assam government notified Dihing Patkai as the seventh National Park of the state.
- [The six other National Parks in Assam are Kaziranga, Manas, Nameri, Orang, Dibru-Saikhowa and Raimona.
- Assam now has the third most National Parks after the 12 in Madhya Pradesh and nine in the Andaman and Nicobar Islands.]

- Dihing Patkai national park will be administered by Soraipung Range of Digboi Forest Division and Jeypore Range of Dibrugarh Forest Division.
- Dehing is the name of the river that flows through this forest and Patkai is the hill at the foot of which the sanctuary lies.
- The Dihing Patkai straddling eastern Assam's Dibrugarh and Tinsukia districts is a major elephant habitat.
- It encompasses the erstwhile Dehing Patkai Wildlife Sanctuary, Jeypore Reserve Forest and the western block of Upper Dihing Reserve Forest.
- The forest village area diverted under Forest Conservation Act has been excluded.
- Stretches of Dirak and Buri Dihing rivers have been included in the park.

### Dehing Patkai Wildlife Sanctuary

- Dehing Patkai Wildlife Sanctuary is known as the Jeypore Rainforest.
- It is the only sanctuary in India which is home to seven different species of wild cats - tiger, leopard, clouded leopard, leopard cat, golden cat, jungle cat and marbled cat.
- It is home to Chinese pangolin, flying fox, barking deer, serow, Malayan giant squirrels, Assamese macaque and White Winged Wood Duck.

### 6.8 Corbett National Park

*A proposal has been made to change the name of Corbett National Park to Ramganga National Park.*

- **Name** - Set up in 1936 as India's - and Asia's - first national park, the national park was called Hailey National Park.
- It was renamed Ramganga National Park (after the river that flows through it) shortly after Independence.
- In 1956, it was rechristened yet again as Corbett National Park.
- **About** - Located in the Himalayan foothills of Uttarakhand, the park encompasses the Patli Dun valley formed by the Ramganga River.
- It has sub-Himalayan belt ecological characteristics, as it falls in the Shivalik and Outer Himalaya geological provinces.
- It has dense moist deciduous forest.
- **Ideal Tiger Territory** - Corbett National Park was the place from where Project Tiger was launched in 1973.
- It is part of the Corbett Tiger Reserve. It has the single largest tiger population in a tiger reserve in the country.
- The national park along with the neighbouring Sonanadi Wildlife Sanctuary makes the critical tiger habitat of the Corbett Tiger Reserve.
- **Other Fauna** - Indian Leopards, Barking Deer, Spotted Deer, Sambar Deer, Jungle Cats, sloth, etc.

### 6.9 Illegal Prawn Farms in Bhitarkanika National Park

- The Orissa High court had directed the district administration of Kendrapara to dismantle all illegal prawn farms in Bhitarkanika National Park.
- It also directed the collector of Kendrapara, where the park is located, to arrange for satellite verification of the entire district for detection and action against the farms.
- All the shrimp farms around the park were illegal as this violated the Coastal Regulation Zone and the rulings of the Supreme Court.
- The forest department will plant mangrove saplings over the dismantled prawn farms to convert the area into mangrove forest.
- Farmers cultivating shrimp without registering with the Coastal Aquaculture Authority are liable to be imprisoned for three years and levied a fine of up to Rs 1 lakh.
- **Concerns** - Prawn farm owners dump the effluents of the farms into the nearby rivers and ponds. They pollute the groundwater sources in the villages. This is destroying the fertile agricultural lands.
- Illegal prawn farms pose a direct threat to the nearby mangrove forests.

- The mushrooming of illegal prawn farms and their effluents are

### **Bhitarkanika National Park**

- In 2015, the Union Environment Ministry declared 192 villages around Bhitarkanika as Eco-Sensitive Zones (ESZs) to prevent ecological damage caused due to developmental activities.
- ESZs prohibit any shrimp farming within 2 kms from Bhitarkanika. For this, the administration should demolish all illegal prawn farms.

### **6.10 Lemru Elephant Reserve**

- The Chhattisgarh Government has proposed to decrease the area of the proposed Lemru Elephant Reserve, in Korba district, to 450 sq km.
- The proposal for the Lemru Reserve was passed by the Assembly in 2005 and got central approval in 2007.
- This reserve is a **natural elephant habitat**. The reserve will be a part of an elephant corridor that connects Lemru (Korba), Badalkhol (Jashpur), Tamorpingla (Surguja).
- Lemru is one of two elephant reserves planned to prevent human-animal conflict in the region, with elephants moving into Chhattisgarh from Odisha and Jharkhand.
- [Badalkhol Tamorpingla is another elephant reserve that was notified in 2011.]
- The area proposed under the reserve is part of the Hasdeo Aranya forests, a very diverse biozone that is also rich in coal deposits.
- The reserve is in a coal-bearing area with an estimated value of Rs 100,000 crore.

### **6.11 Deepor Beel Wildlife Sanctuary**

*Environment Ministry has notified that the Deepor Beel Wildlife Sanctuary, Assam as an eco-sensitive zone.*

- Deepor Beel is a permanent freshwater lake in a former channel of the Brahmaputra River, to the south of the main river.
- It is Assam's only Ramsar site besides being an Important Bird Area.
- It has for decades been threatened by a railway track, a garbage dump, and encroachment from human habitation and commercial units.
- The sanctuary's "guardian village" is Chakardeo.

### **6.12 Kazhuveli Wetlands Bird Sanctuary**

*Ministry of Environment and Climate Change had declared the Kazhuveli wetlands as the 16th bird sanctuary in Tamil Nadu.*

- Kazhuveli wetland is located near Villupuram in Tamil Nadu. It lies adjacent to the Bay of Bengal along the east coast.
- Kazhuveli wetlands is said to be the second largest brackish water lake in South India after Pulicat Lake.
- Kazhuveli brackish water lake wetlands are of adequate ecological, faunal, floral and geomorphological significance for the purpose of protecting, propagating and developing wildlife and its environment.
- It is a feeding ground for long-distance migrants from the cold subarctic regions of Central Asia and Siberia including Black-tailed Godwits, Eurasian Curlew, White Stork and Ruff.
- The Grey-tailed Tattler, a rare migratory wader, has been recorded only here and in Pulicat across the country.

#### **DID YOU KNOW?**

Kazhuveli falls in the Central Asian migratory path of birds

### **6.13 India's Highest Herbal Park**

*At Mana, Uttarakhand, India's highest herbal park was inaugurated.*

- The main aim of the herbal park is to **conserve medicinally and culturally important alpine species**, and to facilitate a study on the propagation of these species, as well as their ecology.
- Most of the species of herbal plants conserved in this park built by Uttarakhand government are,

1. Found in high alpine areas in the Himalayan region,
  2. Included in the “red list” of the IUCN, and
  3. Declared “endangered and threatened” by State Biodiversity board.
- The park is categorised into 4 sections - Sections for “Ashtavarga” species, Saussurea species, species associated with Badrinath (Lord Vishnu), and for assorted alpine species.
  - [“Ashtavarga” species consists of group of 8 Himalayan herbs.]
  - The land for the project was provided by Mana Van panchayat under the Compensatory Afforestation Fund Act (CAMPA).

#### 6.14 Re-wilding of Wild Animals

*Periyar Tiger Reserve (PTR) attempted to reintroduce into the wild an abandoned tiger cub after rearing it in ‘captive’ for two years.*

- **Re-wilding** is systematic, scientifically planned re-introduction of viable populations of lost animals to natural environments.
- It is a form of environmental conservation and ecological restoration that has significant potential to increase biodiversity, create self-sustainable environments and mitigate climate change.
- **SOP** - National Tiger Conservation Authority (NTCA) laid down the Standard Operating Procedures (SOPs)/Guidelines under Section 38(O) of The Wildlife Protection Act, 1972.
- As per these SOPs, there are three ways to deal with orphaned or abandoned tiger cubs.
  1. First way is to make an effort to reunite the abandoned cubs with their mother.
  2. If a reunion of the cub with its mother is not possible, then shift the cub to a suitable zoo.
  3. Reintroduction of the cub into the wild after a certain time when it appears that the cub is capable of surviving in the wild independently. This is what is known as ‘re-wilding’.
- NTCA stresses that the tiger cub should be reared in an in situ enclosure for a minimum of two years, and during this time, each cub should have a successful record of at least 50 ‘kills’.
- Tiger cubs should be in prime health, and of dispersing age (three/four years). There should be no abnormality/incapacitation.
- **Challenges** - Failures of re-wilding led to deaths of many tigers due to illness, injuries and territorial fight. as well as serious livestock depreddations, and even man-eating problems.
- Besides, the re-wilding process is very costly.
- **Choosing the location** - There is a need to protect more habitats strictly, so that the prey densities rise and more tigers can thrive.
- Reintroduction of captive animals in protected areas, which already have the presence of the same species, results in territorial fights. If these animals are released in a protected area, which requires a particular species, then there are chances of survival.

#### 6.15 No Great Indian Bustards in Kutch Bustard Sanctuary

*The Central government informed that there was no Great Indian Bustards (GIB) in Kutch Bustard Sanctuary (KBS) in Gujarat.*

- KBS near Naliya in Kutch district’s Abdasa block is a tiny sanctuary notified in 1992 and spread over just 2 sqkm. But its eco-sensitive zone spread over 220 sqkm covers most of present-day core GIB habitat.
- Besides the KBS, Prajau, Bhanada and Kunathia-Bhachunda are important grasslands that are declared unclassified forests.
- Due to the barrier created by the power infrastructure on all its sides, sightings of GIB inside the KBS’ notified area is becoming rare.
- **SC’s intervention** - In April 2021, the Supreme Court ordered that all overhead power transmission lines in core and potential GIB habitats in Rajasthan and Gujarat should be undergrounded.
- The SC also formed a three-member committee to help power companies comply with the order.

## Great Indian Bustards

- They are the largest among the four bustard species in India. Other three being MacQueen's bustard, lesser florican and the Bengal florican.
- GIBs' historic range included much of the Indian sub-continent but it has now shrunk to just 10% of it.
- Among the heaviest birds with flight, GIBs are the flagship bird species of grassland and hence barometers of the health of grassland ecosystems.
- Being **terrestrial birds**, they spend most of their time on the ground with occasional flights to go from one part of their habitat to the other.
- **Threats** - Overhead power transmission lines is the biggest threat. Others are agriculture; energy production & mining; transportation; human intrusions, and invasive and other problematic species.
- Change in landscape by way of farmers cultivating their land, which otherwise used to remain fallow due to frequent droughts in Kutch.
- Cultivation of cotton and wheat instead of pulses and fodder.
- **Conservation measures** - In 2015, the Central government launched the GIB species recovery programme.
- Under this, the Wildlife Institute of India (WII) and Rajasthan forest department have jointly set up conservation breeding centres.
- In these centres, GIB eggs harvested from the wild are incubated artificially and hatchlings raised in controlled environment.

### 6.16 Big Cats at Coronavirus Risk

*Lions at Chennai's Vandalur Zoo and Ranchi's Bhagwan Birsa Biological Park have died of suspected coronavirus infection.*

- **Vulnerability** - The defining feature of a coronavirus is the spike protein on its surface. The spike protein initiates infection by binding with a host protein, called ACE2 receptor.
- Different species express ACE2 to different extents, and this plays a key role in determining how much a species is susceptible to coronavirus infection.
- In various studies, domestic cats and their big cousins have been estimated to express ACE2 more significantly than many other species. Also, there are similarities in the ACE2 of cats and humans.
- One study found that the most vulnerable species to coronavirus infection, next to humans, are ferrets, followed by cats and civets.
- Another study found that the primates such as chimpanzee rhesus macaque are at very high risk.
- At high risk are species such as blue-eyed black lemur. Cats were found to have a medium risk, while dogs had a low risk.
- There are no studies on the genome of big felines, but it is assumed that since cats can be infected, there is a big chance that lions and tigers will as well, since they will be very close in sequence.

### 6.17 Tigers in the Mountains

*Uttarakhand government highlighted the expanse of the state's tiger map from Corbett National Park to Kedarnath Wildlife Sanctuary.*

- **Range** - Between the terai and the mountains, the tiger range is from an elevation of 1,181 ft (360 m) to 12,073 ft (3680 m) - a testimony of Uttarakhand's success in tiger conservation.
- Because, tiger's usual range is less than 6,000 ft. That makes its presence above 12,000 ft rare. But tigers have shown up before a strategically placed motion-triggered camera at higher altitudes.
- Since 2016, multiple records of tigers above 10,000 feet have been recorded in India.
- **Causes for concern** - Records of high-altitude tigers getting somewhat routine is alarming, as it signifies that warming induced by climate change is making the higher mountains tolerable for tigers.
- But the fact that tigers are found roaming the snow indicates that their upward movement is not deterred by the cold.

- Like Siberian tigers do not actually live in Siberia (but in temperate broadleaf-mixed-pine and pure deciduous forests), it is unlikely that tigers spotted in the snow have settled down there.
- Their survival still depends on the forests below. There can be no trade-off between traditional tiger habitat and these new heights of feline interest.

### 6.18 Tiger Reserves To be Open All Year

Uttarakhand announced that the state's two Tiger Reserves - Corbett and Rajaji - would now remain open for tourism round the year.

- Until now, the reserves would remain closed to tourists during the monsoon for 4-5 months every year.
- **Reasons** - Shutting the Tiger Reserves during the rainy season is important for the tiger and elephant breeding, as the tourism activities in that season may disturb tigers in their mating season.
- Apart from tiger breeding, a number of species do breed in the forest during the rainy months and together they maintain the ecological balance that supports the apex species.
- Besides, wildlife deserves a break from noise, light and other pollutions tourism brings to their habitat. But, shutting the reserves has more to do with humans than tigers (or elephants).
- As the tropical forest is least accessible during the monsoons, the trophy hunters of yore picked the rainy months as the off-season - a window that allows the animal population to recover.
- **Impact of opening parks on poaching** - Opening the parks to tourists in the rainy months may yet put the national animal at risk.
- This is because the poachers consider the monsoon an opportunity when guards struggle to patrol much of the reserve.
- That is why Project Tiger has emphasised enhanced vigilance during the monsoon.
- Uttarakhand has a history of suffering heavy losses to poachers during the rainy season. Diverting the forest staff from 'Operation Monsoon' to tourism duties during this time will make the reserves more vulnerable.

### 6.19 Threats to Sunderbans

A UN rights expert has said that the Sunderbans forest is being threatened by "heedless industrialisation".

- **Threats - Accelerating industrialisation of Sunderbans,**
  1. Threatens the unique ecosystem of Sunderbans itself, and
  2. Poses serious risks to the human rights of the 6.5 million people whose lives, health, housing, food and cultural activities depend on the Sunderbans forest.
- In Indian Sunderbans, the conversion of shoreline mangroves to shrimp farms and other pisciculture farms has led to the frequent clearing of the shorelines once occupied by native mangrove species.
- This **continued loss of shoreline mangrove ecosystems** has created fragmented and fragile mangrove habitats for rare taxa and framed barriers to their movement and dispersal.
- **Building of dykes** to protect the coastal villages from tidal aggression/storm surges make mangrove communities across the Sunderbans' shorelines, the most vulnerable targets of destruction.
- The loss of these mangrove habitats also leads to the loss of species that belong to IUCN's near-threatened or endangered category.
- Accreting mudflat is a favoured habitat for mangrove-dependent fish species, which enter the mudflat with the tidal flow but are **trapped in these nets** during the ebb current of the tides.
- **Solution** - Pursuing short-term economic gain in disregard of environmental costs is unsustainable.

**Sunderbans**

- Stretching along the Bay of Bengal, the Sunderbans is considered one of the natural wonders of the world.
- It is the largest contiguous mangrove forest in the world and home to endangered species such as Bengal tigers, Ganges river dolphins, etc.
- These forests provide benefits for clean air and water that extend far beyond their immediate location.

- So instead of popularising shrimp farming, if more indigenous fishing activities were encouraged, we could protect the coastal biodiversity and also provide livelihood options to the coastal dwellers.

## 6.20 Protecting India's Natural Labs

*India is long known as the world's natural laboratory for geo-scientific learning but we are inching towards the disappearance of most of our geological heritage sites.*

- Indian landmass broke loose from the Gondwana land 150 million years ago and drifted northwards and got entwined with the world's youngest plate boundary.
- The geological features evolved over billions of years through numerous cycles of tectonic and climate upheavals.
- The Kutch region in Gujarat has dinosaur fossils and Tiruchirappalli of Tamil Nadu is originally a Mesozoic Ocean acting as a store house of Cretaceous (60 million years ago) marine fossils.
- The geological heritage of our planet was first recognised in 1991 at **First International Symposium on the Conservation of our Geological Heritage (Digne resolution)**.
- UNESCO facilitated efforts to create a formal programme to promote a global network of geoheritage sites complementing the World Heritage Convention and the UNESCO's MAB.
- Countries like Vietnam and Thailand have implemented laws to conserve their geological and natural heritage.
- The **Global Geoparks Network** was founded in 2004 as an international partnership developed under the umbrella of UNESCO.
- Today, there are 169 Global Geoparks across 44 countries.
- India is a signatory to the establishment of UNESCO Global Geoparks.
- But, it does not have any legislation and policy for conservation of geoheritages.
- Geological Survey of India (GSI) has identified 32 sites as **National Geological Monuments**.
- Yet **no** geopark in India is recognised by the UNESCO.

### Reason for disappearance of our geological heritage sites

- **Lack of geological literacy** - Indian classrooms view disciplines like environmental science and geology inferior to other pure subjects like physics, biology, and chemistry.
- The lack of awareness in geo-heritage parks makes decision-making on climate change difficult.
- **Developmental activities** - The **Anjar site** in Kutch district which has high concentration of iridium providing evidence for a massive meteoritic impact that caused the extinction of dinosaurs about 65 million years ago was destroyed by laying of a new rail track.
- A national geological monument exhibiting a unique rock called **Nepheline Syenite** in Ajmer district of Rajasthan was destroyed in a road-widening project.
- The **Lonar impact crater** in Buldhana district of Maharashtra is under the threat of destruction.
- Unplanned and booming real estate business has destroyed many geoheritage sites.
- Unregulated stone mining activities have also contributed to this destruction.
- The situation calls for immediate implementation of sustainable conservation measures such as those formulated for protecting biodiversity.
- A progressive legal framework is needed to conserve geoheritage sites.
- There is a need for a national conservation policy under the direct supervision of a national body committed to the protection of geo-heritage sites.

## 7. DISASTER MANAGEMENT

### 7.1 Study on Flash Droughts

A recent study has identified India among the global flash drought hotspots from 1980-2015.

- About 10-15% areas under cultivation of rice and maize were affected by flash droughts during the monsoon seasons in India from 1951-2018.
- It is predicted that by the end of the 21st century, the frequency of concurrent hot and dry extremes in India will rise by about five-fold.
- This can cause approximately a seven-fold increase in flash droughts.
- India could experience more flash droughts during the monsoon season than the non-monsoon season.
- The study has also identified the flash drought hotspots,
  1. Corn belt across the mid-western United States,
  2. Barley production in the Iberian Peninsula,
  3. Wheat belt in western Russia,
  4. Wheat production in Asia Minor,
  5. Rice-producing regions in India and the Indochina Peninsula,
  6. Maize production in north-eastern China and
  7. Sorghum production across the Sahel.

#### Flash drought

- Flash drought is the **rapid onset or intensification of drought** and is set in motion by lower-than-normal rates of precipitation, accompanied by abnormally high temperatures, winds, and radiation.
- Together, these changes in weather can rapidly alter the local climate.
- Flash droughts can either be a **short-lived** yet severe event where soil moisture completely depletes or a **multi-week** period of rapid intensification toward drought.
- Unlike conventional drought, which can happen anywhere and at any time, flash drought typically occurs during **warm seasons**.
- **Causes** - Rapid drought intensification occurs due to two key drivers:
  1. A critical lack of precipitation accompanied by abnormally high temperatures, high winds, and/or changes in radiation and
  2. Increased evaporative demand, which is a measure of the extent to which the environment 'tries' to evaporate water.
- [This is unlike common drought that is caused only by decline in precipitation.]
- Geographic differences and climate patterns also impact the development of flash drought.
- In contrast with conventional drought - that occurs throughout the year at any location - flash drought typically occurs during warm seasons.
- **Impacts** - As flash droughts can develop in only a few weeks, they create impacts on agriculture that are difficult to prepare for and mitigate.
- Higher temperature increases evapo-transpiration and further lowers soil moisture, which decreases rapidly as drought conditions continue.
- [Evapo-transpiration is the process by which water is transferred from the land to the atmosphere by evaporation from the soil and by transpiration from plants.]

### 7.2 The Problem with Monsoon

The flash floods and landslides in Kerala is a matter of concern as variations in the monsoon pattern and intensity are increasingly witnessed.

- The torrential rain in Kerala has killed at least 35 people so far and red alert has been declared for 10 dams including Idukki.
- It has caused alarm as the Northeast monsoon lies ahead.
- The IMD has issued an alert for more heavy rainfall in Kerala from October 20.
- The Health Department has sounded an alert against the outbreak of infectious diseases due to heavy rains.
- The inundation of towns in 2018 and mudslides in 2019 had catastrophic effect in the State.

### Reasons

- **Relief** - Kerala hosts a vast stretch of Western Ghats with almost no break between severe spells of rainfall.
- **Cloudburst phenomenon** - Mini cloud bursts are marked by intense short spells, which may not exceed 10cm in one hour.
- For example, Mini cloudburst caused 2019 floods in Kerala.
- **Human intervention** - Illegal quarrying and mining activity has resulted in stones and rubble silting the streams and rivers thus increasing the magnitude of the damage.
- Timber felling, improper tree cutting has also had an adverse impact.
- **Premature silting up of reservoirs** - Premature silting up of reservoirs especially in the steep valleys in the Western Ghats is a major concern.
- **Unplanned constructions** - The construction of Athirappilly dam on the Chalakudy river in Kerala's Thrissur district has been strongly opposed.
- **Unscientific and improper water management** - poor management of reservoirs as happened in 2018 floods aggravates the situation
- **Inefficient legal framework** - The Kerala Conservation of Paddy Land and Wetland Act, 2008 has not been able to prevent construction of houses and other buildings in paddy fields and riverbeds

### Steps to be taken

*According to an estimate by researchers in 2017, quarrying area in Kerala accounts for over 7,157 hectares, much of it in central districts that were hit later by mudslides.*

- Nurturing the health of rivers by proper silting. Keeping the rivers free of encroachments
- Ending mining and deforestation in unstable areas
- Avoiding incompatible constructions
- Accurately mapping the hazard zones
- A more benign development policy treating nature as an asset
- Implementation of **Madhav Gadgil committee** report on Western Ghats
- Gadgil report (2011) recommended designating the entire hilly region of Western Ghats as an Ecologically Sensitive Area.
- The Kasturirangan panel that was constituted to examine the Gadgil report recommended reducing the area to be protected ecologically in Western Ghats to only 37 per cent.
- Following best practices – For instance, **Hakku initiative** in Hyderabad involves a team of six people to identify and visit risk-prone areas and pushes them towards solutions.

### 7.3 Impact of Cyclones on Fishing Sector

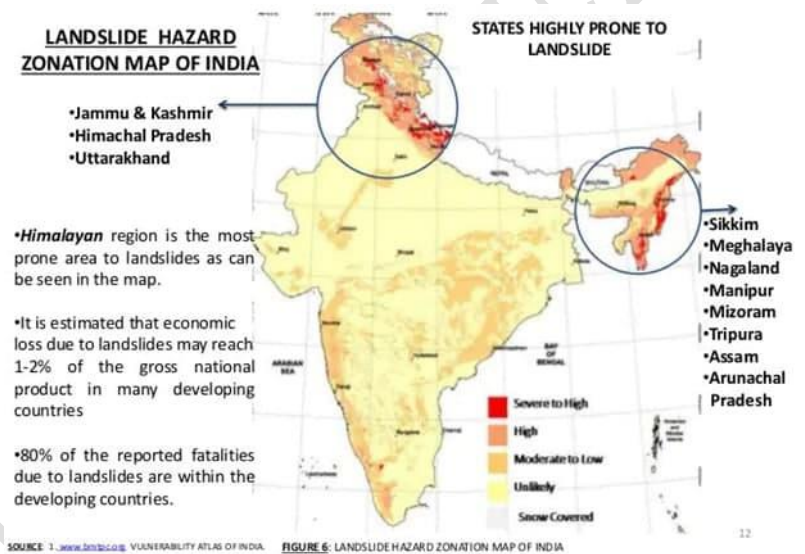
- **Disaster management** - The State Governments concerned provide necessary relief to affected people by natural disaster from the State Disaster Response Fund (SDRF) already placed at their disposal.
- Further assistance is provided by the Ministry of Home Affairs (MHA) from the National Disaster Response Fund (NDRF) as per the procedure for management of relief necessitated by notified natural disasters.
- **Assessment** - In the case of cyclones Amphan, Taukate and Yaas, the Central Government constituted the Inter-Ministerial Central Teams (IMCT) that assessed the damages caused due to cyclones.

- IMCT visited the affected areas of Gujarat, Jharkhand, West Bengal and Odisha for on the spot assessment of damages and recommendations of Sub-Committee for National Executive Committee (SC- NEC).
- Based on the IMCT report, the High Level Committee (HLC) had approved some amount to the fisheries sector from NDRF subject to the adjustment of 50% of balance available in their SDRF account.
- IMCT report recommended help especially to the fisheries sector.
- **Fisheries sector** - The Department of Fisheries (DoF) implements the Schemes for overall development of fisheries sector.
- Fishermen are provided assistance for various components and activities like boat replacement, nets etc., under the Pradhan Mantri Matsya Sampada Yojna is implemented by DoF through the State Governments.

#### 7.4 Landslips in Himachal Pradesh

Himachal Pradesh faces rising instability from environmental factors such as climate change, heavy rainfall and landslides. The rising threat calls for a renewed approach to the developmental designs in the State.

- Landslip/Lanslide in the Kinnaur district of Himachal Pradesh killed at least 14 people and buried several others.
- Severe catastrophe as mud, rocks and debris rained down on vehicles.
- A fortnight back, a similar disaster killed a group of tourists.
- **Landslips** - They have become more common.
- Seismic events threaten to increase their frequency and aggravate the impact.
- The Landslide Hazard Zonation Map of India marks over 70% of Himachal Pradesh as 'high risk' and 14% as 'severe' to 'very high risk'.



- **Earthquakes** - Mountains here are geologically young and therefore active (unstable).
- 32% of the State is categorised as a high damage risk zone for seismicity.
- **Causes** -
  1. Himachal's mountain slopes experience seismicity and rain-induced stresses.
  2. Heavily engineered structures such as dams and hydropower (involve rock blasting, tree felling and inundating large spaces), building roads.
  3. With greater rainfall and cloudburst activity, Himachal Pradesh is bound to face greater uncertainty.

#### 7.5 Heavy Rain and Landslides in Kerala

After two years, intense rain, flash floods, mudslides and landslides were reported in most districts located between central and southern Kerala.

- The intense rain was mainly due to the **low pressure system** developed in the east-central Arabian Sea.
- This system moved closer to Kerala coast and triggered severe weather.
- This year, the southwest monsoon withdrawal has been significantly delayed. But the rainfall is mostly caused by the **localised phenomenon** triggered due to the low pressure system.

#### 7.6 Link between Cloud Bursts and Forest Fires

- A recent study has found a connection between the formation of the tiny particles, the size of a cloud droplet on which water vapor condenses leading to the formation of clouds and forest fires.

- The quantity of such particles called the Cloud Condensation Nuclei (CCN) was found to have peaks associated with forest fire events.
- Cloud condensation nuclei (CCN), which can activate and grow into fog or cloud droplets in the presence of supersaturation (SS) was measured by a droplet measurement technology's (DMT) CCN Counter.
- This observation was carried out under a Climate Change Programme Division, Department of Science & Technology funded project, where the variation of CCN was reported on diurnal, seasonal, and monthly scale.
- This study showed that the highest concentration of CCN in the high altitude was found to be associated with excessive fire forest activities of the Indian subcontinent.
- There were other peaks also associated with a variety of events, such as long-range transportation and local residential emission.

## 7.7 Wildfires

*A massive wildfire continues to burn on the northern tip of Greece's second-largest island called Evia, which is close to the mainland.*

- Wildfires or forest fires (or bushfires in Australia) are unplanned fires that burn through natural areas such as forests, grasslands or prairies.
- They occur during hot and dry seasons, as dry leaves, shrubs, grass and deadwood are easily combustible and easily ignite.
  - Ignition can either happen naturally, such as through lightning strikes, or triggered accidentally or intentionally.
- Such fires typically come to an end when there is no more vegetation to burn or because of rain.
- **Impacts** - As the fires burn through vegetation or forests, smoke and carbon are released into the atmosphere.
- But the fires also release nutrients into the soil and are an important part of ecological succession, plant germination, and soil enhancement.
- **Factors** - The size of a wildfire depends on the amount of vegetation available and also the strength and direction of the wind.
- Some of the other factors that influence the wildfires are weather events such as frequent heatwaves, extreme rainfalls and rising sea levels.

## 7.8 Oil Spill in Gulf of Mexico

*After Hurricane Ida, abandoned damaged oil pipelines have been discovered in the Gulf of Mexico while searching for the origin of a substantial oil spill.*

- Oil spill is the contamination of rivers, bays and seawater due to oil pour as a result of a natural cause or accident or human error.
- **Causes** - Oil spills are caused by,
  1. Anthropogenic or human causes
    - Accidents (Most common) involving tankers, barges, pipelines, refineries, drilling rigs and storage facilities,
    - Deliberate acts by terrorists, acts of war, vandals or illegal dumping.
  2. Natural causes (like tsunami, etc)
- **Impacts** - Most oils float. Oil usually spreads out rapidly across the water's surface to form a very thin oil slick.
- In rare cases, very heavy oil can sometimes sink.
- Depending on the circumstances, oil spills can be very harmful to marine birds, sea turtles and mammals, and also can harm fish and shellfish.
- Oil destroys the insulating ability of fur-bearing mammals (sea otters), and the water-repelling abilities of a bird's feathers.

## Measures to Control Oil Spills

- **Booms** are floating physical barriers, made of plastic, metal or other materials, which slow the spread of oil and keep it contained.
- **Skimmers** can physically separate spilled oil from the water's surface.
- **Sorbents** (materials that soak up liquids by either absorption or adsorption) can be used. Eg: Polyester-derived plastic, volcanic ash, etc.
- **Dispersants** (chemicals that disperse the oil into the water column) can be applied using aircraft or boats.
- In-situ burning of freshly spilled oil.
- Phosphorus-based and nitrogen-based **fertilizers** can be used for the microbes to grow and multiply quickly.
- **Biological agents** (hydrocarbon degrading bacteria like *Pseudomonas putida*) can be used to help break down oil into its chemical constituents.
- Using Elastomers for chemical stabilisation of oil.

## Gulf of Mexico

- It is a partially landlocked body of water on the south-eastern periphery of the North American continent.
- It is the world's largest gulf connected to the Atlantic Ocean by the Straits of Florida, and to the Caribbean Sea by the Yucatán Channel.
- It was formed as a result of plate tectonics around 300 million years ago.
- The climate of the gulf region varies from tropical to subtropical.
- The shallow continental shelf regions of the Gulf of Mexico contain large deposits of petroleum and natural gas.
- This region is known for commercial fishing, as the gulf waters contain huge populations of fish, particularly along the continental shelf.
- Straits of Florida runs between the peninsula of Florida and Cuba.
- Yucatán Channel runs between the Yucatán Peninsula and Cuba.



## 7.9 National Oil Spill Disaster Contingency Plan (NOS-DCP)

- This Plan was issued by the Ministry of Defense in 1996.
- It has designated Indian Coast Guard as the Central Coordinating Authority for combating marine oil spills in Indian waters and undertaking oil spill prevention and control.
- However, the NOS-DCP comes under the purview of the National Disaster Management Authority, Ministry of Home Affairs.
- It mandates the Coast Guard to coordinate with state departments, ministries, port authorities and environmental agencies to assist in oil spill cleaning operations.
- In 2015, the Coast Guard revised the NOS-DCP to meet international standards, setting up an Online Oil Spill Advisory system, etc

## 7.10 Collapse of Coastal Buildings

- The partial collapse of a building near the coast in Florida is a reminder of how vulnerable structures near the coast can be.
- The “marine urban sprawl” plays a major role in rising water levels and land subsidence because of excessive groundwater extraction.
- **Four checkpoints** - In India, any construction along the coast has four fundamental checkpoints. They are,

- **Soil and foundation** - Along coastal areas, there are sandy strata of considerable depth, and beneath this layer is hard rock or marine clay.
- Usually, buildings are done on a pile foundation in these areas. Concrete piles are driven to rest on a suitable stratum deep into the ground taking into consideration the effect of any compressive layer underneath.
- The life of the piles can be increased by choosing materials that withstand the hostile saline environment. This includes chemical additives that improve the sulphate-resistant cement's performance.
- **Material interaction** - In buildings close to the sea, a major concerns are,
  1. **Spalling** - Saltwater seeping into concrete, causing support beams to rust and weaken over time,
  2. **Corrosion** is common in coastal buildings, and erosion can happen depending on the cover of steel,
  3. **Carbonation** causing the cement slurry around the structure to lose its protective ability. Once this chemical reaction reaches the reinforcement, corrosion increases rapidly.
- **Structural audits** - These are a good way to maintain buildings close to large water bodies. A non-destructive test is usually recommended.
- **Sea level** - Besides global warming, the sea has its inherent way of getting back. When you start reclaiming the sea, and you encroach into its territory, the sea will take it back elsewhere.

## 8. BIODIVERSITY

### 8.1 Wood Wide Web

- It is the term used to describe the underground network of microbes that connects the trees.
- Through this system, the trees exchange carbon dioxide gases between each other (for photosynthesis).
- This system may extend through the whole forest, and help young trees that are struggling on a dry patch for carbon transfer from the luckier trees.
- **[Mutualism** is an interaction that confers benefits on both the interacting species. E.g.: Lichens represent an intimate mutualistic relationship between a fungus and photosynthesising algae or cyanobacteria.]
- **Mycorrhizae** are mutualistic associations between fungi and the roots of higher plants.
  - The root-invading fungus gains energy-yielding carbohydrates and other nutrients from the plant.
  - In exchange, the plants get essential nutrients and also difficult-to-find minerals like phosphorus from the microbe.
- **Rhizobacteria** are mutualistic associations between bacteria and roots, and a very wide range of these species are plant growth promoters.
  - These bacteria get sugars from the plants.
  - In exchange, the bacteria help plants ward off pathogens that cause root diseases. They may trigger systemic resistance to a pathogen throughout the plant.

### 8.2 Ambergris

- Ambergris (French for grey amber) is generally referred to as whale vomit. This preternaturally hardened whale dung is produced only by 1% of sperm whales.
- **Formation** - A sperm whale eats several thousand squid beaks a day.
- Occasionally, a beak makes it way to the whale's stomach and into its looping convoluted intestines where it becomes ambergris through a complex process, and may ultimately be excreted by the whale.
- Ambergris is a solid waxy substance that floats around the surface of the water body and at times settles on the coast.
- **Floating Gold** - This excretion is so valuable it is referred to as floating gold. 1 kg of ambergris is worth Rs 1 crore in the international market.
- The reason for its high cost is its use in the perfume markets (like Dubai), especially to create fragrances like musk.

- Ancient Egyptians used it as incense. It is used in traditional medicines.
- Since the sperm whale is a protected species, hunting is not allowed. But, due to Ambergris' high value, the fish has been a target to the smugglers.

### Sperm Whale

- The Sperm Whale (*Physeter macrocephalus*), or cachalot, is the largest of the toothed cetacean. They are often spotted in groups (called pods).
- Spermaceti oil extracted from it is used in oil lamps, lubricants and candles.
- **Protection** - The species is protected by a whaling moratorium.
- IUCN Status - 'Vulnerable'.

### 8.3 Indimimus Jayanti

- *Indimimus Jayanti* has become the twelfth subgenus, or species, of spider cricket identified under the genus *Arachnomimus* Saussure, 1897.
- Found in the Kurra caves of Chhattisgarh, the new subgenus was named Jayanti after Professor Jayant Biswas, a leading cave explorer in India.
- **Difference** - *Indimimus* subgenus is different from the *Arachnomimus* and *Euarachnomimus* subgenera because of the male genitalia structure.
- Insects have a lock-and-key model genitalia structure which is unique to each subgenus.
- **Sounds** - Crickets are noticeable for their loud calls, especially at night.
- Male crickets produce this sound by rubbing their wings against each other. Females listen to these calls using ears located on their legs and approach the males for mating and reproduction.
- **Significance** - Interestingly, males of the Jayanti subgenus cannot produce sound and their females don't have ears.
- They may be communicating by beating their abdomen or any other body part on the cave walls (Vibrational communication).
- Further studies on their skills of vibrational communication may help in designing hearing aids for human which can capture quietest signals and amplify to an audible hearing range.

### 8.4 Bharitalasuchus tapani

- In the mid 20th century, researchers from the Indian Statistical Institute, Kolkata, carried out extensive studies on rocks of the Yerrapalli Formation in what is now Telangana.
- By studying some of these specimens now, a team has found a 240 million year old carnivorous reptile called *Bharitalasuchus tapani*.
- In the Telugu language, Bhari means huge, Tala means head, and Suchus is the name of the Egyptian crocodile-headed deity.
- *Bharitalasuchus tapani* were robust animals with big heads and large teeth, and these probably predated other smaller reptiles.
- They might have been the largest predators in their ecosystems as they were the size of an adult male lion.
- The reptile belonged to Erythrosuchidae, a family of extinct reptiles.

### Yerrapalli Formation

- It is a Triassic rock formation consisting primarily of mudstones that outcrops in the Pranhita-Godavari Basin in south-eastern India.
- It preserves fossils of freshwater and terrestrial vertebrates as well as trace fossils of invertebrates.
- Apart from this *Bharitalasuchus tapani*, the fossil assemblage of the Yerrapalli Formation includes many other extinct creatures such as ceratodontid lungfish, rhynchosaur and allokotosaurian.
- Yerrapalli Formation (fossiliferous locality) is gradually being destroyed by deforestation, mining, agricultural expansion, urbanisation, etc.,

### 8.5 Blue-finned Mahseer

- On the International Union for Conservation of Nature's (IUCN) red list, the Blue-finned Mahseer (Tor Khudree) has been moved from the 'endangered' status to the 'least concern' status.
- However, the golden mahseer is still in danger of going extinct.
- The IUCN group is involved in conservation of the blue-finned and golden Mahseer for 50 years in Lonavala, Maharashtra.
- **Characteristics** - They inhabit both rivers and lakes. Most of species ascend into rapid streams with rocky bottoms for breeding.
- They are omnivorous. They eat algae, crustaceans, frogs, insects and other fish. They also eat fruits that fall from trees overhead.
- **Habitat** - This species is found in River Mota Mola east of Pune and other rivers of the Deccan Plateau.
- The species is migratory; moving upstream during rains. It prefers clean, fast flowing and well oxygenated waters.
- **Threats** - Over harvesting, habitat manipulation and competition from other fish species.

### 8.6 Freshwater Black Softshell Turtle

- Hayagriva Madhava Temple Committee (Assam) signed a MoU with two NGOs, Assam State Zoo cum Botanical Garden and the Kamrup district administration for conserving the rare freshwater black softshell turtle.
- Also, a Vision Document 2030 was launched to raise at least 1000 black softshell turtle (*Nilssonina nigricans*) by 2030.
- These turtles are found along the Brahmaputra River's drainage in Assam, and in ponds of temples in north-eastern India and Bangladesh.
- **Conservation** - The International Union for Conservation of Nature had in 2021 listed the turtle as 'critically endangered'.
- But it does not enjoy legal protection under the Indian Wildlife (Protection) Act, 1972.
- **Threats** - It has traditionally been hunted for its meat and cartilage, traded in regional and international markets.
- Since the turtles are conserved in these ponds only based on religious grounds, many biological requirements for building a sustainable wild population have since long been overlooked.

### 8.7 Pygmy Hogs

- Under the Pygmy Hog Conservation Programme (PHCP), eight of 12 captive-bred Pygmy hogs (*Porcula salvania*), were released in Manas National Park (Assam).
- Pygmy hogs are the world's rarest and smallest wild pigs.
- **Habitat** - It thrives in tall and wet grasslands. It is one of the very few mammals that build its own home, or nest, complete with a 'roof'.
- Its presence reflects the health of its primary habitat, the tall, wet grasslands of the region. So, it is an indicator species of the management status of grassland habitats.
- **Presence** - Once found along a narrow strip of wet grassland plains on the Himalayan foothills - from Uttar Pradesh to Assam, through Nepal's terai areas and Bengal's duars.
- Now, they are found mainly in Assam and southern Bhutan.
- **Threats** - Loss and degradation of grasslands (Habitat loss), illegal hunting, dry-season burning, livestock grazing, afforestation of grasslands, flood control schemes.
- **Conservation** - Pygmy Hogs are protected as "Endangered" in IUCN Red List. It is kept in the "Appendix I" of CITES and the "Schedule I" under the Wildlife (Protection) Act, 1972.

## 8.8 Baby Squids and Water Bears Sent to ISS

- NASA will send 128 glow-in-the-dark baby squids and 5,000 tardigrades (or water bears) to the International Space Station for research purposes.
- These water animals will be sent in a semi-frozen state to the ISS aboard SpaceX's 22nd cargo resupply mission to the ISS. In the ISS, they will be revived and grown in a special bio culture system.
- They are part of experiments that could help scientists design improved protective measures for astronauts going on long-duration space travel.
- **Study on water bears** - One of the studies involves looking at how the water bears would behave in a spaceflight environment.
- [Water bears are chosen because they can adapt to extreme conditions on Earth, including high pressure, temperature and radiation.]
- By learning how the water bears can survive in low gravity conditions, better techniques could be designed to keep astronauts healthy on long-duration space missions.
- **Study on squids** - Understanding of Microgravity on Animal-Microbe Interactions (UMAMI) study will look at how microgravity conditions affect the relationship between the bobtail squid and beneficial microbes.
- Studying this relationship is important as microbes play a crucial role in the normal development of animal tissues and in maintaining human health.
- In space, the findings will help space agencies develop better measures to protect astronauts from adverse host-microbe alterations on long-duration missions.

## 8.9 *Pyrostria laljii*

- Recently, *Pyrostria laljii* has been discovered from the Andaman Islands. It is a 15-meter-tall tree that belongs to the genus of the coffee family.
- The new species is also the first record of the genus *Pyrostria* in India. Plants belonging to genus *Pyrostria* are usually found in Madagascar.
- The tree is distinguished by a long stem with a whitish coating on the trunk, and oblong-obovate leaves with a cuneate base.
- It was first reported from South Andaman's Wandoor forest.
- The other places in the Andaman and Nicobar Islands where the tree is found are,
  - Tirur forest near the Jarawa Reserve Forest and
  - Chidia Tapu (Munda Pahar) Forest.
- *Pyrostria laljii* has been listed as 'Critically Endangered' on the International Union for Conservation of Nature's (IUCN) Red List.
- While the genus *Pyrostria* is not found in India, there are several genera from the family Rubiaceae that are common in India - *Cinchona*, coffee, *Adina*, *Hamelia*, *Ixora*, etc. They have high potential for economic value.

### Rivina Andamanensis

- It is a new species of pokeweed.
- It was found growing under large trees, shaded and rocky areas, along with herbs and shrubby plants.
- It represents the first record of the pokeweed family Petiveriaceae in Andaman and Nicobar Islands.

## 8.10 Black Leopard

- Sightings of the rare Black Leopard (Melanistic Leopard) were reported in the Navegaon Nagzira Tiger Reserve (NNTR), Tadoba Andhari Tiger Reserve and the Pench Tiger Reserve in Maharashtra.
- Black Leopard or Black Panther (Ghost of the Forest) is a melanistic colour variant of spotted any Panthera, particularly of the leopard (*P. pardus*) in Asia and Africa, and the jaguar (*P. onca*) in the Americas.
  - Melanism is a common occurrence in leopards. A melanistic leopard or jaguar is mistakenly thought to be a different species.
- **Habitat** - They are mainly in Southwestern China, Burma, Nepal, Southern India, Indonesia, and the southern part of Malaysia.

- In India, they are reported from densely forested areas of South India, mostly from the state of Karnataka.
- **Threats** - Habitat loss, Poaching, Diseases, Human encroachment, Collision with vehicles, etc.,
- **Conservation** - It is listed in IUCN Red List (Vulnerable), CITES (Appendix I), Wildlife Protection Act, 1972 (Schedule I).

### 8.11 King Cobra

- A king cobra (*Ophiophagus hannah*), was sighted in the recently declared conservation reserve, Tillari, in Sindhudurg district, Maharashtra.
- It is one of the most venomous snakes on the planet. It is the longest of all venomous snakes as it can reach 18 feet in length.
- **Venom** - Their venom is not the most potent among venomous snakes, but the amount of neurotoxin they can deliver in a single bite is enough to kill 20 people, or even an elephant.
- King cobra venom affects the respiratory centers in the brain, causing respiratory arrest and cardiac failure.
- **Habitat** - King cobras live mainly in the rain forests and plains of India, southern China, and Southeast Asia.
- They are comfortable in a variety of habitats, including forests, bamboo thickets, mangrove swamps, high-altitude grasslands, and in rivers.
- They are the only snakes in the world that build nests for their eggs, which they guard ferociously until the hatchlings emerge.
- **Threats** - Heavy deforestation; Habitat destruction. They are harvested for skin, food, and medicinal purposes; international pet trade. They are persecuted by humans who fear their menacing reputation.
- **Conservation** - The International Union for Conservation of Nature has listed the king cobra as vulnerable to extinction. CITES (Appendix II) and Wildlife Protection Act, 1972 (Schedule II).

### 8.12 Vaquita Porpoises

- Mexico's decision to loosen its policy of keeping a fishing free zone around a protected area in the Gulf of California region was a "setback" to keeping alive a near-extinct vaquita porpoise species.
- Vaquita porpoise, the world's rarest and the smallest marine mammal, is on the edge of extinction.
- It is also known as "the panda of the sea" for the distinctive black circles around its eyes. This porpoise was discovered in 1958.
- It is unique among the porpoises as it is the only species of that family found in warm waters, and the size of the dorsal fin is believed to be an adaptation to that, allowing for extra body heat to dissipate.
- **Habitats** - Found only in the northern Gulf of California (Sea of Cortez) in Mexico. Most commonly seen in shallow waters up to 50 metres deep.
- **Threats** - They are caught and drowned in gillnets set up by poachers to catch totoaba, an endangered species of marine fish sought by Chinese buyers on the black market for its prized swim bladders.
- This species die more each year in fishing nets than are being born.
- **IUCN Status** - Critically Endangered

### 8.13 Caterpillar Slug

- A new study has predicted that Purcell's hunter slug or caterpillar slug (*Laevicaulis haroldi*), native to South Africa, could soon become an invasive species attacking western and Peninsular India.
- It is listed as an **endangered** species and was first described in 1980.
- It entered India around 2010-2012 accidentally, through international trade via Mumbai. It feeds on the leaves and bark of mulberry plants. It was also sighted on neem trees, papaya, and calotropis plants.
- **Scenarios** - Two future climate change scenarios of the Intergovernmental Panel on Climate Change (IPCC) were studied to decode which places may be vulnerable to the slug attack.
  - a) RCP 2.6 scenario represents the best-case scenario where we control emissions and limit anthropogenic climate change.

b) RCP 8.5 scenario represents the worst that could happen. We don't follow any mitigation rules and have a high-risk future in terms of temperature and other climatic conditions.

- Under both the scenarios, AP, Karnataka, southern parts of Telangana, northeast TN, Gujarat, western MH, coastal Odisha, West Bengal, and some states in North East India are highly suitable for the slug.
- **Management** - Early detection and control are the key for managing newly introduced species before they become invasive.
- Awareness needs to be created among the people to detect, manage and control this newly introduced species.
- Non-toxic methods of controlling this pest need to be developed.
- Also, a strict quarantine in the ports should be in place to avoid further introductions.

### Invasive Species

- Invasive alien species are any biological species that are introduced outside their natural range.
- They would negatively impact the native biodiversity, ecosystem function, health and human welfare.
- They could reproduce rapidly and out-compete the native species for food, water and space. They are the second-biggest cause for biodiversity loss, next to habitat destruction.
- **Impacts** - An international study reported that invasive species have cost nearly \$26.8 billion per year to the global economy since 1970 and are responsible for the extinction of native and endemic species.

### 8.14 Bhalia Wheat

- In a major boost to wheat exports, the first shipment of Geographical Indication (GI) certified Bhalia variety of wheat was exported today to Kenya and Sri Lanka from Gujarat.
- This GI certified wheat has high protein content and is sweet in taste.
- The unique characteristic of the wheat variety is that grown in the **rain-fed condition without irrigation**.
- The crop is grown mostly across Bhal region of Gujarat - Ahmadabad, Anand, Kheda, Bhavanagar, Surendranagar, Bharuch districts.

### 8.15 Swinhoe's Softshell Turtle

*It is the world's most endangered turtle that is fighting a chance to survive.*

- Also known as giant Yangtze soft shell turtle, it is the largest freshwater turtle in the world. [Freshwater turtles are more threatened than marine ones.]
- It is known as the Hoan Kiem turtle in Vietnam, as it is believed to have emerged from the Hoan Kiem Lake or Lake of the Returned Sword.
- They are found in the wetlands and large lakes of China and Vietnam.
- **Ecological role** - This species is important to the seafloor biosystem, where they contribute by enriching soil nutrients and facilitating seed dispersion.
- **Threats** - Habitat destruction, water pollution, riverbed abrasion, overexploitation for food and illegal trade.
- **Conservation**
  1. IUCN Status - Critically Endangered
  2. CITES - Appendix II

### Turtle

- In soft shell turtles, the top or back is fleshy.
- In hard shell turtles, the top or back is made up of bone and covered by the skin or epidermis.
- The world's largest turtle though, is neither hard shell nor soft, but somewhere in the middle. It is called the Leatherback.



### 8.16 Jalakanyaka

A new marine algae species with an umbrella-like cap, which has been named *Jalakanyaka*, has been discovered on Andaman & Nicobar Islands.

- The new algae species has been named 'Acetabularia jalakanyakae', after the Sanskrit word 'Jalakanyaka' meaning the 'goddess of oceans' or 'mermaid'.
- This species is the 1<sup>st</sup> of the genus Acetabularia to be discovered in India. It is also the first of its kind on the Island.
- Algal diversity is one of the highest in the Andaman & Nicobar Islands.
- **Features** - This delicate species has an intricate umbrella-like design.
- The whole plant is made up of just one cell with only one nucleus.
- Furthermore, a structure called a rhizoid is formed towards the end of the plant cell containing its nucleus.
- This allows the algae to attach to the rocks underneath the shallow tropical ocean, where it grows.
- Another feature of Acetabularia is their **regenerative potential**. For example, if the top part of the algae is cut off, it can regrow the structure.
- **Threats** - Rising seawater temperature decreases oxygen concentration in water, dangerously affecting all organisms that depend on oxygen to live, including this species.



### Algae

- Algae is a group of predominantly aquatic, photosynthetic, and nucleus-bearing organisms that lack the true roots, stems, leaves, and specialized multi-cellular reproductive structures of plants.
- They range in size from microscopic Micromonas species to giant kelps that reach 60 metres in length.
- **Oxygen producers** - Algae produce oxygen through photosynthesis. They turn CO<sub>2</sub> into biomass and release oxygen.
- Marine algae produce almost two-third of oxygen in the air we breathe.
- **Food producers** - Algae convert atmospheric CO<sub>2</sub> into food for the marine ecosystem. They are at the base of the food chain.
- Also, when the algae die, they are consumed by decomposers (mostly fungi and bacteria).
- **Petroleum fossils** - When Algae die, they sink to the ocean floor.
- Over the years, this layer turns into what we know as petroleum.
- Algae is not only important for the environment but for studies and research too.
- But, Algae that has industrial, medical, and survival importance is being affected by Climate change factors like rise in temperature decreases oxygen levels in the water, ocean acidification, etc

### 8.17 Minervarya Pentali

It is a new frog species that was discovered from the globally recognised biodiversity hotspot, the Western Ghats.

- This new species is **endemic** to the southern Western Ghats - Kerala and Tamil Nadu.
- It is also among the smallest known Minervarya frogs.
- It is a species of frog in the fork-tongued frog family, Dicroglossidae.

### 8.18 Amolops adicola

A new species of cascade frog discovered from Adi hills of Arunachal Pradesh has been named after the Adi hills, the abode of Adi tribes.

- The new species belongs to the genus Amolops, which includes medium- to large-sized Cascade frogs from north-east India.

- The species draws its nomenclature from Adi tribes, an indigenous group of people from the Himalayan regions of Arunachal Pradesh.
- This species dwells particularly during the post-monsoon season.
- Another Cascade frog species of the Amolops genus previously discovered from the Sikkim Himalayas is Amolops monticola.

### Cascade Frogs

- They are named so because of their preference for small waterfalls or cascades in flowing hill streams.
- For this, these frogs have developed certain morphological features like expanded digit tips and extensive foot webbing that makes them adapt to strong water currents.
- These frogs belong to Amolops genus. Amolops is one of the largest groups of family Ranidae or ranid frogs.
- Many frogs in the north-eastern India are reported to occur widely but, have relatively small geographical ranges and require special attention for conservation before they go extinct forever.

### 8.19 Slender Loris

Some people suggest that the Tamil Nadu government must declare the Kadavur Reserve Forest a sanctuary for the slender loris.

- Slender loris (*Loris tardigradus*) is a shy, secretive and reclusive species of primate, and has nocturnal habits.
- **Habit** - They are usually solitary but sometimes found in pairs.
- It usually travels from the canopy of one tree to another. At times, it comes down to the bushes at the ground level to feed.
- It sleeps by day in the foliage or in a hole or crevice. It comes out at dusk in search of prey.
- **Location** - It is native to Southern India and Sri Lanka.
- It is commonly found in the tropical scrubs, deciduous forests and scrubs as well as the dense hedgerow plantations bordering farmlands.
- **Food** - It eats lantana berries, insects, lizards, small birds, tree frogs, tender leaves and buds.
- It plays a key role in controlling agricultural crop pests in organic farms.
- **Threats** - Habitat loss, electrocution of live wires, road accidents and illegal smuggling.
- **Conservation**
  1. IUCN - Endangered
  2. CITES - Appendix II
  3. Wild Life Protection Act, 1972 - Schedule I to provide the highest level of legal protection

### Kadavur Reserve Forest

- It is located in Tamil Nadu. It consists of hills and dense dry areas.
- Indian bison, spotted deer, mouse deer, slender loris, jackal, mongoose, black naped hare, wild boar, porcupine, monitor lizard, pangolin, monkeys, pythons, etc are found in the forests.
- Many parts of this forest have been afforested under the Tamil Nadu Afforestation Project (TAP) program aided by Japanese government.

### 8.20 Hybodont Shark

Teeth of new species of hybodont shark of Jurassic age called *Strophodus jaisalmerensis* have been reported for the first time from Jaisalmer region of Rajasthan by the Geological Survey of India (GSI).

- Hybodonts sharks were a dominant group of fishes in both marine and fluvial environments during the Triassic and early Jurassic time.
- But, these sharks started to decline in marine environments from the Middle Jurassic onwards until they formed a relatively minor component of open-marine shark assemblages.
- Hybodonts finally became extinct at the end of the Cretaceous time 65 million years ago.

- The newly discovered crushing teeth from Jaisalmer represent a new species named by the research team as *Strophodusjaisalmerensis*.
- The genus *Strophodus* has been identified for the first time from the Indian subcontinent.

### 8.21 Vishnuonyx

Recently, the fossil of *Vishnuonyxneptuni* (Neptune's Vishnu) species was found in the Hammerschmiede area, a fossil site in Bavaria, Germany.

- Between 12.5 and 14 million years ago, the members of the *Vishnuonyx* genus of otters lived in the major rivers of southern Asia.
- Fossils of these now extinct otters were first discovered in sediments found in the foothills of the Himalayas.
- This is the first discovery of any member of the *Vishnuonyx* genus in Europe; it is also its most northern and western record till date.
- **Vishnuonyx** were mid-sized predators that weighed 10-15 kg.
- They depended on water and could not travel long distances over land.
- Its travels over 6,000 km to Europe were probably made possible by the geography of 12 million years ago, when the Alps were recently formed.
- These Alps and the Iranian Elbrus Mountains were separated by an ocean basin, which would have made it easier for the otters to cross it.

### 8.22 Sea Cucumber

Indian Coast Guard team at Mandapam, Tamilnadu seized two tonnes of sea cucumber, a banned marine species.

- Sea cucumber is primarily smuggled from Tamil Nadu to Sri Lanka in fishing vessels.
- In 2020, the world's first conservation area for endangered sea cucumbers was set up in Lakshadweep Islands.
- **Threats** - Illegal overfishing and smuggling for food & traditional medicine and human population density.
- Sea cucumbers are in high demand in China and Southeast Asia.
- **Geographic hotspots** for conservation action include east Africa, the Coral Triangle in the southwest Pacific and Central-Western Pacific.

Agency or Act	Conservation
IUCN Red List	Endangered
CITES	Appendix II and III
Wildlife Protection Act, 1972	Schedule I

### 8.23 Humboldt Penguin

Mumbai's Byculla Zoo announced the addition of two new Humboldt penguin chicks.

- Humboldt penguin (*Spheniscushumboldti*) is a medium-sized species that belongs to a genus that is commonly known as the 'banded' group.
- It has an average height of over 2 ft.
  - Emperor penguin, the largest of penguin species, stands at over 4 ft tall, while the little penguin has a maximum height of 1 ft.
- Humboldt penguins are endemic to the Pacific coasts of Chile and Peru.
- They are so named because their habitat is located near the Humboldt Current, a large oceanic upwelling characterised by cold waters.
- Humboldt Penguins burrow and create nesting sites in guano (fecal) deposits.
- Their breeding season in the wild is either March-April or September-October depending on the location of the colony.



**Humboldt penguin** < Vulnerable >

- 🐾 *Spheniscushumboldti*
- ⚠️ Gill nets & Guano harvesting
- 📍 Endemic to the Pacific coasts
- 📄 CITES - Appendix I

- They have large, bare skin patches around their eyes, an adaptation to help keep them cool.
- **Threats** - Habitat destruction, overfishing of their prey species, drowning in gill nets, guano harvesting, ecological disasters like oil spills, pollution like trash in the ocean, human interference & El Niño Southern Oscillation events.

### 8.24 Manda Buffalo

*National Bureau of Animal Genetic Resources (NBAGR) has recognised the Manda buffalo as the 19th indigenous and unique buffalo breed of India.*

- Manda buffaloes are found in the Eastern Ghats and plateau of Koraput region of Odisha.
- They are resistant to parasitic infections, less prone to diseases and can live, produce and reproduce at low or nil input system.
- They give birth to a calf every 1.5 to 2 years for the whole life of 20 years, after they get matured at around 3 years.
- **Uses** - These buffaloes contribute to the nutrition of households. Average milk yield is 2 to 2.5 litre in single milking with 8% fat.
- They assist in all the agricultural operations in the undulated hilly terrain for generations.
- With Manda buffalo recognised by NBAGR, both Centre and State governments must devise a strategy for conservation of these buffaloes.
- Besides, research would be carried out to enhance buffaloes' productivity through breeding strategy.



### National Bureau of Animal Genetic Resources

- Affiliated to Indian Council of Agriculture Research (ICAR), NBAGR is the nodal agency for the registration of newly identified germplasm of **livestock and poultry** of the country.
- Mandate - Identification, Evaluation, Characterization, Conservation and sustainable Utilization of Livestock and Poultry Genetic Resources.

### 8.25 Black Tigers

*A study on black tigers of Simlipal Tiger Reserve showed that a mutation in Transmembrane Aminopeptidase Q (Taqqep) gene caused black stripes to broaden or spread into the orange-brown coloured background.*

- Simlipal's small and isolated tiger population led to inbreeding and the anomalous appearance characterised by wide, merged stripes.
- **Pseudo-melanism** is a rare stripe pattern variant of tigers, which is distinguished by stripes that are broadened and fused together.
- This condition is observed in both wild and captive tigers.
- Pseudo-melanism is different from true melanism, a condition characterised by unusually high deposition of melanin, a dark pigment.
- **Rare** - Mutants are genetic variations which may occur spontaneously, but not frequently, in nature.
- Black tigers were sought out as a novelty by trophy hunters for their unusual appearance. So, only a few survived to establish blood lines.
- Besides, pseudo-melanism is caused by a recessive (hidden) gene. But these genes are rare and it is unlikely that two unrelated tigers will carry the same one and pass it on together to a cub.
- In an ideal tiger world, where far-ranging individuals are never short of choices for partners, that makes succession of black tigers a rarity.
- **Success rate** - Under exceptional circumstances, a black tiger may succeed as part of a very small (up to 5 individuals) founding population that is forced to inbreed in isolation for generations.
- This will offer the recessive gene frequent chances to show up.
- **Natural selection** is also favouring melanistic leopards as their darker coats confer a selective advantage in both hunting and avoiding hunters in Simlipal's tropical moist deciduous and semi-evergreen forest.

## Other Records

- Pseudo-melanistic tigers are also present in three zoos in India where they were born in captivity.
  1. Nandankanan Biological Park (Bhubaneswar),
  2. Arignar Anna Zoological Park (Chennai) and
  3. BhagwanBirsa Biological Park (Ranchi)
- All of them have ancestral links to one individual from Simlipal.

## 8.26 Kaiser-i-Hind Butterfly

Arunachal Pradesh's State Cabinet approved the large, brightly coloured Kaiser-i-Hind as the State butterfly.

- Kaiser-i-Hind (*Teinopalpus imperialis*) literally means Emperor of India.
- Kaiser-i-Hind Butterfly is an elusive swallowtail butterfly that usually flies at tree-top level and descends to sit on low vegetation when there is strong morning sunlight.



### DID YOU KNOW?

The State Cabinet also adopted the 'Pakke Tiger Reserve 2047 declaration' on climate change-resilient and responsive Arunachal Pradesh, aimed at lowering emissions and sustainable development.

- It is in flight during April-July and lays eggs on the underside of leaves.
- It is found in 6 States along the Eastern Himalayas at elevations from 6,000-10,000 feet in well-wooded terrain. It also flutters in Nepal, Bhutan, Myanmar, Laos, Vietnam and southern China.
- **Threat** - Hunted for supply to butterfly collectors.

## 8.27 Vulture Bees

- These are tropical stingless bee species that have evolved into **carion-feeding** or **meat-eating bees**.
  - These bees are the only bees in the world that have evolved to use food sources not produced by plants.
- These bees have evolved an **extra tooth** for biting flesh and an **acidic gut** that more closely resembles that of vultures rather than other bees.
- Typically, bees don't eat meat. But the Vulture Bees has evolved the ability to do so, due to **intense competition for nectar**.
  - Vulture bees and related species feed on meat for their **protein**.
- Unlike humans, whose guts change with every meal, the guts of most bee species are colonized by the same 5 core microbes over 80 million years of evolution.
- But, given their radical change in food choice, it is found that the vulture bees' gut bacteria differed dramatically from those of a vegetarian bee.
  - Gut bacteria, like Lactobacillus, harbor Carnobacterium, helps vulture bees fight pathogens on rotting meat. They help produce acid which helps the bees to fight toxins that form on rotting flesh.
- The carrion-feeding bees gathered the flesh in **little baskets on their hind legs**, where other bees collect pollen, or swallowed the meat to store in their stomachs.
- **Purpose** - The bees were preparing to carry the chicken back to their hives, where they would enclose the meat chunks in pods, leave them there for 2 weeks, then feed them to their babies.
- The adults don't need to eat protein. They survive on nectar.

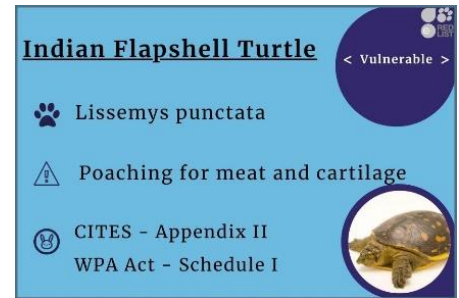
## 8.28 Indian Flapshell Turtles

Forest officials from Odisha have released 40 Indian flapshell turtles (*Lissemys punctata*) that were smuggled into the Satiguda dam.

- Indian flapshell turtle is a freshwater turtle species found in many states.
  - The "flap-shelled" name stems from the presence of femoral flaps located on the plastron.

Smuggling of turtles, one of the Class 1 species of the water animal, is a non-bailable offence under the Wildlife Protection Act, 1972.

- These flaps of skin cover the limbs when they retract into the shell.
- Indian flapshell turtle is a relatively small soft-shell turtle. It is a scavenger in the river.
- **Location** - Indian flapshell turtles are found in shallow, quiet, often stagnant slow-moving rivers, streams and rice paddies.
- They prefer waters with sand or mud bottoms because of their tendency to burrow.
- **Countries** - Pakistan, India, Sri Lanka, Nepal, Bangladesh (Indus and Ganges drainages), and Myanmar (Irrawaddy and Salween Rivers).
- **Diet** - All softshell turtles are predominantly carnivores, though the flapshells eat some plant matter (i.e. Omnivore).
- **Threats** - Poaching for meat and cartilage. Foxes and wild dogs destroy their nests.



### 8.29 Milu Deer

*The comeback of Milu Deer from the brink of extinction marks a rare success for China's conservation efforts.*

- Milu deer (*Elaphurus davidianus*) is a rare and endangered species.
- Also known as Pere David's deer, these animals were on the verge of disappearing towards the end of the 19th century.
- **Habitat** - Milu deer is native and endemic to the river valleys of China.
- They live in natural, open-range habitats, especially in the wetlands. They forage on grass and water plants.
- They particularly love rolling about in the mud, especially during the mating season, which makes the land easier for farmers to cultivate.
- **Threats** -
  1. Hunting for their meat,
  2. Loss of wetland habitat and
  3. Illicit mining and logging have fragmented reserves and left endangered animals marooned in "forest islands".
- **IUCN** - Extinct in the Wild

### 8.30 Christmas Island Red Crabs

*Australia's Christmas Island witnesses the annual red crab migration.*

- The red crab is a species of **land crab**.
- It is endemic to the Christmas Island and Cocos Islands of Australia in the Indian Ocean.
- Every year, these crabs emerge from the forest and make their way to the ocean to breed, swarming across roads, streams, rocks and beaches.
- Male crabs lead the migration and are joined by females along the way.
- Migration starts with the first rainfall of the wet season. This is usually in October or November.
- The exact timing and speed of the migration is determined by the phase of the moon.
  - Red crabs always spawn before dawn on a receding high-tide during the last quarter of the moon.
- **Diet** - Red crabs are opportunistic omnivorous scavengers.
- They mostly eat fallen leaves, fruits, flowers and seedlings, but will also feed on dead animals.
- **Predators** - Red crabs have no natural predators on Christmas Island.
- But the yellow crazy ant, an invasive species introduced to Christmas Island from Africa, is believed to have killed many red crabs recently.

## Christmas Island

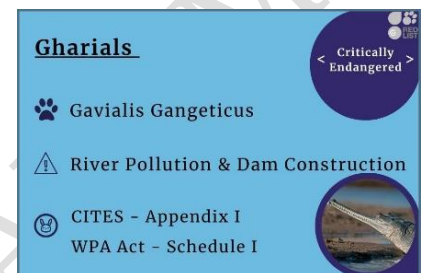
- Christmas Island is administered as an external territory of Australia.
- This island in the Indian Ocean was first sighted in 1615 by Richard Rowe.
- The island is the **summit of an oceanic mountain** whose highest point on the island is Murray Hill.
- The main settlement and chief port is at Flying Fish Cove.



### 8.31 Issi saaneq

Some researchers have determined that a well-preserved dinosaur skull excavated in East Greenland in 1994 belongs to a new species - Issi saaneq.

- Issi saaneq lived about 214 million years ago in the Late Triassic outcrops of the Malmros Klint Formation in Jameson Land, Greenland.
- It was a two-legged medium-sized, long necked herbivore and a predecessor of the sauropods, the largest land animals ever to live.
- The name of the new dinosaur pays tribute to Greenland's Inuit language and means "coldbone".
- The new findings are the first evidence of a distinct Greenlandic dinosaur species.
- The dinosaur differs from all other **sauropodomorphs** discovered so far, but has similarities with dinosaurs found in Brazil, such as the Macrocollum and Unaysaurus, which are almost 15 million years older.
- Together with the *Plateosaurus* from Germany, they form the group of **plateosaurids**: relatively bipeds that reached lengths of 3-10 m.



### 8.32 Western Honey Bee

A new study has shown that the western honey bee species (*Apis mellifera*) most likely originated in Asia, particularly from Western Asia. Until recently, it was believed that these bees had originated in Africa.

- The western honey bee is one of the first domesticated insects, and is the most common of the 7-12 species of honey bees worldwide.
- They are native to Africa, Europe and Asia. It is used for crop pollination and honey production throughout most of the world.
- The study found that the western honey bees expanded independently from Asia into Africa and Europe creating 7 separate geographically and genetically distinct evolutionary lineages traceable back to Western Asia.
- The study highlights several "hot spots" in the bee genome that allowed honey bees to adapt to new vastly different geographic areas.
- While the bee genome has more than 12,000 genes, only 145 of them had repeated signatures of adaptation associated with the formation of all major honey bee lineages found today.

### 8.33 Pyronema

A new study has found that the food source that allows *Pyronema*, a genus of pyrophilous fungi, to appear so quickly in big numbers after a fire is the damage left by the fire itself.

- Like trees, some fungi are adapted to fire. They are known as pyrophilous, or "fire-loving" fungi.
- After a fire, pyrophilous fungi show up from nowhere, basically, even in areas that haven't burned for decades. Some sprout in fiery shades of orange and pink. It's a worldwide phenomenon.
- Charcoal is difficult for many organisms to break down, said Thea Whitman, an associate professor of soil ecology at the University of Wisconsin-Madison and Fischer's co-author.
- The new study found that *Pyronema* can decompose (eat) charcoal.

- This was found by feeding the *Pyronema* with pine seedlings in an atmosphere with carbon dioxide containing carbon-13.
- [Carbon-13 is an isotope whose unusual weight makes it easy to trace.]
- *Pyronema* can eat charcoal, but it really doesn't like to. It may first enjoy that layer of dead organisms, and then switch to charcoal when it must.
- **Significance** - As *Pyronema* is breaking down charcoal after a fire, it is capable of an important player in post-fire recovery of the ecosystem.
- Implications are reduced soil erosion and enhanced moisture retention.

### 8.34 Reintroduction of Gharials in Beas Conservation Reserve

*Punjab's wildlife preservation wing has reintroduced the Gharials in the rivers of Punjab where it had become extinct half a century ago.*

- Gharials (*Gavialis gangeticus*) or gavials are a critically endangered species of Asian crocodiles.
- Their ghara (bulbous knob on their snout) makes them very efficient fishers and also renders gharial the only visibly sexually dimorphic crocodilian.
- **Habitat** - Gharials live in clear freshwater river systems, congregating at river bends where the water is deeper. They're not well-suited for land so they generally only leave the water to bask in the sun or to nest.
- Once found from Pakistan to Myanmar, the reptile's range has shrunk to 2 countries - India, and Nepal (Narayani River).
- In India, their natural habitat is found in the northern part of India, including the,
  1. Primary Habitat - Chambal River
  2. Secondary Habitat - Ghaghra and Gandak river, Girwa river (Katarniaghat Wildlife Sanctuary in UP), Ramganga river in Jim Corbett National Park and the Sone river.

*Population of Gharials are a good indicator of clean river water.*

- **Diet** - They are carnivorous in nature. While adults eat fish, their offspring also eat insects, crustaceans, and frogs.
- Conservation Efforts includes
  - Breeding Centres of Kukrail Gharial Rehabilitation Centre in Lucknow, UP.
  - National Chambal Sanctuary (Gharial Eco Park, Madhya Pradesh).
- **Threats** - As Gharials prefer sandbanks as suitable habitats, wild animals as well as humans often destroy their eggs.
- Increased river pollution, dam construction, massive-scale fishing operations and floods, illegal sand mining and poaching.
- **Related Links** - Crocodilians in India (Crocodilians are a group of reptiles that includes crocodiles, alligators, caimans, and more.)

### Beas Conservation Reserve

- The Beas Conservation Reserve is a 185-kilometre stretch of the River Beas located primarily in the north-west of Punjab.
- In 2019, the Reserve was declared a Ramsar site under the aegis of the 1971 Ramsar Convention on Wetlands of International Importance.
- The Reserve hosts the only known population in India of the endangered Indus river dolphin (*Platanista gangetica minor*).
- Further threatened species include the endangered masheer (*Tor putitora*) and hog deer (*Axis porcinus*) as well as the vulnerable smooth-coated otter (*Lutrogale perspicillata*).
- In 2017, a programme was initiated to re-introduce the critically endangered gharial into the River 30 years after their disappearance.
- **Threats** - Urban and domestic pollution, and impacts of agriculture.

### 8.35 White Rhinos

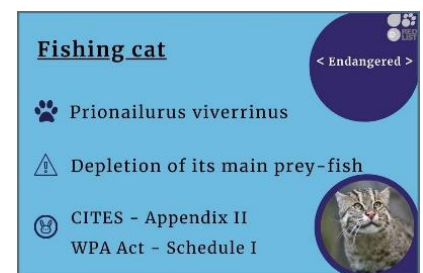
Thirty white rhinos were transferred from South Africa to Rwanda in a Boeing 747.

- White Rhinos are the second-largest land mammal.
- Also known as the square-lipped rhinoceros, white rhinos have a square upper lip with almost no hair.
- Two genetically different subspecies exist: the northern and southern white rhino, and are found in two different regions in Africa.
- White rhino populations decreased by 12% between 2012 and 2017.
- **Southern white rhino** is considered as “Almost Endangered (IUCN)”
- According to the World Wildlife Fund (WWF), there are currently 20,000 southern white rhinos in the world.
- The majority (98.8%) of the southern white rhinos occur in just four countries: South Africa, Namibia, Zimbabwe, and Kenya.
- **Northern white rhino** is on the brink of extinction, with only 2 females remaining.
- They live in the Ol Pejeta Conservancy in Kenya and are protected round-the-clock by armed guards.
- Their near extinction is due to decades of poaching for rhino horn.
- **Social structures** - White rhinos have complex social structures.
- Groups of sometimes 14 rhinos may form, notably females with calves.
- Adult males defend territories of roughly one square mile, which they mark with vigorously scraped dung piles.
- The home range for adult females can be more than seven times larger, depending on habitat quality and population density.
- Breeding females are prevented from leaving a dominant male’s territory, which is marked and patrolled by its owner on a regular basis.
- Males competing for a female may engage in serious conflict, using their horns and massive size to inflict wounds.

### 8.36 Fishing Cat

The Children for Fishing Cat project of Andhra Pradesh recruits children as ambassadors for conservation to save the predator and its home. It is a part of the Godavari Fishing Cat Project, which focuses on community-based conservation of this in the coastal habitats of the region.

- Fishing cat is a wild cat species that is bigger than a domestic cat.
- They are nocturnal. They can easily wade through water and survive in wet landscapes.
- As they have webbing between their toes that helps to catch fish efficiently, their diet is dominated by fish.
- **Habitat** - They abound in estuarine floodplains, tidal mangrove forests and also inland freshwater habitats.
- They are scattered along the Eastern Ghats. They are also found in the foothills of the Himalayas along the Ganga and Brahmaputra river valleys and in the Western Ghats.
- They inhabit the Sundarbans (West Bengal), Chilika lagoon and the surrounding wetlands (Odisha), Coringa and Krishna mangroves (AP).
- **Threats** - Loss of its preferred wetland habitats; Depletion of its main prey-fish due to unsustainable fishing practices; Occasional poaching for its skin; shrimp farming; trapping, snaring and poisoning.



### 8.37 Animal Exchange Programme

After a long gap, the Indira Gandhi Zoological Park (IGZP) welcomed a Himalayan goral, Bengal fox and Nilgai as part of its animal exchange programme with National Zoological Park (NZP) in New Delhi.

## Himalayan goral

- Himalayan gorals or grey gorals (*Naemorhedus goral*) are medium sized herbivores and are the smallest of the goat-antelopes.
- They have a stout & stocky build, which is advantageous for maneuvering the craggy terrain of the Himalayas.
- Himalayan gorals lack a pre-orbital gland, which is present in closely related Himalayan serows.
- **Behaviour** - Himalayan gorals are diurnal but most active during the early morning and evening (**crepuscular**).
- They make small **altitudinal migrations seasonally**; in the colder months they move to lower altitudes to graze, returning to higher altitudes during warmer months.
- Himalayan gorals are gregarious, but adult males live in solitude until the breeding season.
- **Reproduction** - Himalayan gorals are polygynous (Dominant males have mating rights to all females in their ranges).



## 8.38 Bengal fox

- Bengal fox or Indian fox (*Vulpes bengalensis*) are medium sized omnivorous foxes, which is a species of Asian foxes.
- **Habitat** - Bengal foxes generally prefer foothills and non-forested regions such as open grassland, thorny scrub, semi-desert and arid environments. They can also be found in agricultural fields.
- They inhabit burrows built 2 to 3 feet below ground surface that have several openings converging towards the center burrow area.
- **Behaviour** - Bengal foxes are diurnal and crepuscular.
- **Reproduction** - Bengal foxes are believed to live in long-term monogamous pairs.



## 8.39 Nilgai

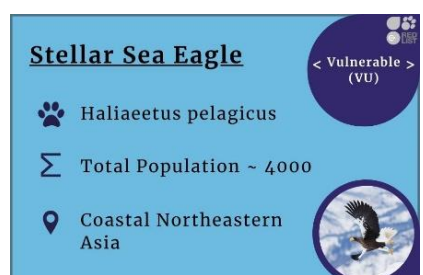
- The Nilgai (*Boselaphus tragocamelus*) or Indian antelope or bluebuck or blue cow is the largest Asian antelope.
- The nilgai is indigenous to the Indian subcontinent.
- The nilgai's conformation is more horselike than cowlike.
- **Habitat** - Nilgai antelopes live in dry areas with a variety of land types.
- In India, they occur in the foothills of the Himalayan Mountains southward to Mysore.
- **Behaviour** - Nilgai antelopes are diurnal with most activity in the early morning and late afternoon.
- They graze and browse, with grass as the main source of their diet.



## 8.40 Steller's Sea Eagle

A long way from its home in Asia, a rare Steller's sea eagle was spotted around Taunton River, Massachusetts.

- Steller's sea eagles (*Haliaeetus pelagicus*) are especially revered in Japan, where they are known as *O-washi*.
- **Habitat** - They are native to Russia, China, Korea and Japan.
- They are believed to breed only in far eastern Russia, along the coasts and surrounding islands of the Sea of Okhotsk and Bering Sea.
- They are most common on the Kamchatka Peninsula.
- **Migration** - Each winter, many Steller's sea eagles migrate from their



breeding grounds to Japan and Korea or even farther afield.

- Other individuals do not migrate, but simply move to open water as winter approaches.
- **Diet** - Open water provides these eagles with their main food sources along coastlines and lakes. Like other eagles, Steller's also steal food from other birds.

#### 8.41 Lesser Florican

The longest in-country migration route of lesser floricans has been tracked for the first time from Rajasthan to Maharashtra.

- Lesser florican (*Sypheotides indicus*) is a small and slender bird species belonging to the bustard group, found in tall grasslands.
- There is a recovery programme launched for this bird by the Dehradun-based Wildlife Institute of India (WII).
- This bird is observed in Rajasthan, Madhya Pradesh, Gujarat and some other regions during the monsoon season, when it breeds and later disappears with its chicks to unknown places.



#### 8.42 Kyhytysuka sachicarum

An international team of researchers has discovered a new marine reptile named *Kyhytysuka sachicarum*.

- It is a new species of Cretaceous hyper-carnivorous ichthyosaur.
- It evolved a unique dentition that allowed it to eat large prey; whereas other ichthyosaurs had small teeth for feeding on small prey.
  - The dentary is the longest bone of the species.
- This species was mostly found in shallow waters.
- It was named as *Kyhytysuka* which translates to 'the one that cuts with something sharp' in an indigenous language from the region in central Colombia where the fossil was found.

It was named so as to honour the ancient Muisca culture that existed in that region for millennia.

#### 8.43 Allium Negianum

A plant discovered in Uttarakhand in 2019 has been newly confirmed as a new species of *Allium*.

- The plant, called *Allium Negianum* is a new species of onion.
- It was discovered in the Indo-Tibetan border area of Malari village, Niti valley of Chamoli district in Uttarakhand.
- It is restricted to the region of Western Himalayas in India and hasn't yet been reported from anywhere else in the world.
- It grows at 3000 to 4800 m above sea level.
- It can be found along open grassy meadows, sandy soils along rivers, and streams forming in snow pasture lands along alpine meadows.
- The alpine meadows are locally known as "Bugyal/Bugial", where the melting snow actually helps carry the seed to more favourable areas.
- It has long been known to local communities and the onion from Niti Valley deemed the best on the market.



#### Allium

- *Allium* is one of the largest genera in Amaryllidaceae, a family of herbaceous, mainly perennial and bulbous flowering plants.
- The genus has about 1,100 species distributed worldwide, including onion, garlic, scallion, shallot and chives.
- It naturally occurs in dry seasons in the northern hemisphere and South Africa.
- The primary center of evolution for the genus extends across the Irano-Turanian bio-geographical region.

- The Mediterranean basin and western North America are considered as the secondary centers of diversity.
- Indian Himalayan region has two distinct centers of Allium diversity
  1. The western Himalaya (over 85% of total diversity) and
  2. The eastern Himalaya (6%), covering the alpine-sub temperate region.

#### 8.44 Mumba Eels

A new species of swamp eel belonging to the genus *Rakthamichthys* that is endemic to India was discovered in a well in Mumbai.

- This blind eel was named *Rakthamichthys mumba*.
- It is a new species of Hypogean eel (Teleostei: Synbranchidae). It is a completely blind subterranean freshwater fish species.
- Unlike other species of its genus, the mumba lacks eyes, fins and scales, has jaws equal in forward extent, different gill aperture, crescentic-shaped cephalic.
- Its body is pinkish-red with numerous blood vessels all over.
- **Difference** - *Rakthamichthys mumba* differs from its congener from Western Ghats of India by the possession of jaws-projecting forward equally, absence of eyes and having more vertebrae.

#### Family Synbranchidae

- Members of this family are very peculiar, relict lineages of percomorphs, consisting of freshwater eel-like fishes of the tropics and subtropics.
- They are distributed across all countries except Antarctica.
- Presently, this family consists of 26 valid species and is unique among teleosts by lacking paired, median and caudal fins.

#### 8.45 Arctic Terns

The annual migration of birds including the Arctic Terns from the Arctic to the Gulf of Mannar Marine Biosphere Reserve has begun.

The seasonal migration occurs every year over the Central Asian Flyway (CAF).

- Arctic Terns (*Sterna paradisaea*) are small water-loving birds with angular wings.
- They are well known for its **long yearly migration**. It migrates from pole to pole (Arctic to Antarctica); travelling 70,000 km each year.
  1. The arctic tern hatches during summer in the Arctic Circle.
  2. During the unbearably cold arctic winter, the arctic tern flies south, following the summer season all the way to the Antarctic Circle.
- Arctic Terns are **social birds**, foraging in groups and **nesting on the ground** in colonies. They often rest on ice and fly on buoyant wings.
- Habitat - Shorelines
- Nesting - Ground (This bird has a circumpolar breeding distribution.)
- IUCN Conservation - Least Concern

#### Central Asian Flyway

- The Central Asian Flyway (CAF) is the shortest flyway out of the 9 flyways in the world.
- This flyway comprises 29 countries including Iraq, Kuwait, Qatar, Kyrgyzstan, Nepal, India, Bhutan, Myanmar and Maldives
- On this route, the migratory birds travelling on the east of CAF also halt at the adjoining sanctuary habitats in Dhanushkodi and other water bodies and inter-tidal shores.

#### Journey in India

- The Arctic birds take the long non-stop haul from the Arctic and European regions to winter in South Asia.

- They usually stopover in the coastal swamps of the Gulf of Mannar between October and December.
- The birds begin their journey through India from the Bhitarkanika National Park, Odisha, and fly over to Kanniyakumari, the southern-most tip of coastal Tamil Nadu.
- The flocks again return in March on their way back.

### Migration of Birds

- Migration of bird species **occurs annually** when the birds live in places that get too cold during the winter, and food supply becomes sparse.
- Birds migrate from the breeding area to a wintering area.
  - Breeding area is where they stay during the warmer seasons such as spring and summer.
  - Wintering area is where they will spend the winter months, and return after the season ends.
- Their route is set and generation after generation, follow the path.
- Birds use different techniques:
  1. **Visual cues** - Mountain ranges and rivers.
  2. **Aural cues** - Birds can hear low-frequency sounds, a skill that allows them to pick up sounds of waves or winds from the mountains and deserts from great distances away.
  3. **Earth's magnetic field** – Birds' eyes work like a magnetic compass, and direct them while detecting the angle and intensity of the magnetic field.

### 8.46 E-coli and Chemotaxis

- E.coli, bacterial resident of the human intestine, show chemotaxis in response to different chemicals present in human gastrointestinal tract.
- [Chemotaxis is the directed motion of an organism toward environmental conditions it deems attractive and/or away from surroundings it finds repellent.]
- Scientists have now found the condition that is most suitable for getting the best chemotactic performance. This finding will help track behavior of E-Coli bacteria in response to chemical signals.
- The response of E-Coli to chemicals in the intestine bacteria plays a crucial role in the functioning of the human intestine.
- E.coli uses its **run-and-tumble motion** to migrate towards the region with more nutrients. The nutrient molecules bind to the chemo-receptors present on the cell membrane.
- This input signal is processed by the sensing module of the signaling network, finally modulating the run-and-tumble motion of the cell.
- One important aspect of signaling network of chemotaxis is the **cooperativity or clustering tendency** of the chemo-receptors, which helps amplifying the input signal.
- As a result, E.coli can respond to very weak concentration gradient. Thus receptor clustering was known to increase the sensitivity of the cell.
- A recent study has shown that there is an optimum size of the receptor clusters at which the E.coli cell shows the best-directed motion guided by chemical signal received from its environment.
- As cluster size increases, sensing is enhanced, which improves chemotactic performance. But for large clusters, fluctuations also increase, and adaptation comes into play.
- The signaling network is now controlled by the adaptation module, and sensing plays a less significant role which brings down the performance.

**Chemotaxis in other Organisms**

- A sperm cell finds the ovum using chemotaxis.
- WBC that are needed for healing injuries find the site of injury or inflammation by chemotaxis.
- Butterflies also track flowers, and male insects reach their targets by using chemotaxis.
- Understanding chemotaxis involves how it is affected by various conditions present inside the cell or in the environment.

### 8.47 General Sherman Tree

*Two wildfires in California (Colony fire & Paradise) are burning through the Sequoia National Park, the Sierra Nevada that is home to the world's largest tree.*

- General Sherman tree (*Sequoiadendron giganteum*) is the world's largest in terms of volume. This tree is about 2,200 years old.
- It stands at a height of 275 feet (taller than the leaning tower of Pisa).
- It has a diameter of 36 feet at the base. Even 60 feet above the base, the tree has a diameter of 17.5 feet.

#### DID YOU KNOW?

Sequoia trees are fairly fire-resistant trees

### 8.48 Red-Eared Slider Turtle

*The Red-Eared Slider Turtle has recently been found accidentally from the Malankara dam in Idukki.*

- It is a native of the southern U.S. (Mississippi river) and northern Mexico.
- They live in still and warm waterbodies such as ponds, lakes, streams, and slow-running rivers.
- Though they can be easily trapped in small waterbodies, it is not the case in larger waterbodies such as reservoirs.
- It is identified as exotic and enlisted in the 100 most invasive species in the world.
- They are considered a major threat to native turtle species, as they mature fast, grow larger, and produce more offspring, and are very aggressive.
- It can grow up to about 33 cm long, with a life span of close to 30 years.
- It is also known to be a carrier of human-infected bacteria such as salmonella.
- EU and Australia have imposed strict regulations on its trading and import.
- It was first observed in private aquariums in the State of Kerala.
- It is favourite among pet lovers as it is very small that can be fit into a match box, easy maintenance and relatively low cost.



### 8.49 Social Bonds in Vampire Bats

*Scientists have shown how the Vampire bats that have forged "friendships" with others will rendezvous with these friends while foraging for a meal.*

- Each of these blood-feasting vampire bats in the colony has its own network of close cooperative social bonds.
- Vampire bats that roost in trees can form long-term social bonds with each other through grooming, sharing regurgitated blood meals and generally hanging out together at the roost.
- The study has found that the social bonds formed in roosts extended into the hunt. It also showed that the female bats have stronger social relationships than males.

#### Vampire Bats

- Vampire bats are the only mammals with a blood-only diet. They reside in colonies of thousands.
- Habitat - Tropical and subtropical regions
- Locations - Warmer regions of Latin America (Central America and South America).
- Specialty - Vampire Bats are amazing runners. They have heat sensors in their snouts that help them find a spot to make a bite.
- IUCN Status - Least Concern
- Threat - Habitat loss

### 8.50 Giloy Herb

*Ministry of Ayush said that the Giloy or Guduchi herb (*Tinospora cordifolia*) is safe to use but similar looking plants in circulation such as *T. crispa* can be harmful.*

- Giloy is a climbing shrub and an essential herb in **Ayurvedic** medicine.
- People have long used it to treat a wide range of issues, including fever, infections, diarrhoea and diabetes.
- Guduchi has well established **hepatoprotective properties**.
- The Ministry had a well-established system of **Pharmacovigilance** (for reporting of suspected adverse drug reactions from Ayush medication), with its network spreading across all over India.

### Hepatoprotection

- Hepatoprotection (Antihepatotoxicity - opposite to hepatotoxicity) is the ability of a chemical substance to prevent damage to the liver.
- Hepatoprotection offered by the plant extracts was primarily attributed to its anti-hepatotoxic and antioxidant properties.

#### 8.51 Study on Meth Addiction in Brown Trout

- A new study suggests that the brown trout, a common fish species found all over the world, can get hooked on meth that washes into their freshwater homes, to the point that they actively seek out the stimulant.
- [After being used by humans, meth enters waterways through sewage systems and discharges from wastewater treatment plants.]
- It found that even a minuscule amount of methamphetamine (meth) in waterways could be enough to cause addiction in freshwater fish.
- It's clear that meth changed how these animals behave, and those effects could potentially hinder their ability to find food, and reproduce in the wild.
- The meth-exposed fish showed a stronger preference for drugged water, compared with the fish that had not been exposed to meth.
- This difference waned the more time the exposed fish spent in the drug-free tank.
- Such unnatural attraction to an area with trace amounts of meth could not only disrupt the fishes' migratory patterns but also undermine their success in foraging for food or finding mates or avoiding predators.

#### 8.52 Heterosis

- A vast majority of commercially grown crops are hybrids, where two inbred lines are crossed, with their first-generation hybrid offspring exhibiting a vigour that is lacking in either of its parents.
- This property of hybrid vigour exhibited by the hybrid crop plants is known as heterosis.
- A recent study has found that there is a strong positive relationship between the heterosis of a hybrid plant and the soil microbes.
- In laboratory-sterilised soils that are totally devoid of microbes, both the inbred parents and hybrid offspring grow equally well i.e. no heterosis.
- When the soil environment was 'rebuild' using bacteria, there was an increase in heterosis.
- Fumigating, or steaming the soil in one experimental plot led to decreased heterosis, because this soil was depleted of microbes.

#### 8.53 Map of Underground Fungal Networks

Scientists have unveiled plans to map the world's huge underground webs of fungi for the first time.

- Underground fungal networks underpin the health of plants, trees and broader ecosystems by creating thread-like webs in soil.
- They suck in CO<sub>2</sub> and transport nutrients like phosphorus to plants.
- Fungal networks are under threat from factors including fertiliser use in agriculture, urbanisation and climate change.
- **Significance of the map** - The world-first map will help identify the most bio diverse hotspots that could better protect natural ecosystems and store carbon dioxide to help tackle climate change.
- The map will be used to identify sites with the potential to store more CO<sub>2</sub>, and withstand changes brought about by global heating.

- It would also identify at-risk areas and work to improve conservation of below-ground biodiversity hotspots.

#### 8.54 Improvement of Quality of Aquatic Life in Chambal

- The aquatic animal population, including dolphins and gharial, in the Chambal River increased significantly in the past year due to a decrease in demand for fish and sand amid the pandemic-induced lockdown.
- [The Chambal River passes through Rajasthan, Uttar Pradesh and Madhya Pradesh.]
- **Threats for the dolphins** - Illegal sand mining and illegal net fishing were the threats for the dolphins. There were the major reasons behind the death of calves.
- The dolphin pools were identified in 2019. The dolphin population was falling every year between 2016 and 2020 but for the first time in six years the population has increased.
- **Reasons** - The Ghat (bank) in-charges were deployed near the pools to check illegal net fishing.
- But with the slowdown of the business of hotels and restaurants during the lockdown and other restrictions imposed due to Covid-19, illegal net fishing has almost stopped.
- Decrease of demand of both sand and fish due to lockdown also helped us in saving calves.
- **Impact** - The improvement of quality of aquatic life in the Chambal River caused an increase in the population of gharial crocodile by 17% and crocodiles by 24%.

#### 8.55 Brood X

- The US President's first trip abroad was delayed when a swarm of cicadas bombarded the plane Air Force One. These swarms are part of Brood X group, based on their life cycles and periodic appearances.
- [Cicadas live underground for extended periods of time, typically 13 or 17 years, and feed on roots of trees both underground and above it.
- The term 'brood' refers to a population of cicadas that is isolated from other populations because of differences in their year of emergence or locality.]
- Brood X is the largest brood of 17-year cicadas and is found in Pennsylvania, northern Virginia, Indiana and eastern Tennessee.
- Brood X cicadas come out of their underground homes every 17 years. They started emerging in May and will be around until the end of June.
- The time when they decide to emerge is dependent on weather, specifically when ground temperatures reach about 17-18°C.
- **Significance of Brood X** - Because of their sheer numbers and the noise they make, cicadas in Brood X often make headlines.
- When the brood last emerged in 2004 in Washington DC, the cicadas made an impact on the cultural scene.

#### Cicadas

- Among periodical cicadas, there are seven species. There are also some annual cicadas, which come out every year.
- **Underground** - When underground, cicada nymphs go through five stages of development. Once they become adults, which take about 17 years for some periodical cicadas, the males emerge from underground.
- When they come out, they shed their exoskeleton (outer skin) to take their winged form.
- **Emerging Outside** - Their emergence is to ensure continuation of their species (procreation).
  1. Male cicadas emerge first and start singing to attract females. They produce the loudest sounds in the insect world.
  2. Female cicadas respond with a clicking sound with their wings.
- This process lasts for about a month, after which the cicadas die. After mating, the eggs are laid in small twigs and branches.
- Once they hatch after about six weeks, the nymphs fall to the ground, and burrow their way into the ground. After becoming adults, these nymphs will emerge again 17 years later (or 13 years in some broods).

- **Danger** - Cicadas also do not bite or sting, but when the males sing, their collective chorus can reach up to 100 decibels, a noise level that can possibly cause severe damage if you are exposed to it for several hours.
- The female may damage the small twigs when she lays her eggs in them.

### 8.56 Role of Bats in the Ecosystem

- The bats prey on insects in farms, fields, forests and grasslands including agricultural pests and disease-causing mosquitoes.
- A study in Thailand has shown that **pest biocontrol** provided by just one species of bat prevented the loss of 2,900 tons of rice per year saving 1.2 million dollars that would provide meals for 26,200 people annually.
- Some bats sip nectar and helps in the cross pollination of flowers.
- They eat fruits and spread the seeds of many important tree species including wild varieties of bananas, guava, cashew, mango, figs, mahua and other fruits.
- Bat droppings (guano) have high concentrations of nitrogen and phosphorous and are widely used as a fertilizer for agricultural crops.
- Bats are the largest mammalian groups after rodents and are among the longest lived mammals for their body size.
- Bats are known or suspected to be the natural reservoirs for many pathogenic viruses such as **Nipah, Hendra, Marburg, Ebola and the coronaviruses** that cause severe acute respiratory syndrome.
- Scientific evidences are pointing that the SARS-CoV2 virus that causes COVID-19 originated in bats.
- Despite being reservoirs for viruses, bats never fall sick.
- In gaining the ability to fly long distances, bats have inherited an **immune system that protects them from viruses**.
- It protects them from multiple chronic age-related diseases and makes them age slower, and live longer.
- Humans have significantly modified the landscape over the years by cutting the forests, clearing the land for agriculture and development resulting in disturbances to the habitat of bats.
- Activities such as mining destroy natural cave systems that bats live in.
- The spillovers are unusual and rare events and tend to occur when there is increased contact between humans and wild hosts.
- Scientists have shown that when bats are disturbed, they become stressed and could shed viruses that they carry, increasing the risk of spillover.
- Spillovers refer to the transmission of pathogens from their natural host or reservoirs to novel hosts such as humans.

### Restoration of Ecological Balance

- **Co-existence** - Several indigenous people are dependent on animals and nature, and have achieved a balance without any harm to both sides.
- Some have isolation practices such as quarantine following hunting.
- The Bomrr clan in Nagaland have traditionally celebrated the annual bat harvest where they gather at a place called Mimi and smoke a cave full of bats to kill them for consumption.
- In the process, the bats bite them or scratch them yet there has been no major disease outbreak among the Bomrr clan.
- To understand why the Bomrr are immune to the viruses in the bats, the National Centre for Biological Sciences (NCBS-TIFR), an aided centre of Department of Atomic Energy is carrying out sero-ecological studies on this human-bat interface.
- **Precautions** – Several precautions can be taken to minimise direct interactions with bats such as
  - Avoid handling or eating bats
  - Avoid eating fallen fruits gnawed by bats
  - Avoid fruits likely to be contaminated by bat fluids

- **Restoring the balance** - Restricting and reversing land-use change practices can help in regaining the balance with nature and animals.
- Integrated approaches such as **One Health**, where human health is linked to that of the environment and animals can result in the best possible outcomes.
- Global commitment is required for the reduction of habitat loss, and for the preservation and restoration of natural habitats and biodiversity.

### 8.57 Increasing Population of Peafowls

*An unusual incident in Kerala - a person died after he was hit by a peafowl (pavocristatus) while driving a bike - has turned the spotlight on the increasing population of peafowls in the state.*

- Studies have shown that the peafowl population has been on the rise in the state since the 1980s.
- Peafowls are a threat to paddy farmers in Kerala; they destroy its seeds and cause man-animal conflict.
- The species are currently habituated more in central Kerala, followed by southeast and northwest parts of the state.
- At least 19% of the states' area is suitable habitat for this species; this may increase by 40-50% by 2050.
- **The growing population of peafowls signals climate change:**
  - They are known to grow and thrive in dry conditions.
  - They are well adapted to living in forest edges and cultivated areas.
- As humans have encroached the foothills of the Western Ghats in Kerala to cultivate crops and construct buildings, it has resulted in the loss of vegetation and has altered the Western Ghats.
- **Agriculture expansion and deforestation** have caused other species to 'invade the human territory'.
- In the end, it is important to establish strategies and controlling methods to manage the peafowl population.

## 9. INDEX & REPORTS

### 9.1 UV Index

*The UV index is produced at the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA).*

- The UV index tells you how much UV radiation of different wavelengths is around **at ground level on a given day**, and the potential of these wavelengths to harm your skin.
- In 2002, the WHO devised the UV index in an effort to make people around the world more aware of the risks.
- The index boils down several factors into a single number that gives you an idea of how careful you need to be in the sun.
- A score of 1 or 2 is low, 3 to 5 is moderate, 6 or 7 is high, 8 to 10 is very high, and 11 and above is extreme.
- **Factors** - The UV index reported is usually the **daily maximum** - that's the highest it will be all day.
- How high it gets depends on factors, including your location, the time of year, amount of cloud cover, and ozone & pollution in the atmosphere.
- The index tends to be higher closer to the Equator and at high altitudes, as the sunlight has to pass through less air before it reaches the ground.
- Another reason is that Earth is very slightly closer to the Sun in the southern hemisphere's summer than the northern summer, meaning the sunlight is a few percent brighter. So, UV is also higher.
- Third reason is the 'hole' in the ozone layer. The ozone layer in the upper atmosphere, which absorbs some UV-B, is thinner towards the South Pole.
- Finally, the air in the southern hemisphere generally has less smoke, dust and other small particle pollution than in the northern hemisphere.
- While this makes the air nicer to breathe, pollution does absorb or block some UV radiation.

- Despite changing in different locations, the UV level is also changing over time. The UV levels have increased in recent decades.

### UV Radiation

- Ultraviolet (UV) radiation is a component of sunlight. It is the light with wavelengths too short for our eyes to see, from 400 to 10 nanometres.
- The important kinds of UV radiation are,
  1. UV-A, with wavelengths from 400 to 315 nanometres,
  2. UV-B with wavelengths from 315 to 280 nanometres and
  3. UV-C has shorter wavelengths, but are mainly blocked by the atmosphere so we don't need to worry about it.
- **Impact** - In the short term, the exposure to UV can cause tanning and sunburn.
- In the longer term, too much exposure to UV can cause cataracts and skin cancer.
- UV-A and UV-B both contribute to skin damage, ageing and skin cancer.
- But UV-B is the more dangerous: it is the major cause of sunburn, cataracts and skin cancer.

### 9.2 Ecological Threat Report 2021

The 'Ecological Threat Report (ETR) 2021: Understanding ecological threats, resilience and peace' was released by the Institute of Economics and Peace.

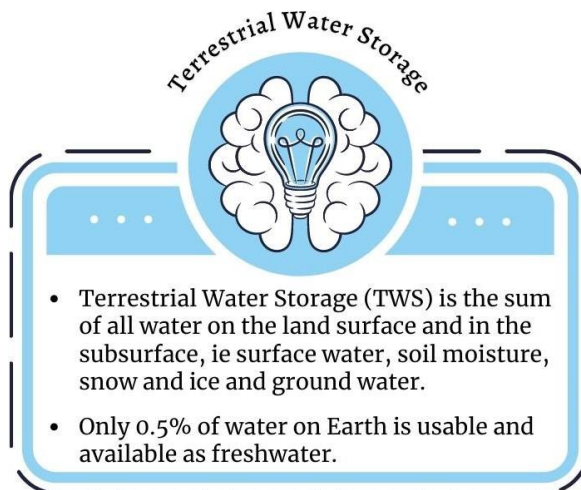
- It assessed the data from sub-national administrative units in 178 countries for threats relating to **food risk, water risk, rapid population growth, temperature anomalies & natural disasters**.
- **Findings** - Of the 178 countries in the ETR,
  - a. 30 were identified as hotspots for having low levels of resilience and a medium to extremely high catastrophic threat score.
  - b. 13 faced extremely high ecological threats and
  - c. 34 others faced high ecological threats.
- The 30 hotspot countries are least likely to be able to mitigate and adapt to new ecological threats, leading to mass displacement.
- The most vulnerable countries are clustered in the Middle East and North Africa, sub-Saharan Africa and South Asia.
- Of the 15 countries most threatened, 3 are in south Asia. As a region, south Asia is the worst-placed, with water and food risks driving the average ETR score in the region.
- Global food insecurity has increased by 44% since 2014, affecting 30.4% of the world's population in 2020, and is likely to rise further.
- From 1990 to 2020, a total of 10,320 natural disasters occurred globally.
  - Flooding has been the most common natural disasters, accounting for 42% of the total disaster count.
- In 2020, 177 countries and territories recorded a warmer average temperature compared to their historical average temperatures.
- The report recommended a policy to combine health, food, water, refugee relief, finance, agricultural and business development into one integrated agency in high-risk areas and empowering local communities.

- Ecological degradation and conflict work in a vicious circle, whereby one degradation of resources leads to conflict and vice versa.
- Climate change will have an amplifying effect, causing further ecological degradation and pushing some countries through violent tipping points

### 9.3 State of Climate Services 2021

The report 'State of Climate Services' 2021 was released by the World Meteorological Organization (WMO).

- According to the report, TWS dropped at a rate of 1 cm per year in 20 years (2002-2021).
- The biggest losses have occurred in Antarctica and Greenland. But many highly populated, lower latitude locations have experienced TWS losses.
- This includes India, where the TWS has been lost at a rate of at least 3 cm per year. In some regions, the loss has been over 4 cm per year too.
- India has recorded the highest loss in TWS if the loss of water storage in Antarctica and Greenland is excluded.
- So, India is the ‘topmost hotspot of TWS loss’. The northern part of India has experienced the maximum loss within the country.
- **Factors** - Water resources across the world are under tremendous pressure due to human and naturally-induced stressors,
  1. Extreme weather events,
  2. Population growth,
  3. Urbanisation and
  4. Decreasing availability of freshwater



**Terrestrial Water Storage**

- Terrestrial Water Storage (TWS) is the sum of all water on the land surface and in the subsurface, ie surface water, soil moisture, snow and ice and ground water.
- Only 0.5% of water on Earth is usable and available as freshwater.

### Indian Scenario

- In India, per capita water availability is reducing due to an increase in population.
- Average annual per capita water availability has been **consistently decreasing** - from 1,816 cubic metres (2001) to 1,545 cu.m. (2011).
- It is projected to further decrease to 1,367 cubic metres in 2031.
- Falkenmark Water Stress Indicator of 21 river basins in India are,

Number of River Basins	Water Stress
5	‘Absolute water scarce’ (per capita water availability below 500 cu. m.)
5	‘Water scarce’ (per capita water availability below 1,000 cu. m.)
3	‘Water stressed’ (per capita water availability below 1,700cu. m.)

- The State of India’s Environment in figures, 2020 says that by 2050, 6 will become absolute water scarce, 6 will become water scarce and 4 will become water stressed.

### 9.4 Climate Vulnerability Index

Delhi-based Environmental think tank Council on Energy, Environment and Water (CEEW) has carried a first-of-its-kind district-level Climate Vulnerability Index (CVI).

- This district-level Climate Vulnerability Index has analysed 640 districts in India to **assess their vulnerability to extreme weather events** such as cyclones, floods, heatwaves, droughts, etc.

- The Climate Vulnerability Index maps,
  1. Exposure (i.e., whether the district is prone to extreme weather events),
  2. Sensitivity (the likelihood of an impact on the district by the weather event), and
  3. Adaptive capacity (what the response or coping mechanism of the district is).
- It helps map critical vulnerabilities and plan strategies to enhance resilience and adapt by climate-proofing communities, economies and infrastructure.

India's Most Climate Vulnerable Districts	State
Dhemaji and Nagaon	Assam
Khammam	Telangana
Gajapati	Odisha
Vizianagaram	Andhra Pradesh
Sangli	Maharashtra
Chennai	Tamil Nadu

- Instead of looking at climate extremes in isolation, the study looks at the combined **risk of hydro-met disasters** (floods, cyclones and droughts), and their impact.
- The study does not take into consideration other natural disasters such as earthquakes.
- While assessing the preparedness of a state or district, the Index takes into account certain indicators like,
  1. Availability of critical infrastructure like cyclone and flood shelters,
  2. Government mechanisms in place including updating of disaster management plans, mitigation strategies, standard operating procedures before, during and after an extreme weather event.

### Findings of Climate Vulnerability Index

- The CVI has ranked 20 states out of which Assam and Andhra Pradesh are the most vulnerable to extreme weather events, and Kerala, Tripura and West Bengal are the least vulnerable.
  - The study points out that the difference in the vulnerability of states ranked is marginal, making all states vulnerable.
- The reason why Kerala and West Bengal have performed better is because they have stepped up their climate action plans & preparedness to handle an extreme weather event.
- While 27 Indian states and UTs are vulnerable to extreme climate events, 463 districts out of 640 are vulnerable to extreme weather events.
- 17 of 20 Indians (More than 80%) live in districts vulnerable to climate risks, out of which every 5 Indians live in extremely vulnerable areas.
- More than 45% of these districts have undergone unsustainable landscape and infrastructure changes.
- 183 hotspot districts are highly vulnerable to more than one extreme climate events.
- 60% of Indian districts have medium to low adaptive capacity in handling extreme weather events.
- **Impacts** - Apart from the intensity and frequency of extreme weather events which have increased in the country, the report finds that **"land disruptions"** have increased the impact of these events.

- Land disruptions primarily point to anthropogenic activity resulting in the disappearance of forests, wetlands, mangroves and other habitats.
  - These ecosystems have traditionally acted as natural buffers against such extreme weather, reducing the impact.
  - With their disappearance, the impact of the weather events have increased and are being felt more across the country.

States	Vulnerability
North-eastern states	More vulnerable to floods
Southern and central states	Most vulnerable to extreme droughts
59% of the total districts in the eastern states	Highly vulnerable to extreme cyclones
41% of the total districts in the western states	

### Recommendations

- Develop a high-resolution **Climate Risk Atlas (CRA)** to map critical vulnerabilities at the district level and better identify, assess, and project chronic and acute risks.
- Establish a centralised **climate-risk commission** to coordinate the environmental de-risking mission.
- Undertake **climate-sensitivity-led landscape restoration** focused on rehabilitating, restoring, and reintegrating natural ecosystems as part of the developmental process.
- Integrate climate risk profiling with infrastructure planning to increase adaptive capacity.
- Provide for **climate risk-interlinked adaptation financing** by creating innovative CVI-based financing instruments that integrate climate risks for an effective risk transfer mechanism.

### 9.5 Pesticides in India

A research titled “Toxicoepidemiology of poisoning exhibited in Indian population from 2010 to 2020: A systematic review and meta-analysis” was done on the prevalence of various types of poisoning in India.

- It has found that pesticides are the leading cause of poisoning in India, with two in every three cases of poisoning happening because of pesticide consumption either intentionally or unintentionally.
- Overall prevalence of pesticide poisoning was at 63% due to widespread use of pesticides for agricultural and household activities.
- The second most common cause of poisoning was miscellaneous agents, followed by drugs, venoms and corrosives.
- The prevalence of poisoning was the highest in north India at 79%, followed by south India (65.9%), central India (59.2%), west India (53.1%), north east India (46.9%) and east India (38.5%).
- **Reasons for pesticide poisoning** - Co-existence of poverty and agricultural farming and thus, the easy availability of pesticides.
- The WHO and its member countries initiated a programme of safe access of pesticides, which has resulted in a decrease in the prevalence of fatal poisoning by 10% across the world.
- However, pesticides remain the leading cause of poisoning in south Asian countries including India and in South East Asia and China.

## 9.6 Status of Leopards, Co-predators and Megaherbivores-2018

- This report was released by the Environment Minister. It is a testimony to the fact that conservation of tigers leads to the conservation of entire ecosystem.
- During all India tiger estimation 2018, leopard population was also estimated within the forested habitats in tiger occupied states of the country.
- The overall leopard population in tiger range landscape of India in 2018 was estimated at 12,852 (SE range 12,172 - 13,535).
- This is a significant increase from the 2014, figure that was 7,910 (SE 6,566-9,181) in forested habitats of 18 tiger bearing states of the country.

## 9.7 Oxfam's Report

- It said that 'net-zero' carbon targets announced by many countries may be a dangerous distraction from the priority of cutting carbon emissions.
- It says that if the challenge of change is tackled only by way of planting more trees, about 1.6 billion hectares of new forests would be required to remove the world's excess carbon emissions by 2050.
- To limit global warming below 1.5°C and prevent irreversible damage from climate change, the world should cut emissions by 45% by 2030 from 2010 levels, with the sharpest being made by the biggest emitters.
- Currently, countries' plans to cut emissions will only lead to a 1% reduction by 2030.
- Oxfam's report estimates that if only land-based methods to deal with climate change are used, food rises are expected to rise by 80% by 2050.
- If the entire energy sector were to set similar 'net-zero' targets, it would require a land area nearly the size of the Amazon rainforest, equivalent to a third of all farmland worldwide.

## 9.8 Animal Discovery 2020

*Recently, Animal Discovery 2020 was prepared by the Zoological Survey of India (ZSI) and released by the Environment Ministry.*

- It reveals that India has added 557 new species to its fauna. Now, there are 1,02,718 faunal species in India.
- It shows that India is positioned 8<sup>th</sup> in mega biodiversity countries in the world with 0.46 BioD index. Around 23.39% of India's geographical area under forest and tree cover.
- [BioD index is calculated by its percentage of species in each group relative to the total global number of species in each group.]
- Animal Discoveries are the only authentic source of faunal discoveries of India. It is published by the ZSI since 2009 every year.
- It is a document on new species and new records of fauna.

## Zoological Survey of India

- Set up by British zoologist Thomas Nelson Annandale in 1916, the ZSI is India's apex organization on animal taxonomy.
- It is a subordinate organization of the Environment Ministry.
- Headquartered in Kolkata, the ZSI BSI has 16 regional circles at different regions of the country.
- ZSI promotes **survey, exploration and research** leading to the advancement of knowledge on many aspects of exceptionally rich faunal diversity of India.
- It has been declared as designated repository for **National Zoological Collection** under the National Biodiversity Act, 2002.

## 9.9 Groundswell Report

*This report, released by the World Bank, has warned that the Climate change could push more than 200 million people to leave their homes by 2050 unless urgent action is taken.*

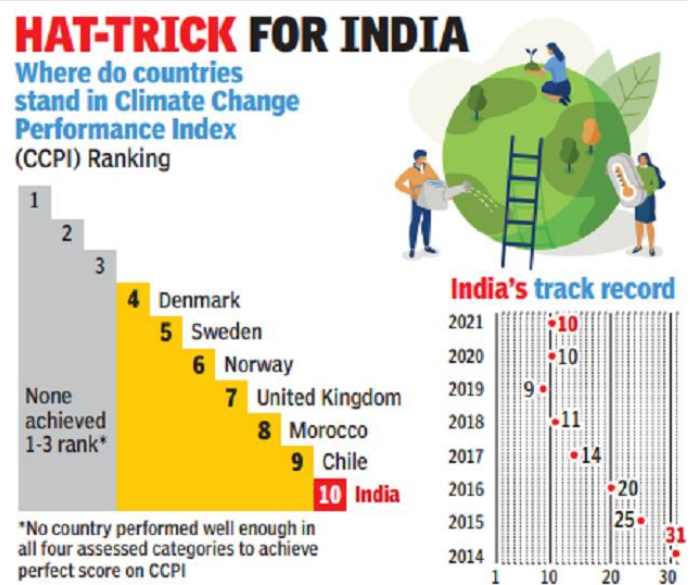
- Under the most pessimistic scenario, the report predicts more than 216 million people across 6 world regions could be on the move by 2050.

- This will lead to “hotspots of internal climate migration” by 2030 that will continue to spread and intensify by 2050.
- **Sub-Saharan Africa** has been identified as the most vulnerable region due to desertification, fragile coastlines and the population’s dependence on agriculture.
- Under the most climate-friendly scenario, the world could still see 44 million people being forced to leave their homes.
- Globally, 3 out of 4 people that move stay within countries.
- **Suggestions** - The report provides recommendations that can help slow the factors driving climate migration.
  1. Achieving net-zero emissions by mid-century (Temperature goals of the Paris Agreement),
  2. Embedding internal climate migration in green, resilient, and inclusive development planning,
  3. Preparing for each phase of migration, so that internal climate migration as an adaptation strategy can result in positive development outcomes.
- The World Bank has called on states to reduce global emissions and bridge the development gap to avoid the effects of slow-onset climate change such as water scarcity, decreasing crop productivity, etc.

### 9.10 Climate Change Performance Index

The 17th edition of the Climate Change Performance Index was released.

- This index was compiled by Germanwatch, the New Climate Institute, and the Climate Action Network.
- The index is an independent monitoring tool for tracking the climate protection performance of 60 countries and the European Union.
- **Findings** - The recent edition of the index kept the first 3 ranks of the overall rankings empty as no country had performed well enough in all index categories to achieve an overall very high rating.
- The first 3 ranks in the greenhouse gas emissions category were kept empty too.
- Overall, the overall top performers in the list of 60 countries were Denmark, Sweden and Norway.
- Australia, South Korea, Russia and the US are among the lowest performing countries along with Kazakhstan and Saudi Arabia.
- In terms of greenhouse gas emissions, Sweden, Egypt, Chile and the UK are in the top 7 of this category.
- **India** is at number 10 in the overall rankings. It is a high performer except in the renewable energy category, in which it is ranked “medium”.
- India is benefiting from its relatively low per-capita emissions.
- India is ranked 10 in terms of greenhouse gas emissions.



### 9.11 UN Report on Mullaperiyar Dam

A report by the UN University-Institute for Water, Environment and Health has mentioned about certain safety concerns of the Mullaperiyar dam.

- The report stated that around 93% of the world’s largest dams are located in 25 nations.
- The construction of large dams has been declining steadily in the last 40 years.
- **Life expectancy** - The average life expectancy of a dam is 50 years.

- Globally around 10,000 more dams have reached or exceeded the alert age limit of 50 years and many are expected to approach 100 years soon.
- In India, around 1,115 large dams will be roughly 50 years old in 2050
- Around 4,250 large dams will be more than 50 years old in 2050.
- 64 large dams in India will be more than 150 years old in 2050.
- **Mullaperiyar** - The report said that Mullaperiyar dam, built in 1895, is situated in a landslide-prone area (seismically active area).
- If India's Mullaperiyar Dam were to fail, 3.5 million people are at risk.
- The dam shows significant structural flaws and its management is a contentious issue between Kerala and Tamil Nadu States.
- Commissioning or de-commissioning of dams owned by State Governments is exclusively within the purview of the dam owning State.

### 9.12 Ocean State Report 5

Copernicus Marine Environmental Monitoring Service has released the 5<sup>th</sup> edition of Ocean State Report (OSR 5).

- The report has said that the global ocean is undergoing severe changes from natural variations, over-exploitation and anthropogenic influences.
- These changes caused the **sea level to rise by 3.1 millimeters each year** on an average between January 1993 and May 2020.
- The report showed that the sea ice is steadily decreasing in the Arctic.

Oceans/ Seas	Sea level rise
Baltic Sea	4.5 mm per year
Iberian Biscay Ireland Seas	3.6 mm per year
Pacific Islands (Total Area)	3.4 mm per year
North West Shelf	2.9 mm per year
Mediterranean Sea	2.5 mm per year
Black Sea	1.7 mm per year

- It has also showed that the warming ocean waters have caused many marine species to move towards cooler waters.
  - This migration has led to the introduction of non-native and invasive species to different marine ecosystems.
- Around 50% of Earth's oxygen production takes place in the ocean, sustaining marine life cycles.
- This is threatened by growing human activities leading to climate change and eutrophication. This deoxygenates the oceans and seas and has adverse consequences on the marine life.
- **Tools & technologies** - The report suggested new tools for monitoring ocean changes:
  1. Forecast alert systems in Malta,

2. Prediction models for jellyfish blooms in the Mediterranean Sea,
  3. Real-time monitoring programmes for tailored sea ice data.
- These tools can help scientists and policy-makers adapt to a changing ocean on a local, regional and global scale.

### 9.13 Update on Global Fuel Economy Initiative

*The International Energy Agency's (IEA) has given an update on the Global Fuel Economy Initiative (GFEI) 2021.*

- Fuel economy measures the distance a vehicle can travel per unit of a particular fuel, such as kilometre per litre.
- It is a key indicator of greenhouse gas and pollutant emissions from the use of cars.
- GFEI 2021 report presents the latest update to the Global Fuel Economy Initiative's biannual benchmarking report on light-duty vehicle sales.
- The report tracks the progress of fuel economy of new light-duty vehicles from 2005 to 2019.
- According to GFEI 2021, the global goal to halve the fuel consumption of new light-duty vehicles by 2030 from 2005 levels is stalling.
- The average rated fuel consumption of new light-duty vehicles fell by only 0.9% between 2017 and 2019.
- The 3 major car markets - China, the European Union and the US - accounted for 60% of global sales of light-duty vehicles in 2019, which totalled 90 million, down 7% from 2017.
- Total improvements are lower than the 2.8% yearly fuel economy improvements needed to meet the target.
- A number of factors were responsible for the slowing pace of improvement between 2017 and 2019. These included,
  - a) Stagnating fuel economy standards in the US and the EU up to 2019
  - b) The rising market share of SUVs, which can use almost one-third more fuel than a medium-sized car
  - c) The rising cost of squeezing out further efficiency gains from mature technologies
  - d) The slow adoption of electric cars to compensate for larger vehicles
- The report says that for internal combustion engine cars, most emissions occur at their tailpipe ('tank to wheel'), while less than 20% of overall emissions are related to the production of their fuels ('well to tank').
- By contrast, for battery electric and fuel cell electric vehicles, almost all the emissions are incurred in producing and delivering the electricity or hydrogen on which they run.
- **Battery electric vehicles had the lowest emissions** in 2019, followed by plug-in hybrids and hydrogen fuel cell electric vehicles.
- Hybrid vehicles have the lowest well-to-wheel emissions among vehicles with internal combustion engines using gasoline, diesel or compressed natural gas.
- Fuel consumption should fall 4.3% per year on average from 2019 to 2030, to halve the fuel consumption of new light-duty vehicles.
  - This is triple the average annual pace of improvement since 2005.

#### Global Fuel Economy Initiative

- The Global Fuel Economy Initiative is collaboration between the UNEP, IEA, the University of California, International Council on Clean Transportation, International Transport Forum and the FIA Foundation.
- GFEI promotes fuel efficiency in cars and light duty vans, through the adoption of the cost effective fuel efficiency technologies.
- The objective of the GFEI is to help stabilize greenhouse gas emissions from the global light duty vehicle fleet through a **50% improvement of vehicle fuel efficiency worldwide by 2050**.
- GFEI promotes the introduction of cleaner, more energy efficient vehicles in developing and transitional countries.
- It offers support to governments to develop fuel economy policies.

### 9.14 SOIL Report 2021

- The State of India's Livelihoods (SOIL) Report is an annual Report released by the ACCESS Developmental Services.
- It is an authoritative commentary on
  1. Policy and programmes of the government, potential opportunities for the poor, and
  2. Role of the private sector and the civil society in livelihoods promotion.
- It tracks the trends and analyses the environment in the sector.
- **Findings** - The 2021 Report has analysed only Farmer Producer Companies (FPCs).
- In the last 7 years, just 1-5 % of FPOs have received funding under central government schemes introduced to promote them.
- Only 5% of total registered FPOs have been able to secure the grants under Equity Grant Scheme and Credit Guarantee Scheme.
- FPOs registered under Companies Act make up a large majority of the organisations while the FPOs registered as cooperatives /societies are less in number.

## GEOGRAPHY

### 10. GENERAL GEOGRAPHY

#### 10.1 World's Fifth Ocean

The National Geographic magazine has recognised the 'Southern Ocean' as the world's fifth ocean hoping others will soon follow suit.

- [The other four Oceans are Pacific, Atlantic, Indian and Arctic Oceans.]
- Usually, the magazine has followed the International Hydrographic Organization (IHO) on marine names.
- The change in name is in alignment with the National Geographic Society's initiative to conserve the world's oceans.
- The Southern Ocean is the **only ocean to touch three other oceans** and to **completely embrace a continent** rather than being embraced by them.
- Its northern limit is a latitude of 60 degrees south. It is also defined by its **Antarctic Circumpolar Current** that was formed 34 million years ago. The current flows from west to east around Antarctica.
- By officially changing the name of the waterbody, the National Geographic hoped to draw attention to the following issues,
  - Rapid warming of the Southern Ocean due to global warming,
  - Industrial fishing on species like krill and Patagonian toothfish

#### International Hydrographic Organization

- It is an intergovernmental organization that works to ensure all the world's seas, oceans and navigable waters are surveyed and charted.
- Established in 1921, it coordinates the activities of national hydrographic offices and promotes uniformity in nautical charts and documents.
- It issues survey best practices, provides guidelines to maximize the use of hydrographic survey data and develops hydrographic capabilities in Member States.
- India is also a member of IHO.

#### Recognition

- The IHO too had recognised 'Southern Ocean' as a distinct body of water surrounding Antarctica in 1937 but had repealed the same in 1953.
- However, the US Board on Geographic Names and the National Oceanic and Atmospheric Administration recognize the term 'Southern Ocean'.

## 10.2 Movements of Earth

- As Earth zooms around the sun, it also turns on its own axis about once every 24 hours (precisely, every 23 hours, 56 minutes and 4 seconds).
- Earth measures 40,070 kilometers in circumference, so when you divide distance by time, that means the planet is spinning 1,670 kmph.
- Meanwhile, Earth orbits the sun at about 110,000 km/h. It is determined by taking the distance Earth travels around the sun and dividing it by the length of time Earth takes to complete one orbit (about 365 days).
- Earth is about 149.6 million km away from the sun, and it is assumed to travel in a generally circular path (it's actually more elliptical).
- The solar system is also moving; it's located within the Milky Way, which orbits around the galaxy's center. The solar system orbits the Milky Way's galactic center at about 720,000 km/h.
- Then there's the entire Milky Way, which is pulled in different directions by other massive structures, such as other galaxies and galaxy clusters.
- For humans standing on the surface of our planet, they don't feel Earth hurtling around the sun because they're also hurtling around the sun at the same speed. There's no relative motion.

## 10.3 Great Unconformity of the Grand Canyon

*A new study comes closer to solving a puzzle called the "Great Unconformity" of the Grand Canyon.*

- First noted by John Wesley Powell in 1869, the Great Unconformity is a geologic feature of the Grand Canyon.
- Great Unconformity is a **missing gap of time** (more than 1 billion years) in the **rock record** of the Canyon that covers almost 2 billion years of Earth's past.
- The new study reports that a series of small yet violent faulting events may have rocked the region during the breakup of an ancient supercontinent called Rodinia.
- The resulting havoc likely tore up the earth around the canyon, causing rocks and sediment to wash away and into the ocean.
- These findings could help fill in missing pieces of what happened during this critical period for the Grand Canyon.



## Thermo Chronology

- In the above study, to explore the transition in the rock layers, a method called 'thermo chronology' was employed.
- Thermochronology is the science and practice of inferring thermal histories of minerals and rocks from chemical, isotopic, or physical properties of minerals that are sensitive to both temperature and time.
- It tracks the history of heat in stone.
- When geologic formations are buried deep underground, the pressure building on top of them can cause them to get toasty.
- That heat, in turn, leaves a trace in the chemistry of minerals in those formations.

## 10.4 Earth's First Landmass

*A new study suggests that the Earth's first continents, known as the cratons, emerged from the ocean between 3.3 billion and 3.2 billion years ago.*

- This new study has challenged the widely accepted view that the continents rose from the oceans about 2.5 billion years ago.
- It has also found that the earliest continental landmass to emerge may have been Jharkhand's Singhbhum region.

- **Sandstones** - The study found sandstones in Singhbhum with geological signatures of ancient river channels, tidal plains and beaches over 3.2 billion years old, representing the earliest crust exposed to air.
- All these water bodies could have only existed if there was continental land.
- Thus, it was inferred that the Singhbhum region was above the ocean before 3.1 billion years ago.
- Patches of the earliest continental land, however, exist in Australia and South Africa, too.
- The team studied the **zircons** (with uranium) in the rocks using a technique called mass spectrometry to find the age of the rocks.
- **Granites** - The granites that form the continental crust of Singhbhum region are 3.5 to 3.1 billion years old.
- They were formed through extensive volcanism that happened about 35-45 km deep inside the Earth.
- This process continued on-and-off for several years until all the magma solidified to form a thick continental crust in the area.
- Due to the thickness and less density, the continental crust emerged above surrounding oceanic crust owing to buoyancy.
- The earliest emergence of continents may have contributed to a proliferation of photosynthetic organisms, which would have increased oxygen levels in the atmosphere.
- Once you create land, what you also create is shallow seas, like lagoons.

- The sandstones tell us 'when the first landmasses were formed' and the granite tells us 'how the first landmasses were formed'.
- Studying these sedimentary rocks gives information about the formation of first landmass, as sedimentary rocks could only form once land broke through the surface of early Earth's oceans.
- If an individual/organisation is included in the 1267 list, it helps in restricting their movement, financial penalties and assets freeze among others

### 10.5 Causes of Earth's First Mass Extinction

*A recent paper has come up with a new reason behind the first mass extinction, also known as the Late Ordovician mass extinction.*

- For decades, the prevailing school of thought in our field is that global warming causes the oceans to lose oxygen and thus impact marine habitability, potentially destabilising the entire ecosystem.
- But the new paper notes that the **cooling climate likely changed the ocean circulation pattern.**
- This disrupted the flow of oxygen-rich water from the shallow seas to deeper oceans, leading to a mass extinction of marine creatures.
- Upper-ocean oxygenation in response to cooling was anticipated because atmospheric oxygen preferentially dissolves in cold waters.
- However, a lack of oxygen or anoxia in the lower ocean expanded to the deep oceans during the period.
- [Generally, anoxia in Earth's history is associated with volcanism-induced global warming.]
- This deep-sea anoxia affected ocean circulation, which is an important component of the climatic system.
- The paper concludes that climate cooling may have led to changes in nutrient cycling, primary producer communities which ultimately drove the Late Ordovician mass extinction.

“Some researchers have pointed out that we are currently experiencing a sixth mass extinction as the result of human-induced climate change.”

Mass Extinction	Period	Specialty
Devonian mass extinction	375 million years ago	Wiped out about 75% of the world's species
Permian mass extinction or Great Dying	250 million years ago	Wiped out about 95% of all species
Triassic mass extinction	200 million years ago	Wiped out about 80% of Earth's species, including some dinosaurs
Ordovician mass extinction	445 million years ago	Wiped out about 85% of all species
Cretaceous-Paleogene mass extinction (K-T or K-Pg extinction)	66 million years ago	Wiped out non-avian dinosaurs

### 10.6 Dead Sea & Sinkholes

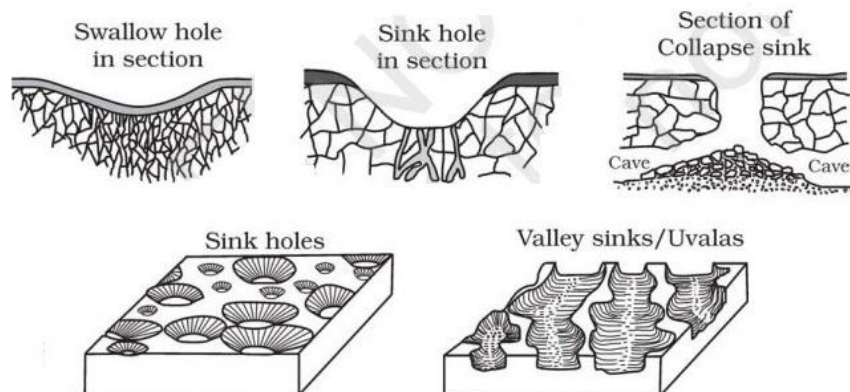
Thousands of sinkholes have formed around the Dead Sea, which has lost a third of its surface area since 1960.

#### Sinkholes

- A sinkhole is an opening more or less circular at the top and funnel-shaped towards the bottom.
- Its size varies in area from a few sq. m to a hectare and with depth from a less than 0.5 metre to 30 metres or more.
- Some of these form solely through solution action (solution sinks).
- Others might start as solution forms first and if the bottom of a sinkhole forms the roof of a void or cave underground, it might collapse leaving a large hole opening into a cave or a void below (collapse sinks or dolines).

#### DID YOU KNOW?

Sinkholes are very common in limestone/karst areas. Solution sinks are more common than collapse sinks



- Quite often, sinkholes are covered up with soil mantle and appear as shallow water pools. Anybody stepping over such pools would go down.
- When sink holes and dolines join together because of slumping of materials along their margins or due to roof collapse of caves, long, narrow to wide trenches called valley sinks or Uvalas form.

## Dead Sea

- Dead Sea or Salt Sea is the landlocked salt lake between Israel and Jordan located at the lowest point on earth.
- It is one of the four saltiest bodies of water in the world.
- It is the world's deepest hypersaline lake.
- Dead Sea is called the Dead Sea due to the harsh environment (extreme salinity of its water) in which plants and animals cannot flourish.
- The special conditions of the lake are an outcome of its extreme geo-morphological structure alongside a harsh desert climate.
- But, it has been receding by about a metre every year.



## 10.7 Atlantification

*A recent study has found that Atlantification started at the beginning of the 20th century. The Arctic has warmed by 2 degrees Celsius since 1900.*

- Long ago, the Arctic and the Atlantic oceans existed in harmony, with warm and salty Atlantic waters gently flowing into the Arctic.
- The Arctic had a layered nature - sea ice on top, cool freshwater in the middle, and warm, salty water at the bottom - that helped hold the boundary between the polar ocean and the warmer Atlantic.
- But everything changed when the larger Atlantic Ocean began flowing faster than the Arctic Ocean could accommodate.
- This weakened the distinction between the layers and transformed Arctic waters into something closer to the Atlantic.
- This process is called Atlantification. It is part of the reason why the Arctic is warming faster than any other ocean.
- Atlantification is not a new invasion of the Arctic. But what's new is that the properties of the Arctic are changing.

## New Study

- Recent study found that the researchers extracted a yardlong sediment core from the seafloor of Kongsfjorden, a glacial fjord in the east end of the Fram Strait.
- [Fram Strait is a gateway between the Norwegian archipelago Svalbard and Greenland, where Arctic and Atlantic waters mingle.]
- This sediment archived 800 years of historical changes in Arctic waters.
- Researchers sliced up the core at regular intervals and identified the samples' foraminifera - single-celled organisms that build intricate shells around themselves using minerals in the ocean.
- **Process** - When foraminifera die, their shells drift to the seafloor and accumulate in layers of sediment.
- The creatures are crucial clues in sediment samples; by identifying which foraminifera are present in a sample and analyzing the chemistry of their shells, scientists can glean the properties of past oceans.
- Researchers noticed a sudden, massive increase in the concentration of foraminifera that prefer salty environments - a sign of Atlantification, around 1907 give or take a decade.
- This is far earlier than anyone had documented.
- Additionally, a molecular biomarker could pinpoint a specific year, 1916, when coal mining began in Kongsfjorden.
- Since the foraminiferal shift occurred just before this marker, the researchers estimate Atlantification began
- The authors are not sure of the precise reasons behind the early Atlantification. If human influences are the cause, the whole system is much more sensitive to greenhouse gases than we previously thought.

## 10.8 Future of El Niño and La Niña

A study simulated the El Niño-Southern Oscillation (ENSO) using South Korea's supercomputer Aleph.

- The study completed a series of century-long Climate model simulations covering present-day climate and 2 different global warming levels.
- It notes that the intensity of the ENSO temperature cycle can weaken as carbon dioxide increases.
- It found that increasing atmospheric CO<sub>2</sub> can cause a weakening of future simulated ENSO sea surface temperature variability.
- It found that the sea-surface temperature deviates from normal level at CO<sub>2</sub>-doubling (2×CO<sub>2</sub>) conditions and became robust at CO<sub>2</sub> quadrupling (4×CO<sub>2</sub>).
- Reasons for the collapse:- **Movement of atmospheric heat** was studied to decode the collapse of the ENSO system.
  1. The future El Niño events will lose heat to the atmosphere more quickly due to the evaporation of water vapour.
  2. There will be a reduced temperature difference between the eastern and western tropical Pacific, inhibiting the development of temperature extremes during the ENSO cycle.
- There can be a weakening of the **tropical instability waves** of the equatorial Pacific in the projected future, which can cause a disruption of the La Niña event.
- There is a **tug-of-war** between positive and negative feedback in the ENSO system, which tips over to the negative side in a warmer climate.
- This means future El Niño and La Niña events cannot develop their full amplitude anymore.

### EL NINO-SOUTHERN OSCILLATION

- El Niño and La Niña are the two natural climate phenomena occurring across the tropical Pacific Ocean. Together, they are called ENSO.
- They influence the weather conditions all over the world.
- El Niño period is characterised by warming or increased sea surface temperature in the central and eastern tropical Pacific Ocean.
- La Niña event causes the water in the eastern Pacific Ocean to be colder than usual.

### La Niña & Monsoon

- La Niña ('little girl' in Spanish) and El Niño ('little boy') refer to the see-sawing of surface temperatures of the Pacific Ocean.
- El Niño and La Niña are the opposite phases of the El Niño-Southern Oscillation (ENSO) cycle of the Pacific Ocean.
- It involves changes in the sea-surface temperatures (SSTs) in the waters of the Eastern and Central Pacific Ocean.
- It is a recurring phenomenon and the change in temperature is accompanied by changes in the patterns of upper and lower level winds, sea level pressure, and tropical rainfall across the Pacific Basin.

### Impact of La Niña on the North-East monsoon

- While a La Niña is known to enhance rainfall associated with the South-West monsoon, again with exceptions, it has correlated negatively with the North-East monsoon. This is due to two reasons,
  1. Low-pressure areas, depressions or cyclones form relatively north to their normal position during a La Niña year.
  2. Instead of moving West-North-West towards the East Coast of India, they tend to recurve and move away, robbing the South Peninsula of its share of rainfall.

### La Niña this year

- Normally, La Niña subdues the concurrent North-East monsoon.
- But, this year, La Niña is contributing to the excessive NE monsoon. This is due to the rain-driving low-pressure areas/depressions in the Bay of Bengal/Arabian Sea so far.
- The Indian Ocean Dipole (IOD) or Indian Niño had gone from a slightly negative mode into neutral even as the NE monsoon was establishing.
- [IOD involves a periodic oscillation of SST between positive, negative and neutral.]

- Negative IOD could have wrecked the NE monsoon irrespective of the Pacific mode, since warming of the East Indian Ocean could divert rain systems away from the Bay.
- Weather systems seek out the nearest warm water pool to thrive and prosper.
- Given the neutral IOD phase, the flows from upstream South China Sea/ West Pacific may have been directed into the Bay, beefing up the NE monsoon.
- Monitoring the SSTs of the 'Nino' regions of the Equatorial Pacific shows that these phenomena may recur every 3 to 5 years.
- Each cycle lasts 9 months to a year or perhaps even more, manifesting in floods/drought across geographies.

La Nina	El Niño
During a La Nina, SSTs are elevated beyond 27.5 degrees Celsius over the West Pacific.	During a El Niño, SSTs are elevated over the East Pacific.
When SSTs go up, it supports evaporation and cloud-building, triggering storms and heavy rain.	When the SSTs cool, the exact reverse happens. It suppresses evaporation, cloud-building, storm formation and rain.
Normally, a La Niña subdues the concurrent North-East monsoon in India.	El Niño has been associated with drought years in India, with exceptions.

### 10.9 Study on Migration of River Delta

*In order to understand how their course may change in future, a new study has examined 48 river delta systems across the world from a variety of climatic and socioeconomic contexts.*

- The researchers identified 4 aspects that determine the movement and migration of river delta systems:
  - a) Interplay between the effects of rivers, tides, and waves
  - b) Amount of sediment that the channel carries (aka sediment flux)
  - c) Frequency & magnitude of floods that occur
  - d) Average size of the channel.
- Also, high tides increase the input of the saline seawater in the delta and interact with the river discharge.
- Researchers hypothesised that increases in the sediment flux will cause greater changes in the delta channel and so, cause it to migrate more.
- The study found that all deltas exhibiting large migration rates, in excess of 3 metres per year, are dominated by river action rather than tides.
- During high tides, there is increased input of seawater in the delta and the sediment that has already flowed out of the channel is pushed back into the delta, 'acting as a stabilising force'.
- However, there are deltas that have a low migration rate but are dominated by river discharge.
- **Reason** - The study argues that the reason could lie in the sediment being transported by the river (**fluvial sediment flux**).
- Merely because the delta is river-dominated and has a significant tendency to change its channel does not necessarily mean it will do so.
- Sediment flux is a key driver for channel migration, as the course of the water naturally changes when sediment gets deposited/ discharged at the mouth of the delta.
- Another reason is the **Biome classification**. River deltas in frigid zones of the Earth will naturally have permafrost balance out all ingredients for a high migration rate.
- Combined effects of all these factors, especially flood forcing, were also considered.
- **Types** - Juxtaposition of all these shows that when there is high sediment flux, high flood frequency, and high degrees of river forcing, the systems have the highest rates of channel migration.
- Examples - The Godavari River, India and the Yellow and Yangtze River deltas in China.

- When there is low sediment flux, low flood frequency, and low degrees of river forcing, the systems have the lowest rates of channel migration.
- Examples - The Vistula, Poland; Ebro, Spain; Rhine, Germany and Tone, Japan.
- The Ganges river delta is an example of a system where a combination of migration-enhancing and migration-dampening factors balances each other out.
- Ganges has large volume, high sediment flux, and high flood frequency; but, experiences almost 50% tidal forcing, acting as a stabiliser.
- This data on the changes delta systems have undergone in the recent past can help governments manage population density and plan future city development.

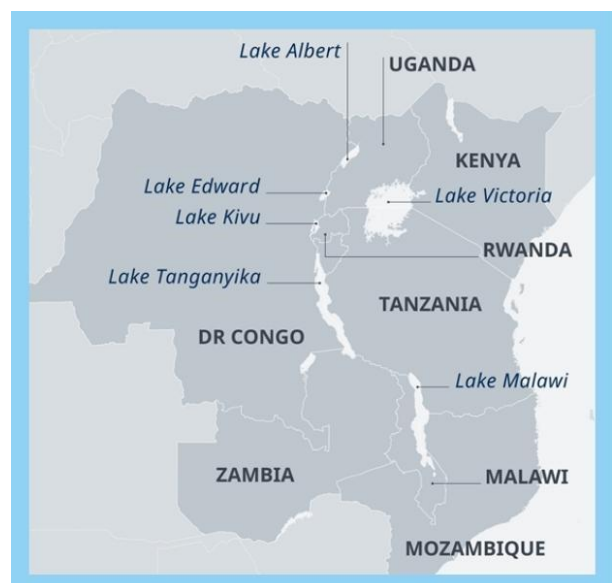
### Aerosol Nucleation

- Scientists from the University of Hyderabad have found frequent formation of sub-3 nanometres aerosol particles in the atmosphere.
- They measured particle size distribution of neutral sub-3nm (1 to 3 nm) particles using AIRMODUS nano Condensation Nucleus Counter (nCNC) at an urban location in India.
- **Terminologies** - The formation of small molecular clusters of sub-3nm size is technically called aerosol nucleation.
- The subsequent growth of these newly formed clusters to the large sizes is called atmospheric new particle formation (NPF).
- NPF occurs everywhere in the terrestrial troposphere, and therefore it is a large source of aerosol numbers to the atmosphere.
- This has critical importance as a major fraction of these newly formed particles can reach to sizes of cloud condensation nuclei where they have climatic impacts.
- **Findings of the Study** - The speed with which this pool of sub-3nm particles form clusters grow depends on various factors.
- Only half of these events newly formed molecular clusters grow past 10 nm sizes. Thus particle size distributions display a conventional banana-shaped aerosol growth, which is indicative of regional NPF event.
- The team found a strong positive correlation between sub-3nm particle concentrations and sulphuric acid concentrations.
- NPF often starts with sulphuric acid in the atmosphere. Other vapours such as ammonia, amines and organics also play a crucial role in the growth of newly formed particles.

### 10.10 Rift Valley Lakes

*A report has found that the water levels of lakes in Kenya's Great Rift Valley increased significantly, due to climate change, human activities and an active tectonic belt.*

- Rift Valley Lakes are a series of lakes in the East African Rift valley that runs through eastern Africa from Ethiopia in the north to Malawi in the south.
- These include the African Great Lakes (Victoria, Tanganyika and Malawi) as well as Turkana, Albert, Edward, Kivu and other lakes.
  - Lake Victoria is the second largest freshwater lake in the world after Lake Superior in the US.
  - Lake Tanganyika is the longest lake in the world.
- Rift Valley lakes are well known for the evolution of at least 800 **cichlid fish species** that live in their waters.
- **Threats** - Deforestation, pollution from agricultural and industrial activities, run-off from urban areas and overfishing threaten the health of many of the lakes and their water basins.



## Rift Valley

- A rift valley is a lowland region that forms where Earth's tectonic plates move apart, or rift.
- Rift valleys are found both on land and at the bottom of the ocean, where they are created by the process of seafloor spreading.
- Rift valleys differ from river valleys and glacial valleys in that they are created by tectonic activity and not the process of erosion.

### 10.11 La Palma Island

*There was volcanic eruption in the La Palma Island of the Canaries archipelago.*

- La Palma Island of Spain is the most north-western island in the Canary Islands. It was formed as a result of a volcanic formation.
- **Geographical features** - La Caldera de Taburiente is a large volcanic caldera (10 km in diameter). It was established as a national park named Taburiente National Park.
- Roque de los Muchachos (Highest Mountain in the island) houses the GRANTECAN (Gran Telescopio Canarias) astronomical observatory.
- Its well-watered slopes are densely wooded and deeply dissected by ravines.
- **Economy** of La Palma revolves around irrigation-based farming.
- Bananas, tomatoes, and tobacco, along with embroidery, are exported from the port of Santa Cruz de la Palma - the island's capital.
- Tourism also has importance.

### 10.12 Hurricane Ida

*It is a Category 4 storm that has hit on the same date as the Hurricane Katrina that ravaged Louisiana and Mississippi in 2005.*

- Hurricane Ida will most definitely be **stronger** than Katrina, the costliest storm in American history.
- Ida is coming to the same general place of Katrina from a slightly different **direction**.
- Storms that are bigger in width have larger storm surge because of the broader push of the water. They also cause huge damage.
- Ida has the potential to be more of a natural disaster whereas the big issue in Katrina was more of a man-made one because of levee failures.
- [A levee breach or levee failure is a situation where a levee fails or is intentionally breached, causing the previously contained water to flood the land behind the levee.]
- **Rapid intensification** - Ida was fed by the eddy of the Loop Current, going from 169 kph winds to 241 kph winds in just 8 hours.
- The Loop Current is the deep patch of incredibly warm water.
- It takes warm water off the Yucatan Peninsula does a loop in the Gulf of Mexico and spins up the eastern edge of Florida into the Gulf Stream.
- Normally when a storm intensifies or stalls it takes up all of the region's warm water and then hits colder water that starts to weaken the storm or at least keeps it from further strengthening.
- Ida is gaining power over a water area with above 26 degrees Celsius) more than 150-m deep. It has started the process of eyewall replacement.

## Eyewall Replacement

- After a hurricane rapidly intensifies, it becomes so strong and its eye so small that it often can't quite keep going that way.
- So, it forms an outer eyewall and the inside eyewall collapses, which is called eyewall replacement.
- When a new eyewall forms, often a storm becomes larger in size but a bit weaker.

### 10.13 Earthquakes in Haiti

*A powerful earthquake (magnitude 7.2) killed hundreds and injured thousands more in Haiti (which faces frequent earthquakes).*

- An island country located in the Caribbean Sea, on the island of Hispaniola in the Greater Antilles archipelago.
- Bordered in land by the Dominican Republic in east.
- Maritime borders with the Bahamas, Colombia, Cuba, and Jamaica.
- Haiti's **unique geology** makes it **seismically active** and prone to devastating earthquakes.
- Located near the intersection of two tectonic plates—the North American plate and the Caribbean plate.
- Multiple fault lines between those plates cut through or near the island of Hispaniola.
- The recent earthquake likely occurred along the **Enriquillo-Plantain Garden fault zone**:
  1. cuts across Haiti's south-western Tiburon Peninsula
  2. the source of many earlier big earthquakes in Haiti
- **Other reasons**
  1. High population density of 11 million people.
  2. Typical concrete and cinder block buildings designed to withstand hurricanes but are vulnerable to collapse when the ground shakes.
  3. Given the factors, it is much a natural hazard that overlaps with a vulnerable design and system, and not really a natural disaster.

### 10.14 Mount Nyiragongo Volcano

*After a week Mount Nyiragongo volcano in the Democratic Republic of Congo (DRC) erupted, earthquakes are still being reported around it.*

- **Location** - Mount Nyiragongo is an active stratovolcano in the Virunga volcanic chain inside the Virunga National Park, which has been listed in the UNESCO's List of World Heritage in Danger.
- Nyiragongo owes its existence to the activity of the African Great Rift (Albertine Rift). The rift is constantly extending and opening.
- **Particularly dangerous** - As the Mount Nyiragongo is located on a highly active segment of the African rift, the magma ascends quickly from about 100 km beneath the Earth's surface.
- Another reason for concern is the extreme fluidity of the lava that allows little time for people to escape.
- Other dangers associated with rifting, and volcano activity in the region,
  1. Dangerous earthquakes;
  2. Explosions when the hot lava reaches Lake Kivu waters causing its sudden boiling;
  3. Release of carbon-rich gases, particularly methane, during rifting and eruption, leading to explosions;
  4. Potential for carbon-rich gas accumulation at the bottom of lake Kivu, which may cause surface water to sink, releasing lethal gases threatening Goma.
- Following the last eruption in 2002, the National Institute of Geophysics and Volcanology in Italy started a programme of hazard evaluation and risk mitigation from lava flow invasion in Goma, DRC.
- Nyiragongo and nearby Nyamuragira are together responsible for 40% of Africa's historical volcanic eruptions.

### 10.15 Mount Semeru / Mahameru

*The eruption of Mount Semeru, East Java, Indonesia has killed at least 14 persons and left dozens injured.*

- Semeru, an active volcano in East Java, is located in a subduction zone, where the Indo-Australian plate subducts under the Eurasia plate.

- It is the highest volcano on Java that lies at the southern end of a volcanic massif extending north to the Tengger caldera.
- This **stratovolcano** is also known as Mahameru (The Great Mountain.)
- Semeru has been in almost continuous eruption since 1967. It is known for its regular ash explosions that occur at intervals of 10-30 minutes.
- The recent eruption of the Semuru volcano was triggered due to **heavy rain**.
- Days of heavy rain had gradually eroded Semeru's lava dome, a mound of hardened lava that acts like a volcano's plug, which partially collapsed.



### 10.16 Drought in Colorado River Basin

The US government has declared the 1<sup>st</sup> water shortage for the Colorado River basin due to a historic drought.

- This will lead to water cuts in some south-western US states and some parts of north-western Mexico starting October 2021.
- Due to this historic drought, the release of water from Lake Mead and Lake Powell will be affected that will impact the entire Colorado basin.
- But even with a great water storing capacity, over the years the demand for water from the basin has increased whereas supply is restricted.
- Governors of 10 western US states have requested the US President to declare a Federal Emergency Management Agency (FEMA) drought disaster in these states.
- This will provide more assistance to thousands of farmers in these states.

### Colorado River

- The Colorado River flows from the Rocky Mountains and it is fed by snowmelt from the Rocky and Wasatch mountains.
- It flows a distance of over 2,250 km across 7 south-western states and into Mexico.
- Because of its intensive development it is often referred to as the “Lifeline of the Southwest.”
- The Colorado River Basin is divided into,
  1. Upper Basins (Wyoming, Colorado, New Mexico, Utah and northern Arizona) and
  2. Lower Basins (parts of Nevada, Arizona, California, south-western Utah and western New Mexico).
- In the Lower Basin, the Hoover Dam, Davis Dam, Parker Dam and the Imperial Dam controls floods and regulates water delivery and storage.

### 10.17 Weddell Sea as Marine Protected Area

Ministry of Earth Sciences said that India is co-sponsoring a proposal of the European Union for designating East Antarctica & Weddell Sea as Marine Protected Areas (MPAs).

- Weddell Sea is an embayment of the Antarctic coastline that forms a southward extension of the Southern Ocean. It has the Weddell Gyre.
- It is bounded,
  1. On the west by the Antarctic Peninsula of West Antarctica,
  2. On the east by Coats Land of East Antarctica, and
  3. On the extreme south by ice frontal barriers of the Filchner and Ronne ice shelves.

### Marine Protected Area

- A marine protected area 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.

### Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR)

- It is an international treaty to manage Antarctic fisheries to preserve species diversity and stability of the entire Antarctic marine ecosystem.
- It came into force in April 1982.
- It is responsible for the formulation, adaptation and implementation mechanisms of the MPAs.
- Since 2009, CCAMLR members have developed proposals for MPAs for various regions of the Southern Ocean.
- CCAMLR's scientific committee examines these proposals.
- After CCAMLR members agree upon them, elaborate conservation measures are set out by the commission.
- **India** has been a permanent member of CCAMLR since 1986.
- Work pertaining to CCAMLR is coordinated in India by the Ministry of Earth Sciences through its attached office, the Centre for Marine Living Resources and Ecology (CMLRE) in Kochi, Kerala.



## 11. INDIAN GEOGRAPHY

### 11.1 Lightning

*At least 30 people were killed in separate incidents of lightning in Rajasthan, Uttar Pradesh and Madhya Pradesh.*

- Lightning is a **very rapid and massive discharge of electricity** in the atmosphere, some of which is directed towards the Earth's surface.
- These discharges are generated in **giant moisture-bearing clouds**.
  - Height of these clouds is 10-12 km and their base lies within 1-2 km of the Earth's surface. Temperature towards the top of these clouds are in the range of (-) 35 to (-) 45 degrees Celsius.
- As water vapour moves upward in the cloud, the falling temperature causes it to condense.
- Heat is generated in the process, which pushes the molecules of water further up. As they move to temperatures below zero degrees celsius, the water droplets change into small ice crystals.
- They continue to move up, gathering mass until they are so heavy that they start to fall to Earth. This leads to a system in which smaller ice crystals move up and bigger crystals come down simultaneously.
- Collisions follow, and trigger the release of electrons - a process similar to the generation of electricity. As the moving free electrons cause more collisions and more electrons, a chain reaction ensues.
- This process results in a situation in which the top layer of the cloud gets positively charged, while the middle layer is negatively charged.
- The electrical potential difference between the two layers is huge. So, in very little time, a massive current starts to flow between the layers.
- An enormous amount of heat is produced, and this leads to the heating of the air column between the two layers of the cloud. As the reddish heated air column expands, it produces thunder.

- **Precautions** - People are most commonly struck by “ground currents” of the lightning. They should move indoors in a storm. They shouldn’t take shelter under a tree or lay flat on the ground.
- **Frequency** - Lightning is the biggest contributor to accidental deaths due to natural causes. Incidents of lightning are on an increasing trend over the last 20 years, especially near the Himalayan foothills.
- More common than is sometimes realised in the urban areas. On average, India sees 2,000-2,500 lightning deaths every year.

### 11.2 Inland Navigation

- The National Waterways (NWs) that are operational are,
  - a) NW-1 (Ganga-Bhagirathi-Hooghly river system from Allahabad to Haldia),
  - b) NW-2 (River Brahmaputra from Dhubri to Sadiya),
  - c) NW-3 (West Coast Canal from Kottapuram to Kollam along with Udyogmandal and Champakara Canals)
- Also, NW-10 (river Amba), NW-68 (Mandovi), NW-73 (Narmada), NW-83 (Rajpuri Creek), NW-85 (Revadanda Creek-Kundalika River System), NW-91 (Shastri river-Jaigad creek system), NW-97 (Sunderbans Waterways), NW-100 (Tapi) and NW-111 (Zuari) are operational.
- Navigability of the waterway is monitored through regular hydrographic surveys and channel inspection by Regional Directorates supported by Sub-Regional Offices located along the NWs.
- A constant vigil is kept on the river regime behaviour and accordingly appropriate river conservancy measures are taken to ensure fairways for safe movement of vessels.
- Based on the observation during channel inspection and hydrographic surveys, River Notices are issued and placed on Inland Waterways Authority of India (IWAI) website.
- River Information System (RIS) aims to streamline the exchange of information between waterway operators and users to optimize traffic and transport processes in inland navigation.
- RIS has been commissioned on NW-1 (river Ganga) which is operational between Haldia-Farakka (Ph-I) and Farakka - Patna (Ph-II) stretches of the waterway.

### 11.3 Waterways for freight transport

*India has an extensive network of cost-effective and environment-friendly inland waterways which are highly underutilized for freight transport and hinterland connectivity.*

- The Ministry of Ports, Shipping and Waterways has declared 111 waterways (5 existing and 106 new) as National Waterways (NWs) under the National Waterways Act, 2016.
- The Inland Waterways Authority of India (IWAI) says 25 of the 111 National Waterways (NWs) are fit for cargo and passenger traffic and developmental activities are underway for 13.
- The Ganga-Bhagirathi-Hooghly River system designated as National Waterways 01 is 1,620 km long and runs across Uttar Pradesh, Bihar, Jharkhand, and West Bengal.
- Gujarat, Kerala, Goa, Assam, and Andhra Pradesh are also among the states that have inland waterways under development.
- **The Jal Marg Vikas Project** for increasing the capacity of waterways was undertaken by the IWAI, and was approved by the Cabinet Committee on Economic Affairs on 3 January 2018.
- To promote inland waterways as a supplementary mode of transport, the Ministry of Ports, shipping, and waterways last year waived user charges for a period of three years.
- The government also came up with digital solutions such as CAR-D (Cargo Data) Portal and PANI Portal.
- **CAR-D (Cargo Data) Portal** - It is a web-based portal for the collection and compilation, analysis, and dissemination of all cargo and cruise movement data of NWs to the stakeholders. It is expected to promote ease of doing business.
- **PANI Portal** or the Portal for Asset and Navigation Information is an integrated solution that compiles river navigation and infrastructure information on a single platform.

- The portal provides detailed information such as the fairways, infrastructure facilities, cross-river structures, and emergency services.
- The Inland Vessels Bill 2021 is tabled in the Lok Sabha to promote economic and safe transportation and to bring uniformity in the law.

#### 11.4 Shift in September Monsoon Rainfall

A research showed that monsoon precipitation is sensitive to the choice of irrigation practices in South Asia. It investigated the impact of agricultural water use on the Indian Summer Monsoon using a climate model.

- It found that excess irrigation over northern India shifts the September monsoon rainfall towards the north-western part of the subcontinent increases widespread weather extremes over Central India.
- This is also caused by an increase in irrigation and consequent increase in evapotranspiration [Evapotranspiration is the sum of evaporation from the land surface plus transpiration from plants.]
- Meteorological hazards expose the vulnerable farmers and their crops to risks of failure.
- Increasing crop risk is predominantly driven by the decreasing number of farmers, and the wheat risk is also attributed to increasing minimum temperatures during the crop growing season.
- The findings on irrigation-monsoon feedbacks and the agri-cartographic products will directly benefit the National Initiative on Climate Resilient Agriculture by the GoI.

#### National Initiative on Climate Resilient Agriculture

- National Initiative on Climate Resilient Agriculture (NICRA) was launched in 2011 by Indian Council on Agricultural Research (ICAR) to enhance the resilience of agriculture to climate change.
- [ICAR is an autonomous body responsible for coordinating agricultural education and research in India that reports to the Department of Agriculture and Research (DARE) in the Ministry of Agriculture.]
- NICRA recognizes India's vulnerability to climate change with nearly half of its population dependent on agriculture. Objectives of NICRA are,
  - **Research** to improve production and risk management so as to enhance climate resilience of Indian agriculture.
  - **Technology demonstration** to enable vulnerable districts in coping with climate change through demonstration of site specific technologies on farmer s fields.
  - **Capacity building** of scientists and other stakeholders in climate resilient research.
- To know more about the National Initiative on Climate Resilient Agriculture, [click here](#).

#### 11.5 24% Rain Shortfall

According to IMD, India ended August with a 24% shortfall from the predicted amount of rainfall.

- August normally receives the 2<sup>nd</sup> highest rainfall in the four monsoon months.
- So even a substantial rainfall in September would not wipe out the deficit.
- This brings India's overall monsoon rainfall deficit to 9%, meaning "below normal" rainfall.
- In June, the IMD forecast rainfall in northwest, south, east and central India would be "normal" or within an 8% error window of their historical average.
- This forecast too has been significantly off the mark, with Northwest India and Central India registering a 14% shortfall.

#### Reasons for August monsoon failure

- The key reason has been an extended break in rainfall from August 8-18.

Normal	Percentage departure of realized rainfall is within $\pm 10\%$ of the Long Period Average
Below Normal	Percentage departure of realized rainfall is $< 10\%$ of the Long Period Average
Above Normal	Percentage departure of realized rainfall is $> 10\%$ of the Long Period Average
Deficient Year	When the rainfall deficiency is more than 10% and 20-40% area of the country is under drought conditions
Large Deficient Year	When the rainfall deficiency is more than 10% and when the spatial coverage of drought is more than 40%

- Wind-bearing depressions in the Bay of Bengal, coupled with moisture from the Arabian Sea, usually inject surges of rain over central India.
- But this did not happen increasing the break-like conditions.
- Effects of global warming were also impacting monsoon rainfall.
- The number of rain-bearing depressions in the Bay of Bengal was declining and pre-monsoon cyclones, such as Tauktae possibly altered heat distribution patterns over the landmass.

They influenced moisture distribution and thereby causing erratic rainfall.

### 11.6 Long Period Average

The National Weather Forecasting Centre of the India Meteorological Department (IMD) has forecasted the Southwest monsoon seasonal (June to September) rainfall over the country as a whole.

- It has said that the rainfall is most likely to be normal i.e., 96 to 104 % of Long Period Average (LPA).
- **Long Period Average** is the average rainfall recorded during the months from June to September, calculated during the 50-year period.
- It is kept as a benchmark while forecasting the quantitative rainfall for the monsoon season every year.
- IMD maintains an independent LPA for every homogeneous region of the country, which ranges from 71.6 cm to 143.83 cm.
- It maintains five rainfall distribution categories on an all-India scale.
  1. **Normal or Near Normal** - When per cent departure of actual rainfall is +/-10% of LPA, that is, between 96-104% of LPA.
  2. **Below Normal** - When departure of actual rainfall is less than 10% of LPA, that is 90-96% of LPA.
  3. **Above Normal** - When actual rainfall is 104-110% of LPA.
  4. **Deficient** - When departure of actual rainfall is less than 90% of LPA.
  5. **Excess** - When departure of actual rainfall is more than 110% of LPA.

### 11.7 Factors responsible for Sudden Rain

Heavy rain in September ensured that the water levels in India's main reservoirs are back to their optimum levels.

- This has happened despite the fact that the rainfall during this monsoon season had only marginal impact on the reservoir levels.
- **Factors** responsible for unexpectedly high rainfall in September are,
  1. Madden-Julian Oscillation, a moving equatorial wind-system,
  2. Weakening of the negative Indian Ocean Dipole, a phenomenon similar to the El Nino oscillations in the Pacific Ocean, and,
  3. Cyclone Gulab.
- **Regional variations** - Water levels in the reservoirs vary from region to region. This water level pattern is similar to the rainfall pattern that was witnessed during the monsoon months this year.

Reservoir Region	Water Level
Northern and Eastern states	Lower than normal
Southern and Western states	Higher than normal
Central region (UP, Uttarakhand, Madhya Pradesh and Chhattisgarh)	Normal levels

## 11.8 Reasons for Extreme Weather in India

*Even as the southwest monsoon began to retreat from the subcontinent, Kerala and Uttarakhand received record rainfall in October, 2021.*

- The rain-bearing '**low pressure system**' that is active in the Arabian Sea contributed to the heavy rain in Kerala.
- **Western disturbances** are what caused the rain in northern India.
  - Western disturbances are periodic influxes of moisture-laden clouds from the Mediterranean that are common during winter.
- As the Bay of Bengal is still warm, strong winds from there are reaching as far as Uttarakhand and will cause rainfall in north-eastern India.
- **Global Warming** - Both low pressures, and the western disturbances, are tangentially connected to the larger pattern of global warming.
  - The Bay of Bengal is historically the warmer ocean that seeds low pressures and cyclones that bring rain to India.
  - In recent years, however, the Arabian Sea, too, has been warmer than normal, leading to significant cyclonic activity.
- Overall elevated temperatures are contributing to warmer waters in the Arctic Ocean & drawing colder air from the poles with greater intensity.
- This has added to the increased moisture, thereby seeding more intense western disturbance activity over north India.

## 11.9 Cyclones over Arabian Sea More Frequent

*IMD Study based on 50-year dataset (1970-2019) of extreme weather events has shown that there has been an increased occurrence of extreme weather events, including severe cyclonic storms in recent decades.*

- There has been a significant rise in mean temperature across the globe, which is expected to trigger more intense meteorological events.
- Analysing the past data of cyclones over the North Indian Ocean (Bay of Bengal and Arabian Sea) during the period 1891–2020 shows that the frequency of extremely severe cyclonic storms has
  1. Increased in recent few years over the Arabian Sea since 1990, and
  2. Remained the same over the Bay of Bengal.

## Atlantic Meridional Overturning Circulation (AMOC)

- This major ocean current, to which also the Gulf Stream belongs, may have been losing dynamic stability in the course of the last century.
  - AMOC transports warm water masses from the tropics northward at the ocean surface and cold water southward at the ocean bottom.
- As AMOC influences weather systems worldwide, a potential collapse of this ocean current system could have severe consequences.
- It is known from Earth's paleoclimate proxy records that the AMOC can exhibit a substantially weaker mode of operation (in addition to the currently attained strong mode).
- This **bi-stability** implies that abrupt transitions between the two circulation modes are in principle possible.
- The AMOC is currently at its weakest in more than 1000 years.
- Because the loss of dynamical stability would imply that the AMOC has approached its critical threshold, beyond which a substantial and in practice likely irreversible transition to the weak mode could occur.
- The fingerprints that AMOC left in sea-surface temperature and salinity patterns of the Atlantic ocean also suggests that the AMOC weakening during the last century may be associated with a loss of stability.
- This loss of the dynamic stability is caused due to many factors like global warming; freshwater inflow from the melting of the Greenland ice sheet, melting sea-ice, increasing precipitation and river run-off; etc.

- Freshwater is lighter than saltwater and reduces the tendency of the water to sink from the surface to greater depths, which is one of the drivers of the overturning.

### 11.10 Cloudbursts

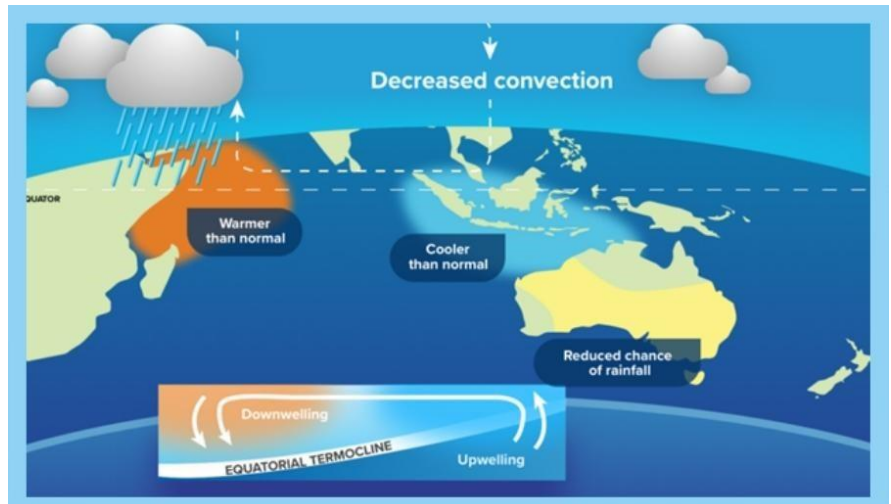
Recently, cloudbursts have been reported from several places in Jammu and Kashmir, UT of Ladakh, Uttarakhand and Himachal Pradesh.

- Cloudbursts are short-duration, intense rainfall events over a small area.
- According to the India Meteorological Department (IMD), it is a weather phenomenon with unexpected precipitation exceeding 100mm/h over a geographical region of approximately 20-30 square km.
- A 2017 study of cloudbursts in the Indian Himalayas noted that most of the events occurred in the months of July and August.
- A 2020 study showed that the meteorological factors behind the cloudburst over the Kedarnath region.
- It showed that during the cloudburst, the relative humidity and cloud cover was at the maximum level with low temperature and slow winds.
- Because of this situation, a high amount of clouds may get condensed at a very rapid rate and result in a cloudburst.
- **Frequency** - Studies have shown that climate change will increase the frequency and intensity of cloudbursts in many cities across the globe.
- World Meteorological Organization said that there is about a 40% chance of the annual average global temperature temporarily reaching 1.5°C above the pre-industrial level in at least one of the next five years.
- There is a 90% chance of at least one year between 2021 and 2025 becoming the warmest on record and dislodge 2016 from the top rank.
- IIT Gandhinagar states that as temperatures increase the atmosphere can hold more and more moisture.
- This moisture comes down as a short very intense rainfall for a short duration probably half an hour or one hour resulting in flash floods in the mountainous areas and urban floods in the cities.
- Also, there is evidence suggesting that globally short duration rainfall extremes are going to become more intense and frequent.
- With warming climate or climate change, we will surely witness these cloudburst events in increased frequency in the future.

### 11.11 Decadal prediction for Indian Ocean Dipole

A new study claims to have found out decadal prediction skills for the Indian Ocean Dipole (IOD) to enable monsoon forecast for the next 5-10 years in advance.

- Retrospective decadal forecasts, with initial conditions from 1960 to 2011 from existing four models were analysed.
- It was found that the two models - **MIROC5 from Japan and CanCM4 from Canada** - show significant prediction skills for up to 10 years, with strongest leads up to 2 years.
- **Influencing factors** - The predictability of IOD comes from the subsurface ocean signals in the Southern Ocean.
- The El Nino-Southern Oscillation events, which occur in the tropical Pacific, are also well known as a major climate driver.



### Indian Ocean Dipole

- The IOD, also known as the Indian Niño, is an irregular oscillation of sea-surface temperatures.

- It involves an aperiodic oscillation of sea-surface temperatures (SST), between "positive", "neutral" and "negative" phases.
- As part of it, the western Indian Ocean becomes alternately warmer (positive phase) and then colder (negative phase) than the eastern part of the ocean.
- A **positive phase** sees above normal sea-surface temperatures and greater precipitation in the western Indian Ocean region with a corresponding cooling of waters in the eastern Indian Ocean.
- This tends to cause droughts in adjacent land areas of Indonesia and Australia.
- The **negative phase** involves warmer water and greater precipitation in the eastern Indian Ocean, and cooler and drier conditions in the west.
- A **neutral phase** would mean sea temperatures were close to average across the Indian Ocean.
- The IOD thus affects the strength of monsoons over the Indian subcontinent.
- The IOD is one aspect of the general cycle of global climate, interacting with similar phenomena like the El Niño-Southern Oscillation (ENSO) in the Pacific Ocean.
- An IOD can either aggravate or weaken El Nino's impact on the Indian monsoon.
- If there is a positive IOD, despite an El Nino year, it can bring good rains to India.

### 11.12 Cold Wave in North India

Recently, the India Meteorological Department (IMD) has predicted a cold wave in parts of Punjab, Haryana, Chandigarh, Gujarat, Rajasthan and Uttar Pradesh over the next few days.

- **Cause** - According to IMD, the above region could witness a cold wave due to the western disturbance move as a cyclonic circulation over north Pakistan and adjoining Jammu and Kashmir.
- [Western disturbances are storms that originate in the Mediterranean region and bring winter rainfall to northwest India.]
- After this western disturbance moves, the IMD expects strong north-westerly and westerly cold winds over north India.
- **New pattern** - This wind pattern is new. Earlier, winds were calm and light all through November. This much fall in temperature needs consistent winds.

### Cold Wave

- The IMD defines a cold wave qualitatively as a condition of air temperature which becomes fatal to the human body when exposed.
- Cold waves usually occur from mid-December to the end of February. Sometimes, a cold wave may set in before mid-December.
- The cold waves depend on weather systems and wind patterns from the middle latitudes, that is from Europe or West Asia, since the winds from these regions bring cold weather.
- **Factors** that bring cold waves to India include the movement of cold air masses brought about by upper-level winds.
- They can be triggered by strong westerly winds approaching northwest India and transporting cold air towards the southeast direction.
- Build up of an extended area of relatively high pressure over northwest Asia can also bring cold waves.
- **IMD's Conditions** - In 'cold wave' conditions, the minimum temperature is less than or equal to 4 degree Celsius at a weather station in the plains, and departs from the normal temperature 4.5 to 6.4 degrees below for that period.
- For hilly regions, a cold wave is declared when the minimum temperature is less than or equal to 0 degree Celsius and the minimum temperature is 4.5 degrees to 6.4 degrees below the normal.
- In 'severe' cold wave conditions, the minimum temperature is less than or equal to 10 degree Celsius, and departs from the normal by 6.5 degrees or more, or if cold wave conditions persist for four days or more.
- The 'normal' temperature is calculated for every 5 days by taking the average temperature for these days over the past 30 years.

### 11.13 Chillai Kalan

With the winter solstice, the 'chillai kalan' has started in the Kashmir Valley.

- 'Chillai Kalan' is a Persian term which means 'major cold'.
- Chillai Kalan is the 40-day harshest spell of winter of the Kaashmir Valley.
- It is the coldest part of winter, starting from December 21 to January 29 every year. The cold wave is triggered by the sub-zero temperature.
- The ongoing cold wave is said to reach its peak with Kashmir's mountains covered in snow for weeks.
- It is said the snow during the period lasts longer and replenishes the streams, rivers and lakes of Kashmir.
- The bone-chilling cold condition is followed by a 20-day-long 'Chillai Khurd' and 10-day-long 'Chillai Bacha'.
- **Impacts** - The number of heart attack and stroke patients at Kashmir hospitals doubles in winter due to the chilly weather.
- Not only the elderly, but young and healthy people come to hospitals with heart problems, and some of them are even brought dead.

### 11.14 Change of Course of Glacier

A new study has found that nearly 20,000 years ago, a 5-km-long Himalayan glacier abruptly changed course and over time fused into an adjacent glacier in present-day Pitoragarh, Uttarakhand.

- This sudden turn in the glacier's course in the Himalayas may be caused due to,
  1. Climate Change and
  2. Change in Tectonic Movement (active fault).
- The glacier, which lies in an extremely inaccessible region, was large enough that it formed its own "valley".
- The accumulated debris that accompanies the glacier formation probably turned it from a north-eastern to a south-eastern course.
- As the Himalayan region is among the world's youngest mountain ranges, the inherent instability of the underlying tectonic plates frequently trigger earthquakes and landslides.
- **Significance** - The event had "similarities" to the February disaster (2021) in Rishiganga valley, in which a large mass of rock and debris detached from a glacier and hurtled down the Rishiganga River.
- So, it is clear that the Himalayan region is ecologically fragile and prone to events such as these are certain.
- [The fragility of the Himalayan region may be due to weathering, percolation of melt-water in joints, crevasses, freezing & thawing, snowfall, overloading, & gradually operating tectonic forces forcing rocks to disintegrate mechanically.]

### 11.15 Bauxite

Koraput district administration in Odisha organised a public hearing on environmental issues regarding the bauxite mining lease granted to Hindalco Ltd.

- Bauxite is a **non-ferrous metallic mineral**.
- Bauxite is found mainly in **tertiary deposits** and is associated with **laterite rocks** occurring extensively either on the plateau or hill ranges of peninsular India and also in the coastal tracts of the country.
- Major Bauxite reserves are in Jharkhand, Maharashtra, MP, Chhatisgarh, Gujarat, Karnataka, Tamil Nadu, Goa and UP.
- Huge deposits of bauxite have been discovered in the Eastern Ghats in Orissa and Andhra Pradesh, Tamil Nadu (Salem, Nilgiri and Madurai district), and UP (Banda district) also have workable deposits of bauxite.
- India's reserves of bauxite are sufficient to keep the country self-reliant.
- India also exports bauxite to a number of countries. The leading importer of Indian bauxite is Italy.
- **Uses** - Bauxite is used in manufacturing of aluminium. It is also used for manufacturing of white colour cement and certain chemicals.

#### DID YOU KNOW?

Odisha (Kalahandi, Sambalpur, Bolangir and Koraput) is the largest producer of Bauxite in India.

### 11.16 Adi Tribes

- Adi tribe of Adi-Pasi, Arunachal Pradesh is a Scheduled Tribe under Article 366 of the Constitution.
- They came from southern China in the 16th century and speak the Tibeto-Burman language.  
*“Adi-Pasi or Adi hills (adi means ‘hill’ or ‘mountain top’). Historically, this region was known as Abor hills.”*
- The tribe divides into two main divisions - the Bogum and Onai.
- Adi Tribe is a Scheduled Tribe under Article 366 of the Constitution.
- Adi Tribe's reputation as **fierce warriors**, and the inhospitable terrain in which they live, have ensured the survival of Adi culture for centuries.
- **Religion** - Adi practice animism (or spirit-based religion).
- Their main god is Dionyi-Polo (which roughly translates as 'Sun-Moon'), the eye of the world; there is also a host of other spirits and deities.
- **Festivals** of the Adi tribes,
  1. Harvesting festival ‘Solung’ and
  2. Hunting festival ‘Aran’.
- **Dance** - Popir is the indigenous dance of the Adi tribe. Teams of young girls in perfect rhythmic unison perform the ‘Phoning’ dance of Adis.

### 11.17 Kadar Tribe

*Some families of Kadar tribe has got pattas for homestead inside the Anaimalai Tiger Reserve (ATR).*

- Kadar is a small tribe of southern India residing along the hilly border between Cochin in Kerala and Coimbatore in Tamil Nādu.
- Kadars are one of the five primitive tribal groups in Kerala, where they constitute nearly 5% of the State's total tribal population.
- **Economy** - The Kadar live in the forests and do not practice agriculture.
- They build shelters thatched with leaves and shifting location as their employment requires.
- They have long served as specialized collectors of honey, wax, sago, cardamom, ginger, and umbrella sticks for trade with merchants from the plains. Many Kadar men work as labourers.
- **Language** - They speak the Dravidian languages of Tamil and Kannada.
- **Religion** - Modern kadars like to known as Hindus. Their favourite deities are Ayappan, Kali and Malavazhi.
- Primitive polytheism and the worship of invisible gods have considerably disappeared. But a few elders still worship the rising sun.
- Their customs and conventions indicate that they had been strong animists not long ago.
- **Status** - The Kadar tribe has been listed as a Particularly Vulnerable Tribal Groups (PVTG) in Kerala, but not in Tamil Nadu.
- A tribe listed in the PVTG allows the tribe to have habitat rights under the Forest Rights Act 2006.

### 11.18 Sümi Nagas

*The wisdom of Sumi Nagas to use the ecological indicators to facilitate agricultural practices and predict seasonal variation is vanishing with time.*

- Sümi Naga tribes are the major ethnic group among Nagas, who are **Indo-Mongoloid** tribal groups, in Nagaland, India.
- Sümi Nagas practiced Aki Kiti (a semi-contact combat sport), and headhunting like other Nagas before their conversion to Christianity.
- Sumis have two different clan heads, Swu (Sumi) and Tuku (Tukumi).
- **Festivals** - Their grandest festival, Tuluni, is marked with feasts as the occasion occurs in the bountiful season of the year.

- Ahuna is a traditional post-harvest festival of the Sumis.
- Sumi Nagas is **primarily agrarian** and depends on forests for both food and livelihood. So several of the indicators facilitate agricultural practices and predict seasonal variation.
  - For instance, fruiting of mulberry (Morus) trees indicates spring and their harvest means summer is here.
  - Then, to predict winter, the Sumi tribe uses a universal indicator - migrating birds.
- Sümi is one of the **recognised scheduled tribes** of India.

### 11.19 Konyak Tribes

- The Konyaks are the largest of Naga tribes. They are traditional hunters and warriors of Nagaland. The Konyaks were the last to give up the practice of head-hunting as late as the 1980s.
- They are easily recognized by their tattooed faces. Their main occupation is agriculture.
- They inhabit the area extending from Nagaland into Arunachal Pradesh, Myanmar as well.
- They have institutions of learning like the morung of other Naga tribes.
- **Religion** - Konyaks were animists, worshipping elements of nature, until Christian missionaries arrived in the late 19th Century.
- The society is mostly Christian now.
- **Festivals** - Aoleng Manyu Festival is the biggest festival of the Konyaks. It is celebrated in the first week of April to welcome the spring.
- 'Lao Ong Mo' Festival is the traditional harvest festival celebrated in the months of August/ September.
- **Language** - The Konyak language belongs to the Northern Naga sub branch of the Sal subfamily of Sino-Tibetan.

### 11.20 Kittur Karnataka

*The Karnataka Cabinet renamed the Mumbai-Karnataka region, consisting of 7 districts, as Kittur Karnataka.*

- The name change was demanded by pro-Kannada bodies saying that there is no point in retaining the old name when border disputes often emerge.
  - Border disputes started after the unification of Karnataka.
  - The States Reorganisation Act of 1956 made Belagavi and 10 talukas of Bombay State a part of the then Mysore State (renamed Karnataka in 1973).
- The renaming is to detach itself from any ties with Maharashtra.
- Every year during the Kannada Rajyotsava celebration (November 1), the Maharashtra Ekikaran Samiti (MES) observes a black day in the state as well as Belagavi.
  - MES says that parts of Belagavi were forcibly separated from Maharashtra during the reorganisation of states in 1956.
- By rechristening Mumbai-Karnataka as Kittur Karnataka, the government is trying to dissociate itself from any ties with the erstwhile Presidency or colonial-era nomenclature.

### Kittur

- The name Kittur comes after a historical taluk in Belagavi district of north Karnataka.
- It was ruled by Rani Chennamma (1778-1829), a legend of the Lingayat community.
- Kittur Rani Chennamma had fought against the British about 40 years before Jhansi Rani Laxmibai.

### 11.21 Kalyana Karnataka

*Earlier in 2019, the Karnataka Cabinet had renamed the Hyderabad-Karnataka region as Kalyana Karnataka.*

- Kalyana Karnataka comprises of 6 north-eastern districts of the State. It is one of the most backward regions of Karnataka.

- The reasons why the government effected the change are,
  1. To do away with remnants of colonial nomenclature,
  2. To do away with the connection with the Nizams,
  3. To erase the memories of the atrocities of the Razakars
  4. To promote the Sharana culture and
  5. To give special attention to the region's development.
- In 2012, the Hyderabad-Karnataka region was accorded special status by the Centre by the insertion of Article 371(J) into the Constitution (special status).

### Kalyana

- The name Kalyana comes from the Kingdom of Kalyana.
- Kingdom of Kalyana was the epicentre of the 12th-century Sharana movement and the Vachana Sahitya preached and followed by Basavanna, a Lingayat saint in the Bhakti movement.

### 11.22 Mount Manipur

*The Union government rechristened Mount Harriet, a historical tourist spot in the Andaman and Nicobar islands, as 'Mount Manipur'.*

- Mount Harriet is the third highest peak in the Andaman and Nicobar Islands.
- It served as the summer headquarters of the Chief Commissioner during British Raj.
- Close by the Mount Harriet is the Mount Harriet National Park known for its wide variety of birds.
- **Manipur's connection to Mt. Harriet** - Anglo-Manipur War of 1891 was fought between the kingdom of Manipur and the British.
- Manipuris who had fought the British in the War, including Maharaja Kulachandra Dhawaja Singh, were exiled to a hillock in the Andaman Islands.
- The battle was triggered by a coup in the palace of Manipur, which had been marked by internal factionalism in the years leading up to 1891.
- The British government took advantage of the "internal dissension" among the princes of the royal family.
- The war led to Manipur becoming a princely state under the indirect rule of the British crown.
- **Original name** - Mount Harriet is believed to be named after British artist, Harriet Christina Tytler, who was the wife of Robert Christopher Tytler, a soldier who served in the British Indian Army.

### 11.23 Dagmara Hydro Electric Project

- A Memorandum of Understanding (MoU) has been signed between NHPC Limited and Bihar State Hydroelectric Power Corporation Limited (BSHPC) for Implementation of 130.1 MW Dagmara HE Project.
- [National Hydroelectric Power Corporation (NHPC) Ltd is a Category-A Miniratna Company under Ministry of Power.
- Now, NHPC is the largest organisation in the Hydropower field has 24 operational power stations with a total installed capacity of 7071 MW.]
- The Dagmara HE Project, the largest hydropower project of Bihar is to be implemented by NHPC on ownership basis.
- This Run-of-the-River hydro project is located near village Dagmara on the right bank and Simri on the left bank, about 22.5 km downstream of Bhimnagar barrage on Kosi river.
- [Run-of-river hydro projects use the natural downward flow of rivers and micro turbine generators to capture the kinetic energy carried by water.
- Typically water is taken from the river at a high point and diverted to a channel, pipeline, or pressurised pipeline (or penstock). ]

### 11.24 Kinnaur Hydroelectric Project

- The people of Kinnaur, Himachal Pradesh, are fighting to save their rivers and forests threatened by the proposed 804 mega watt Jangi Thopan Powari hydroelectricity project (JTP HEP) over the Satluj.
- The run-of-the-river (ROR) project envisages construction of,
  1. A concrete gravity dam of ±88 metre high above the deepest foundation level across river Satluj near Jangi village, and
  2. An underground powerhouse on the right bank upstream of Tehsil boundary (Kashang Nallah).
- The diversion of water will involve construction of a 12-km-long tunnel.
- Construction of the dam will result in the submergence of about 156 ha of forest and private land. The length of the reservoir will be 10.6 km.
- Multiple aspects of the tunnel will impact the Jangi, Akpa, Khadura, Thopan and Rarang villages in the Jangram Valley.
- The only reliable source for drinking, domestic and agricultural water is mountain springs fed by glaciers.
- Tunnel for water diversion is a major component of HEP.
- The process of tunnelling disturbs the hydrogeology of the region significantly and thus impacts the springs drastically.
- Agriculture in the cold desert is not feasible without irrigation.
- The major source of irrigation for highly valued horticulture and off-season vegetables are derived from these springs and the absence of the same will drastically impact the life and livelihood of this region.
- The project lies in the Scheduled Areas and tenders the Provisions of the Panchayats (Extension to Scheduled Areas) Act, 1996, and hence makes the applicability of any provision more enforceable.
- So, it is mandatory for the company to take a no-objection certificate from all GPs concerned to commence any such project in the tribal areas.

### **Kinnaur**

- Kinnaur district is mainly marked by its cold desert, tribal population, and fragile topography, rich and diverse culture, apple orchards, off-season vegetables and the Satluj River.
- Satlej River has been dammed at multiple places along the valley to create an extra feature to Kinnaur's identity as Himachal's hydropower hub.
- An integral part of the old Hindustan-Tibetan Route, Jangram Valley, lies on the right bank of the Satluj river in the district.
- The Satluj has taken the biggest load of state hydropower ambition since the early 90s.
- A total of 142 Hydroelectricity projects of 10031 MW are either commissioned, under-construction planned on Satluj River. 92% of the river will either be flowing through tunnels or will be part of reservoirs.
- Such a cumulative scale of disturbance with the river's natural state drastically impacted the life, livelihood and ecology in the Satluj basin.
- Kinnaur has the largest Chilgoza pine (edible seeds) forests. The HEP will impact these forests.

### **11.25 The Ken-Betwa River Linking Project**

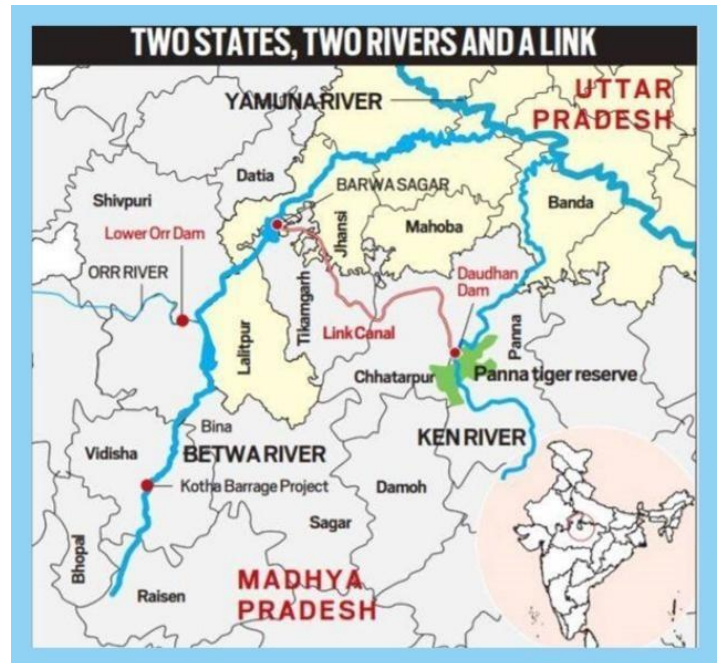
*The Union Cabinet approved the funding and implementation of Ken-Betwa inter-linking of rivers project that will be completed in 8 years.*

- On March 22, 2021, a memorandum of agreement was signed among the Ministry of Jal Shakti and the governments of Madhya Pradesh and Uttar Pradesh to implement the Ken-Betwa Link Project.
- The project envisages transferring water from the Ken river to the Betwa river, both tributaries of the Yamuna.
- It is the first project under the National Perspective Plan for interlinking of rivers.
- The Ken-Betwa Link Canal will be 221 km long, including a 2-km long tunnel.
- **Phases-** The project has two phases, with four components.
- Phase-I - Involves one of the components — **Daudhan Dam complex** and its subsidiary units such as Low Level Tunnel, High Level Tunnel, Ken-Betwa Link Canal and power houses.

- Phase-II - Involves three components — **Lower Orr Dam, Bina Complex Project and Kotha Barrage.**
- **Special Purpose Vehicle** - An SPV called Ken-Betwa Link Project Authority (KBLPA) will be set up to implement the project.
- **NIRA**- The Centre has set in motion the process of creation of National Interlinking of Rivers Authority (NIRA)
- It will be an independent autonomous body for planning, investigation, financing and implementation of the interlinking of river (ILR) projects in the country.
- The NIRA will have powers to set up SPV for individual link projects.

### Need

- The project lies in **Bundelkhand**, a drought-prone region, which spreads across 13 districts of Uttar Pradesh and Madhya Pradesh.
- The project is expected to provide
  - Annual irrigation of 10.62 lakh hectares,
  - Supply drinking water to about 62 lakh people
  - Generate 103 MW of hydropower
  - Generate 27 MW of solar power
- The project is expected to boost socio-economic prosperity in the backward Bundelkhand region on account of increased agricultural activities and employment generation.
- It would also help in arresting distress migration from this region.
- It will pave the way for more interlinking of river projects to ensure that scarcity of water does not become an inhibitor for development in the country.



### Concerns

- **Submergence of Panna Tiger Reserve**- According to the National Water Development Agency under the Jal Shakti Ministry, the Daudhan dam, to be built on the Ken river will involve a submergence of 9000 ha area.
- This will partly submerge the Panna Tiger Reserve in Madhya Pradesh and affect the habitat of vultures and jackal.
- But the project was cleared by the apex wildlife regulator, the National Board for Wildlife, in 2016.
- **Delay in CLMP**- For environment management and safeguards, a Comprehensive Landscape Management Plan (CLMP) has been proposed but it is still under finalisation by the Wildlife Institute of India (WII).
- **Pending cases**- The environmental clearance was challenged and is pending at the National Green Tribunal (NGT)
- The stage II (final) Forest Clearance and subsequent state approval in this case from the Madhya Pradesh government is also pending.

### Required Clearances

- Techno-economic clearance - Given by the Central Water Commission
- Forest clearance and environmental clearance – Given by the Ministry of Environment & Forests
- Resettlement and rehabilitation plan of tribal population - Given by the Ministry of Tribal Affairs
- Wildlife clearance - Given by the Central Empowered Committee

### Other River-Linking Projects

- The Periyar Project was commissioned in 1895 under which transfer of water from Periyar basin to Vaigai basin was envisaged.

- In the 1970s, the then Union Irrigation Minister Dr K L Rao suggested the construction of a National Water Grid for transferring water from water-rich areas to water-deficit areas.
- Later, Captain Dinshaw J Dastoor proposed a Garland Canal to redistribute the water from one area to another.
- But the government did not pursue these two ideas further.
- In August 1980, the Ministry of Irrigation prepared a **National Perspective Plan for water resources development** envisaging inter-basin water transfer.
- The NPP comprised two components.
  - Himalayan Rivers Development
  - Peninsular Rivers Development
- Based on the NPP, the National Water Development Agency (NWDA) identified 30 river links– 16 under Peninsular component and 14 under Himalayan Component.
- Projects such as Parambikulam Aliyar, Kurnool Cudappah Canal, Telugu Ganga Project, and Ravi-Beas-Sutlej were undertaken by the government.

### 11.26 River Devika National Project

*The River Devika Project in Jammu & Kashmir is being compared with the pioneer “NamamiGange” project of the Central Government.*

- The Devika river originates from the hilly Suddha Mahadev temple in Udhampur district of Jammu and Kashmir.
- It flows down towards western Punjab (now in Pakistan) where it merges with the Ravi river.
- The Devika river holds great religious significance as it is revered by Hindus as the sister of river Ganga.
- In 2019, the Devika Bridge in Udhampur was inaugurated. This Bridge takes care of traffic congestion and also ensures smooth passage of Army convoys and vehicles.

### 11.27 Dam Safety Bill 2019

*Tamil Nadu government has strongly condemned the Union government for not considering the interest of states while passing the Dam Safety Bill.*

#### Need

- **Large dams** - India ranks third globally with 5,745 large dams in operation.
- As a large amount of water may be stored in a dam's reservoir, its failure can cause large scale damage to life and property.
- **Ageing of dams**- According to the National Register of Large Dams by the Central Dam Safety Organisation (CDSO) in the Central Water Commission, 67 dams were built prior to the 20th century and 1,039 dams during the first 70 years of the 20th century.
- **Dam failure**- Since 1979, there were 42 instances of dam failure, the latest being Annamayya reservoir in Kadapa district of Andhra Pradesh that led to the death of at least 20 people in November 2021.
- **Lack of legal and institutional architecture** - Even though the CWC and CDSO has been functioning as the apex body to advise States on issues of dam safety, there is no specific Central law since the ownership of dams and their maintenance falls in the purview of the States.
- In July 1986, a panel of experts recommended to the Centre that legislation be framed.

#### Features of the Bill

- **Aim**- The Bill proposes to help all states and Union Territories adopt uniform dam safety procedures.

- As per Entry 17 of the State List, states can make laws on water supply, irrigation and canals, drainage and embankments, water storage and water power, subject to Entry 56 of the Union List.
- Entry 56 of the Union List allows Parliament to make laws on the regulation of inter-state rivers & river valleys if it declares such regulation to be expedient in public interest.

- It aims to provide for surveillance, inspection, operation and maintenance of the dams for prevention of dam failure-related disasters and to provide for institutional mechanism to ensure their safe functioning.
- **Applicability-** The Bill covers those dams having the height of over 15 metres and between 10 and 15 metres with certain stipulations.
- **Obligation of dam owners-** Dam owners will be responsible for the safe construction, operation, maintenance and supervision of a dam.
- **National Committee on Dam Safety-** It provides for setting up of a National Committee on Dam Safety with 3 year tenure, comprising the chairman of the Central Water Commission, along with representatives of the central and state government and experts.
- It will be headquartered in Delhi and will be headed by an officer not below the rank of Additional Secretary to the Government of India.
- **State dam safety organization-** A state dam safety organisation will be formed to investigate and gather data for proper review and study of the various features of the design, construction, repair and enlargement of dams, reservoirs and appurtenant structures.
- It must report events such as dam failures to the National Dam Safety Authority and also maintain records of major dam incidents of each specified dam.
- **Offences and penalties-** Anyone obstructing a person in the discharge of his functions under the Bill or refusing to comply with directions may be imprisoned for a year and in case of loss of life, the person may be imprisoned for 2 years.

### Concerns

- **Encroachment of the sovereignty of States-** Several States, including Karnataka, Kerala, Tamil Nadu and Odisha, opposed the legislation on the ground that it encroached upon the sovereignty of States to manage their dams.
- **Constitutional validity-** The constitutional validity of the legislation has been raised since water is a State subject.
- It is unclear how Parliament would have the jurisdiction to frame a law for dams on rivers where the river and its valley are entirely within a State.
- **Compensation-** The silence on the payment of compensation to people affected by dam projects was cited as another shortcoming.
- **Tamil Nadu's concerns-** Tamil Nadu has been a critic of the legislation as it fears that it will lose its hold over four of the dams located in Kerala including Mullaperiyar and Parambikulam.
- The Centre must hold talks with the States to allay their fears and frame rules suitably for legislation.

### 11.28 Sardar Sarovar Narmada Dam

- In the ongoing summer, the Sardar Sarovar Narmada dam released about 1.3 Million Acre Feet (MAF) water for irrigation between April 1 and May 31 in its command area of 21.29 lakh hectares.
- The Sardar Sarovar Narmada Dam or Sardar Sarovar Project (SSP) is a terminal dam and gravity dam built on the Narmada River at Kevadia in Narmada district of Gujarat.
- It is the second biggest dam in terms of volume of concrete used in it. It is the third highest concrete dam in India.
- The Sardar Sarovar Project (SSP) involves a series of large irrigation and hydroelectric multi-purpose dams.
- It took form in 1979 as part of a development scheme to increase irrigation and produce hydroelectricity.
- The SSP includes two powerhouses - River Bed Power House (RBPH; 1,200 MW) and Canal Head Power House (250 MW).
- The power benefits from the project are to be shared thus: Madhya Pradesh at 57%, Maharashtra at 27% and Gujarat at 16%

### River Narmada

- River Narmada's water is shared amongst four party states - Gujarat, Rajasthan, Madhya Pradesh and Maharashtra - in the ratio stipulated by the 1979 award of the Narmada Water Dispute Tribunal.

- Out of the 28 MAF capacity of Narmada basin, Gujarat has been awarded a share of 9 MAF, while Madhya Pradesh has 18.25 MAF, Rajasthan 0.50 MAF, and Maharashtra 0.25 MAF.
- Called the 'lifeline of Gujarat', River Narmada usually has no water for irrigation during summers.
- However, in the ongoing summer, the Sardar Sarovar Narmada dam released 1.3 MAF water for irrigation between April 1 and May 31.
- **FRL** - The Sardar Sarovar Dam attained its full height in 2017, but it could not be filled up to the Full Reservoir Level (FRL) of 138.68 meters in 2017 and 2018 due to monsoon deficit.
- However, good rainfall in the catchment in 2019 and 2020 ensured that it achieved FRL for two consecutive years said the Sardar Sarovar Narmada Nigam Ltd (SSNNL).

### 11.29 Jog Falls

- Jog Falls, being the second- highest plunge waterfalls in India is situated in the dense evergreen forests in Shimoga district, Karnataka.
- It is the third-highest waterfall in India after the Nohkalikai Falls in Meghalaya and Dudhsagar Waterfalls in Goa. Jog Falls is also known as Gerusoppe Falls, Gersoppa Falls, and Jogada Gundi.
- The Sharavathi river falls at a place called Gerusoppa-Jog, and gets segmented into four cascades, known as Raja, Rani, Rover and Rocket.

### 11.30 Idukki Reservoir Opened

*With predictions by the India Meteorological Department (IMD) of a fresh bout of heavy rainfall in Kerala, as a precautionary measure, water was released from the Idukki reservoir.*

- Idukki reservoir itself does not have shutters. So, the Cheruthoni dam, part of the reservoir, was opened to release water.
- In anticipation of the opening of Idukki reservoir, the Bhoothathankettu and Idamalayar dams had also been opened for smooth flow of water.
- **Path** - When the shutters are opened, water will first reach the Cheruthoni River through the spillway and join the Periyar River at Vellakayam. Then, the water will reach the Lower Periyar dam.
- It will travel through Neriyaamangalam, Bhoothathankettu and Idamalayar dams to reach Ernakulam district. The water is expected to flow through Periyar and its tributaries and finally join the Arabian Sea.
- **Decision** to open the shutters of the above dams was taken by a high-level committee appointed by the state government.
- The committee looked into the technical aspects of the water level in the dams and the impact it would have on settlements alongside the rivers.
- **Previously** - In 2018, the Cheruthoni dam shutters were opened during the heavy floods that year.
- Sudden rise in water levels in the Periyar following the opening of the dam shutters had inundated villages and settlements, leading to many deaths and damage to property.

#### DID YOU KNOW?

Idukki Reservoir is the largest dam in Kerala and one of the highest arch dams of Asia.

### 11.31 Mullaperiyar Dam

*Kerala Chief Minister has written to his Tamil Nadu CM, stressing the urgent need for the gradual release of water from the Mullaperiyar dam through the tunnel to Tamil Nadu.*

- The 130-year old Mullaperiyar dam is located on the **confluence of the Mullayar and Periyar River** in Kerala's Idukki district.
- It was built by **Pennycuik** to create a harmonious atmosphere in the east coast by taking the water there and have people cultivate crops.
- It is operated and maintained by the **Tamil Nadu** for meeting the drinking water and irrigation requirements of 5 of its southern districts.
- The dam resulted in the formation of a big lake - the Periyar Lake. People call it the Thekkady Wildlife Sanctuary.

- **Issues** - Institute for Water, Environment and Health of the United Nations University has said that the Mullaperiyar dam suffers from structural issues and the possibility of a dam-break.
- Moreover, the dam is located in an earthquake-prone area.
- There is a leakage in the dam as the technology which was put into use for constructing the dam 125 years ago was obsolete compared to the sophisticated construction methods used now.
- Sand mining became another major contributor to further deepening of rivers.



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Out of 100 questions asked in UPSC Civil Services (Preliminary) Examinations, 2021 Paper I, **38 questions** are directly reflected from the IAS Parliament. 8 are partially reflected.



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