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Contents

ANTARCTIC ENVIRONMENT

Context:

The warming of the Antarctic Peninsula is causing changes to the physical and living environment of Antarctica.

About:

- Antarctica has the **driest, windiest, coldest**, and the most hostile environment — a place untouched by war and highly regarded for scientific research and cooperation.
- Humans only began exploring Antarctica extensively on land during the 20th century.
- In the decades since the development of technology, research has led to increased access to the region, along with the gradual establishment of scientific stations, with a few territorial claims to the continent.
- Antarctica contains approximately 90 percent of Earth's ice and roughly 70 percent of the planet's freshwater.

■ The Antarctic environment comprises diverse habitats and ecosystems that include:

- ice-covered areas
- ice-free vegetated areas and rocks
- saltwater and freshwater lakes and streams
- Intertidal areas; sea ice; and mid-water, Deepwater and benthic regions of the Southern Ocean

■ Climate

- Antarctica has an extremely cold, dry climate. Winter temperatures along Antarctica's coast generally range from -10° Celsius to -30° Celsius (14° Fahrenheit to -22° Fahrenheit).
- During the summer, coastal areas hover around 0°C (32°F) but can reach temperatures as high as 9°C (48°F).

Precipitation in the Antarctic is hard to measure.

- It always falls as snow. Antarctica's interior is believed to receive only 50 to 100 millimetres (2-4 inches) of water (in the form of snow) every year.
- The Antarctic desert is one of the driest deserts in the world.
- **Flora and Fauna**
  - Lichens, mosses, and terrestrial algae are among the few species of vegetation that grow in Antarctica.
  - More of this vegetation grows in the northern and coastal regions of Antarctica, while the interior has little if any vegetation.
  - The most familiar animal of Antarctica is probably the **penguin**.
  - They have adapted to the cold, coastal waters.
  - Their wings serve as flippers as they "**fly**" through the water in search of prey such as squid and fish. Their feathers retain a layer of air, helping them keep warm in the freezing water.
  - One of the apex, or top, predators in Antarctica is the leopard seal. The leopard seal is one of the most aggressive of all marine predators.

■ The political turn

However, Antarctica's enormous, fragile and pristine environment is protected by **the Antarctic Treaty**.

- The treaty was initially signed in Washington on December 1, 1959, by 12 countries and later came into force in 1961. As of now, the total number of Parties to the Treaty is 54, committing themselves to the protection of the continent — "a natural reserve, devoted to peace and science."
- **Madrid Protocol 1991**, it further bans the mining and drilling for petroleum in the area south of 60°S latitude.
- Together with the treaty, it forms part of the **Antarctic Treaty System**, promoting scientific cooperation as well as protection of the Antarctic environment and wildlife, preservation and management of historic sites, sustainable tourism, large-scale information exchange, and related interests.
- The treaty's protocols are set for **renewal in the year 2048**.
- Antarctica as of now, is fully protected.
- But in the next 25 years, this could change.
- All the commitments can be ignored, and Antarctica's natural resources treasure and scientific opportunities may all be exploited.
- The polar war in the Arctic has already begun and Antarctica could become the next geopolitical hotspot.
- The Ross Sea is one of the most likely sites for hydrocarbons in the Southern Ocean with an estimated 300-500 billion tonnes of natural gas and at least 135 billion tonnes of oil.

Arctic Ocean and its Relevance

Context:

Recently, India unveiled a new **draft** '**Arctic**' **policy** that, among other things, commits to expanding scientific research, "sustainable tourism" and mineral oil and gas exploration in the **Arctic** region.

Analysis

■ Mapping the region

- The Arctic region comprises the Arctic Ocean and parts of countries such as Canada, Denmark (Greenland), Norway, Russia, USA (Alaska), Finland, Sweden and Iceland.
- These countries together form the core of the **Arctic Council,** an intergovernmental forum.

- **Arctic Ocean**, smallest of the world's oceans, centering approximately on the North Pole, is almost completely encircled by the landmasses of North America, Eurasia, and Greenland.
- It lies entirely within the Arctic Circle and contains,
  - deep (~ 4500m) basins,
  - the slowest spreading oceanic ridges in the world
  - about 15% of the world's continental shelf area

■ Resource rich Ocean

- The natural resources of the Arctic are the **mineral and animal resources** within the Arctic Circle that can provide utility or economic benefit to humans.
- **Living resources:** These are primarily the abundant **fisheries**.
- **Mineral resources:** They include major reserves of **oil and natural gas**, large quantities of minerals including iron ore, copper, nickel, zinc phosphates and diamonds.
- **Fresh water:** It is a critical renewable resource that can be obtained. Several of the world's largest rivers flow into the Arctic Ocean. This offers the opportunity for two possible developments.

■ Role in regulating Climate

- Despite its remoteness, the Arctic Ocean is a critical component in the interconnected "machine" that regulates Earth's climate.
- **Influence on Atlantic meridional overturning circulation (AMOC):** The "global conveyor belt" of currents (i.e AMOC) that regulate temperatures across the globe starts with the cold water of the North Atlantic.
- The Arctic Ocean plays a significant role in strengthening this ocean current.
- Fresh water from melting glaciers, thawing sea ice, and the Greenland ice sheet flooding through the Fram Strait has the potential to slow down or disrupt this cycle.
- **Stratospheric Polar Vortex** swirls around the Arctic, trapping cold air near the Pole. Warming of the Arctic Ocean can weaken this polar vortex disturbing the weather pattern in North America and other regions around the Arctic coast.

■ Why the region assumes significance for India?

- Though none of India's territory directly falls in the Arctic region, it is a crucial area as the Arctic influences atmospheric, oceanographic and biogeochemical cycles of the earth's ecosystem.
- The frigid Arctic, which keeps losing ice due to global warming, is one of the batteries feeding the variations in Indian monsoons, over 7,000 kilometres away.
- Studying the response to warming in the form of melting is quite relevant to India as it provides tools to monitor changes in the Arctic.

■ Indian initiatives in Arctic

- India already has a research station in the Arctic, Himadri, for the research work.
- India received the 'Observer' country status in the Arctic Council in 2013 and is one among the 13 countries across the world, including China, to have that position.
- The status was renewed in 2018.

The Atlantic Niño's Role in India's Erratic Monsoon

Context:

- Farmers from Madhya Pradesh threatened to take IMD to court for the inaccurate monsoon forecast this year.
- A question was also raised in Parliament about whether the Arctic warming had led to an erratic monsoon this year.

Background

- Monsoon predictions are a monumental challenge, especially when it comes to the spatial distribution and the northward migration of the monsoon trough.
- **Forecast models tend to rely heavily on El Niño** for monsoon predictions.
- But only about 50 per cent of the dry years are explained by El Niño.
- Clearly, **Atlantic Niño is a significant player in monsoon evolution** and models and forecasters must pay attention to this Atlantic tele connection.
- **Atlantic Niño** is El Niño's little cousin in the Atlantic, also known as the Atlantic Zonal Mode.
- The biggest rainfall deficits from the Atlantic Niño tend to occur over the Western Ghats and the core monsoon zone.

How Atlantic Niño plays a role if Indian and Atlantic Oceans are not connected?

- The Atlantic and Indian Oceans are not directly connected in the tropics via the ocean.
- The Atlantic Niño affects the monsoon **by producing atmospheric waves,** which propagate into the Indian Ocean.
- These waves affect air temperatures over the Indian Ocean and influence the land-ocean thermal contrast as well as **Low Pressure Systems (LPS).**

Way forward

- Overall, monsoon prediction skill has gone up in the IMD but even a **70 per cent accuracy** means the forecasts will be wrong 30 per cent of the time.
- Many of the Atlantic Niños occur during non-El Niño years and this offers a window of **opportunity to increase forecast skills based on the accurate prediction of the Atlantic Niño.**

CARBON PRICING

Context:

Countries around the world raised $84 billion last year by charging firms for emitting carbon dioxide, up around 60% from 2020 as prices in many schemes hit record highs and a handful of new carbon levies were launched, the World Bank said in a report on Tuesday.

Background:

- In the 1920s, a British economist, Arthur Pigou, highlighted the social benefits of making industries pay for the costs of the pollution they caused.
- In time, this concept was taken up in different ways, which have led to the concept of 'carbon pricing'.

■ WHAT IS CARBON PRICING?

- Carbon pricing is the value ascribed to the external costs – usually social costs – of pollution emitted by an industry.
- The price on carbon emissions is applied either through a carbon tax or an emission trading system.

> According to the World Bank, carbon pricing is **the value ascribed to the external costs of pollution emitted by an industry.** External costs are those that do not affect the industry itself directly – most industries receive the full benefits of fossil fuel consumption, but only bear a trivial fraction of its climatic cost. Instead, public systems pay a socially tragic price – such as the costs of losing crops because of poisoned air/water and health care costs because of heat/cold waves or extreme weather events from global warming.

- Carbon pricing/taxes/trade are under the control of a country's government.
- The government decides what taxes to levy and polluters pay these taxes to the government.
- Ideally, these taxes should be used to either offset the extra burden of carbon taxation on low-income groups or on remedial projects to offset the effects of pollution.

■ Why a price on carbon?

- Carbon is priced because carbon-based gases (of which carbon dioxide or CO_2 is most prevalent) are the most abundant greenhouse gases (GHGs) in most emissions.
- Therefore, pricing carbon provides an incentive for households, firms, industries, and governments to reduce emissions cost-effectively.
- Currently, the price on carbon emissions is applied in two ways; **one is through a carbon tax**, and the **other through a cap-and-trading or emission trading system** (ETS).

■ CARBON TAX:

- Carbon tax is the price that governments impose on polluters for each metric ton of carbon dioxide emissions generated.

■ CARBON TRADING:

- Carbon trading is a market-based approach in which each polluter is allotted a specific quota or allowance of pollution that it can emit.
- Polluters are then allowed to trade these permits with each other.

■ Criticisms of the carbon pricing system:

- There are several arguments that have been put forward (apart from the issues on carbon taxation) to highlight that carbon pricing, including carbon trading is insufficient to mitigate climate change.
- Carbon pricing places more importance on increasing efficiency than on effectiveness and encourages optimisation of existing systems rather than on transforming them to reduce pollution.
- It has been pointed out that current issues with emissions are a fundamental systemic problem of society, and not just a market problem; therefore, they will require more than just a 'price on pollution' to overcome.

■ How does carbon pricing work in India?

- Currently, India does not have any explicit carbon pricing or cap-and-trade mechanisms; instead, it has an array of schemes that place an implicit price on carbon.
- The **Perform, Achieve and Trade (PAT) scheme** aims to reduce emissions from energy intensive industrial sectors by setting specific energy reduction targets.
- The **Coal Cess** is a tax on coal that was introduced in 2010, which aimed to use the collected revenue to finance clean-energy initiatives and research via the **National Clean Energy Fund.**
- **Renewable Purchase Obligations (RPOs)** and **Renewable Energy Certificates (RECs)** are aimed at encouraging India's growing renewable energy sector.
- Internal Carbon Pricing is a tool used by the private sector in India to reduce emissions voluntarily.

Climate change is impacting the structure of Earth's atmosphere

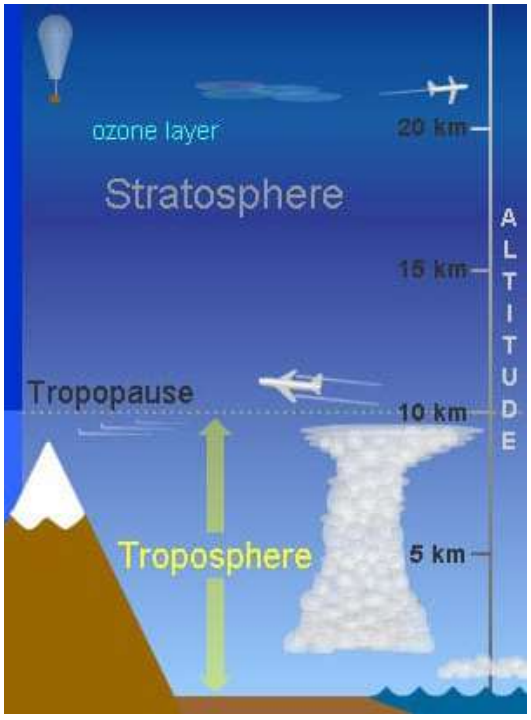
Context

A recent study suggests that climate change is causing a significant impact on the 'structure of the Earth's atmosphere.

Analysis

■ Understanding Earth's atmosphere

- Earth's atmosphere is very thin, with a mass of only about one-millionth that of the planet itself.
- Earth's atmosphere has five major and several secondary layers. From lowest to highest, the major layers are the
  - Troposphere
  - Stratosphere
  - Mesosphere
  - Thermosphere
  - Exosphere



■ What has been found?

They found that the tropopause region is pushing up the boundary with the Stratosphere by about 50-60 meters (about 165-195 feet) per decade.

■ What is responsible for this change?

This rising is caused by warming temperatures near Earth's surface, causing the lower atmosphere to expand.

■ Conclusion & Way forward

Unfortunately, greenhouse gas emissions from human activities are going to affect Earth's climate for decades and even centuries. In addition to this, humans will keep on adding carbon dioxide to the atmosphere at a rate far greater than it is removed by a natural process, thus creating a long-lived reservoir of the gas in the atmosphere and oceans.

In the coming decade, climate change will particularly depend on the number of greenhouse gases emitted into the atmosphere and how much they get absorbed by the ocean, the biosphere, and other sinks. It will also depend on how sensitive Earth's climate is to those emissions.

Cold wave in north India

Context:

Severe cold have gripped northern India as the mercury dropped to near freezing temperature in Rajasthan's Churu.

What exactly is the Cold Wave?

- Cold wave is defined by the rate at which the temperature drops and the lowest point to which it drops, which varies depending on the geographical region and time of year.
- A cold wave, according to the **IMD**, is defined as **a quick drop in temperature across a vast area accompanied by "a considerable cooling of the air, or the invasion of very cold air".**
- Cold waves are linked to "transient disturbances in the mid-latitude westerlies" in the northern sections of India, particularly the hilly regions and adjacent plains.

What triggers a cold wave?

- According to the IMD, the factors that bring cold waves to India include the movement of cold air masses brought about by upper-level winds.
- Strong westerly winds approaching northwest India can transport cold air towards the southeast direction. Consistent winds are required to trigger a fall in temperature.
- Build-up of an extended area of relatively high pressure over north-west Asia can also bring cold waves.
- Clouding over the region leads to lesser penetration of solar insolation into the earth and hence fall in maximum temperatures.
- Formation of an anti-cyclone in lower and mid-tropospheric levels can also be a driver of cold waves.
- In January 2021, due to the La Nina condition which is a weather phenomenon caused due to the cooling of the Pacific Ocean combined with western disturbances, brought in rains and snowfall resulting in a sharp drop in temperature and long spells of cold in northern and central India, including Delhi.

Dam safety in India

Context:

The **Dam Safety Bill 2019** has been passed by both the houses and it is expected to begin a new era of dam safety & water resources management in India.

Need for Large Dams

- Dams are used to store water in reservoirs throughout the year amid highly variable seasonal flow of rivers in a country like India.
- Water available through these reservoirs are utilised for drinking purposes, irrigation for agricultural operations, Hydro Power generation etc.
- Reservoirs also support Inland Navigation.
- Dams mitigate flooding in downstream areas of the river flow.

Deteriorating health of Large Dams

- After China and USA, **India is the 3rd largest dam-owning nation in the world.** There are around 5,700 large dams in the country, of which about **80% are already over 25 years old**. Nearly 227 dams that are over 100 years old are still functional.
  - For e.g., The Mullaperiyar dam, built in 1895 on the Periyar river in Idukki district of Kerala.
- According to the Central Water Commission (CWC), the **ageing of dam assets warrants serious concern on their safety aspects** in terms of meeting prevalent norms.
- Some **40 dams have collapsed in India since Independence**. One of the worst disasters took place in Gujarat in 1979 when the Machhu dam collapsed resulting in the loss of thousands of lives.
- **Climate change related extreme weather events**, especially floods, are expected to **accelerate a dam's ageing process**, especially where large dams were designed using historical hydrological data or do not meet present day design standards structurally.
- **Reservoir sedimentation** affects the safety of dams and, without proper management, negatively impact the environment.
- Although, not all dam failures can be attributed to ageing of the structure, the commonly cited triggers of failures, i.e., **structural flaws, extreme floods, landslides, internal erosion**, are more likely in older dams because **ageing increases the vulnerability** of a dam to such triggers.

Existing Dam safety regulations in India

- In India, the **Central Dam Safety Organisation**, under the Central Water Commission (CWC), provides **technical assistance to the Dam Owners**, and maintains data on Dams.
- The **National Committee on Dam Safety**, devises Dam Safety Policies and Regulations.
- Several States and Public Sector Undertakings (PSUs) that own dams in the country, set up their own **Dam Safety Organisations (DSOs**), and have taken up measures for ensuring dam safety in their respective jurisdictions.
- Currently, 18 States and some autonomous bodies such as **Damodar Valley Corporation or Bhakra Beas Management Board of Bhakra-Nangal Project** have their own Dam Safety Organizations.
- In the absence of a Central Law, however, the **safety regulations vary from state to state**.

Provisions of the Dam Safety Bill, 2019

- The Bill **covers the dams constructed before or after the commencement of this Act**, having the **height of over 15 metres** and between 10 and 15 metres with certain stipulations.
- The Bill provides for an **institutional mechanism at both Central and State levels**. To ensure dam safety, there will be **four layers of monitoring**, two at the central level and two at the state level.
- **A National Committee on Dam Safety (NCDS),** headed by the chairman of Central Water Commission (CWC) and representatives of central and state governments, will be constituted to help evolve uniform dam safety policies, protocols, and procedures.
  - The Bill also provides for the establishment of a **National Dam Safety Authority (NDSA)** as a regulatory body for nationwide implementation of dam safety policies and standards.
- This Bill provides **for regular inspection and hazard classification** of dams. It also provides for drawing up of **emergency action plans** and comprehensive dam safety reviews by an independent panel of experts.
  - There is provision for an **emergency flood warning system** to address the safety concerns of downstream inhabitants.
- This Bill has penal provisions, involving offences and penalties, for ensuring compliance of the provisions.

Issues with the Bill

- **Constitutional validity:** Water falls under the State List of the Seventh Schedule of the Constitution. The Centre has brought the legislation under Article 246 of the Constitution read in the Union list. Article 246 empowers Parliament to legislate on any matter enumerated in List I of the Union list.
  - This circumvention has left many sceptics questioning the validity of the legislation.
- **Payment of compensation:** The bill does not include any clause on the payment of compensation to people affected by dam projects
- **Losing control over old dams:** Many States, including Karnataka, Kerala, Tamil Nadu and Odisha, have opposed the Bill because they say it encroaches upon the sovereignty of States to manage their dams, and violates the principles of federalism enshrined in the Constitution.

Way Forward

- **Dam Safety Bill:** The Centre can hold talks with the States to allay their fears and frame rules suitably for the legislation.
- **Decommissioning of Dams:** To avert the catastrophic consequences of ageing dams, international practices like decommissioning should be utilised. Decommissioning or removal, partially or entirely, is less costly than repairing or rebuilding.
- **Forum to voice the concerns of people**

Double - Dip La Niña

Context:

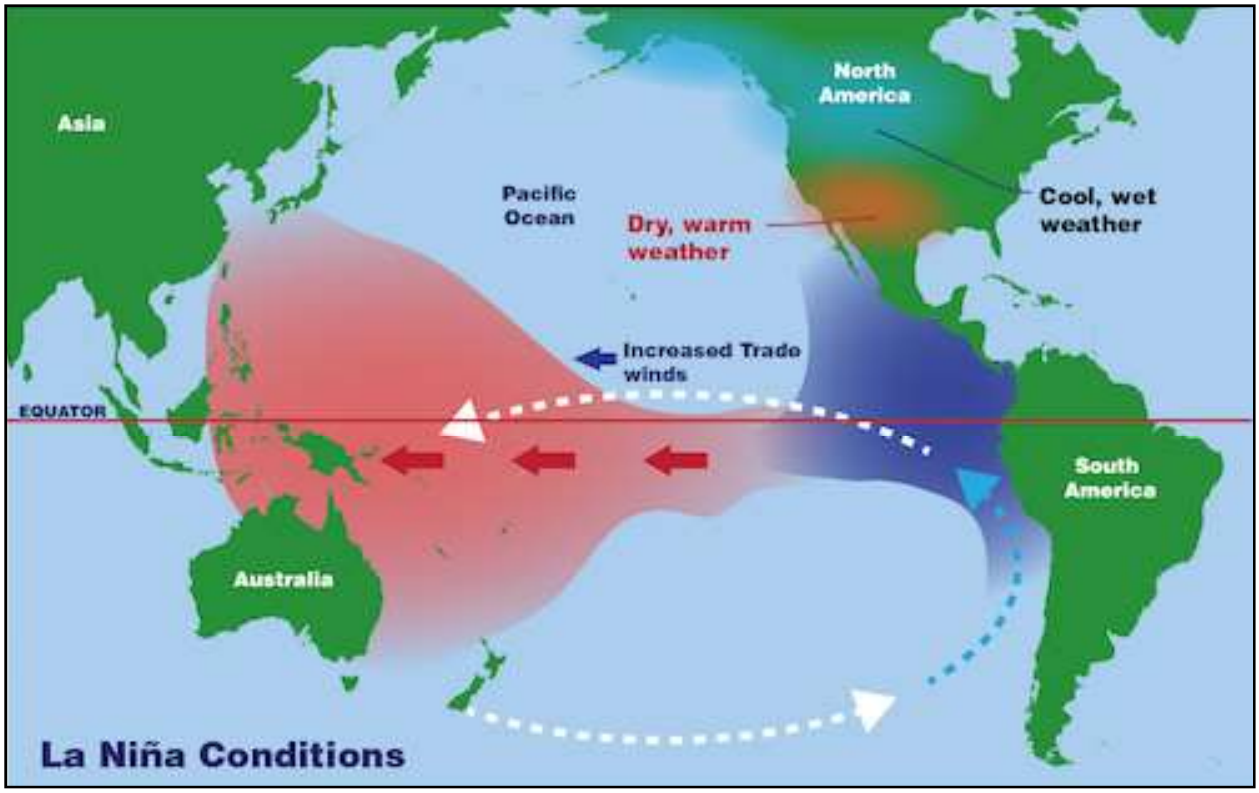
La Nina has redeveloped, according to the National Oceanic and Atmospheric Administration (NOAA, an American scientific agency). Consecutive La Ninas are referred to as Double-Dip.

What Are La Nina And Double Dip?

- In Spanish, La Nina translates as Little Girl. Ocean water off the coast of South America to the central tropical Pacific cools to below-average temperatures during a La Nina.
- La Nina is one of the components of the El Nino Southern Oscillation (ENSO) cycle, which is defined by contrasting warm and cool oceanic and atmospheric conditions in the tropical Pacific Ocean.
- Consecutive La Nina events following a period of ENSO neutrality are not unusual and are referred to as a "Double-Dip."

Occurrence

- This cooling happens as a result of stronger-than-normal easterly trade winds, which churn cooler, deeper seawater to the surface of the ocean.
- When this occurs, sea temperatures in the far western Pacific can rise above average.



Impact:

- **On the Walker Circulation:** The exceptionally warm water in the eastern Pacific then influences the Walker Circulation (an equatorial Pacific Ocean atmospheric system of airflow), acting as a focal point for cloud, rainfall, and thunderstorms. This shift in the Walker Circulation has an effect on weather patterns throughout the world.
- **On the Pacific Jet Stream:** As the oceans warm, the Pacific jet stream moves south of its neutral position. As a result of this change, parts of the northern United States and Canada are drier and warmer than usual. But, in the Gulf Coast and Southeast of the United States, these seasons have been wetter than usual, resulting in higher floods.
- On Marine life: El Nino also has a significant effect on marine species off the Pacific coast.
  - El Nino results in a weakening or complete cessation of upwelling. Upwelling is the process by which cooler, nutrient-rich water rises to the surface from the depths.
  - Without deep-water nutrients, there is less phytoplankton off the coast. This has an effect on fish that consume phytoplankton and, in turn, on everything that consumes fish.

- **On the Indian Ocean:** Temperatures are rising in the western Pacific, the Indian Ocean, and off the Somali coast. It also results in severe flooding in Australia and considerably better monsoon rains in India.

India to Add 100 more Earthquake Observatories by 2026

Context:

The Government has announced that India is going to open **35 earthquake observatories** by the end of 2021 and is aiming to increase the number by adding **100 more earthquake observatories** by the year 2026.

ANALYSIS

■ Occurrence of earthquake

- The earthquake is characterized by severe shaking of the ground and severe shaking of structures above the ground.
- This happens due to the release of the transmitted pressure of moving **lithospheric or crustal plates.**

■ The Earthquake Risk in India

- During the last 15 years, 10 major earthquakes have been reported, resulting in over 20,000 deaths.
- Based on the **current seismic zone map of the country**, over 59% of India's land area is under threat of moderate to severe seismic activity.
- The entire Himalayan belt is considered vulnerable to major earthquakes of magnitude exceeding 8.0.
- Scientific publications have talked about the likelihood of the occurrence of very severe earthquakes in the Himalayan region.
- The North-Eastern part of India experiences moderate to large earthquakes. The region experiences an earthquake with a magnitude greater than 6.0 every year.
- The Andaman & Nicobar Islands often experiences earthquakes because it is situated on an inter-plate boundary.

■ Why more earthquake Observatories are required?

- The Indian subcontinent is undoubtedly one of the **world's most disaster-prone areas** in terms of natural calamities like, earthquakes, landslides, cyclones, floods, and tsunamis.
- **Under-sea earthquakes,** capable of generating tsunamis on the Indian coastal regions are also a point of concern.
- Thus, it becomes important to put in place a robust warning system to equip ourselves to make timely predictions.
- In order to do so, a network of **well-distributed observatories** all across the country is required.
- It will increase the **detection capability of an earthquake** up to magnitude 2.5 throughout the country, which is around the magnitude of 3.5 on the **Richter scale**.
- It can also capture small seismic activity that went undetected earlier.

■ Can we make predictions for future earthquakes?

- So far, there is not any proven scientific technique, anywhere in the world, to predict the occurrence of earthquakes with a reasonable degree of accuracy with regard to space, time and magnitude.
- The warning time, however, is getting much shorter and of the order of a few seconds if a well-established spatial network of observatories is in place.
- The success rate of a warning system should be assessed thoroughly before the system can be considered for real-time operations.

■ What are the other methods available for earthquake detection?

- **Artificial Intelligence** (Machine learning techniques) gives us options to takes on Earthquake Prediction. But it's a long way to cover before it can reliably bring to use to predict catastrophic earthquakes.
- **Geodetic observations**—especially interferometric synthetic aperture radar (InSAR) and satellite optical imagery have shown promising results.
- **Laser beams** can be deployed to detect plate movement by directing the beam across the fault line.
- Abnormal exhalation of Radon gas is observed from the interior of the earth. So, the levels of it can be monitored - a sudden increase may suggest an earthquake.

Assessment of geological feature of Lakshadweep

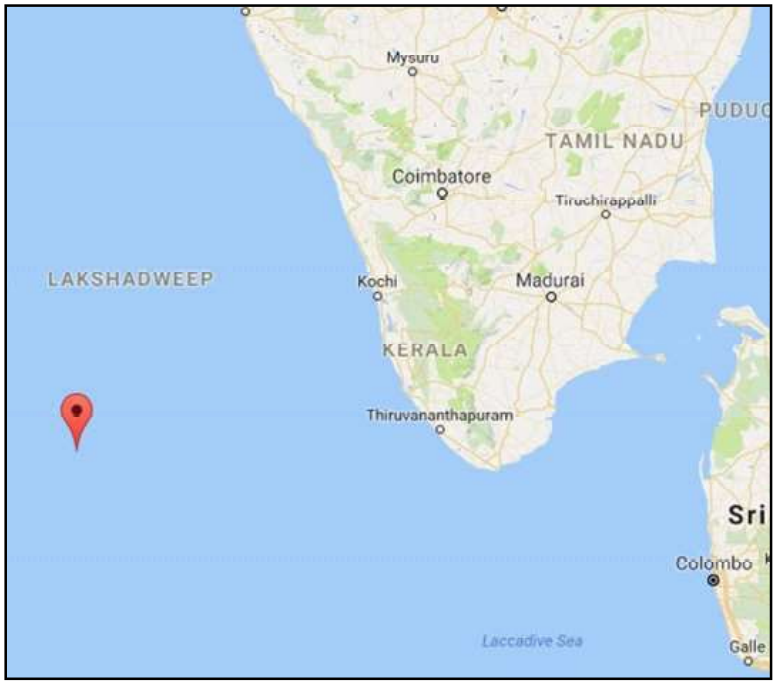
Context:

The tiny islands that make up the Union Territory of Lakshadweep are in turmoil. The islanders are upset about a series of recent disruptions in their lives and apprehensive about a set of proposed laws with the potential to alter the very character of the archipelago.

Analysis

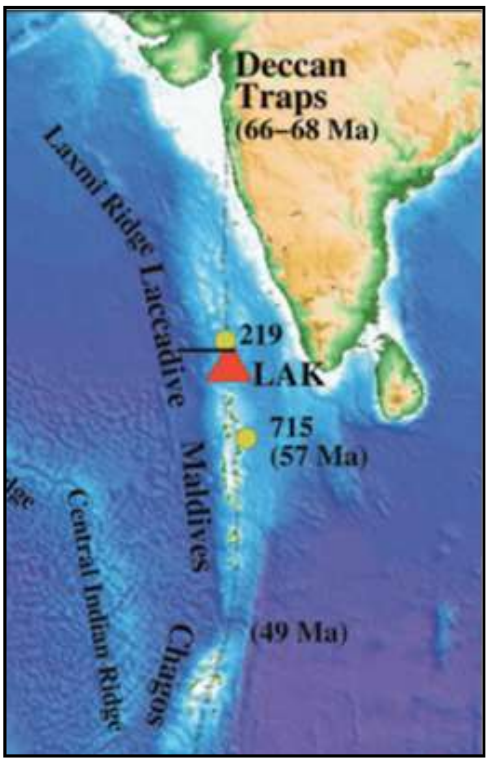
■ Physical Features

- Located in the Arabian Sea, Lakshadweep is a group of 36 islands comprising of 12 atolls, three reefs, five submerged sand banks and 10 inhabited islands
- The maximum height of the island is 6 metres above the mean sea level.
- The soil of region is sandy.
- There is no rivers or streams, waterfalls, lakes, reservoirs, etc., in the district (entire UT of Lakshadweep is considered as single district)



- The islands are generally aligned from north to south with one exception namely, **Androtт**, which lies east to west.

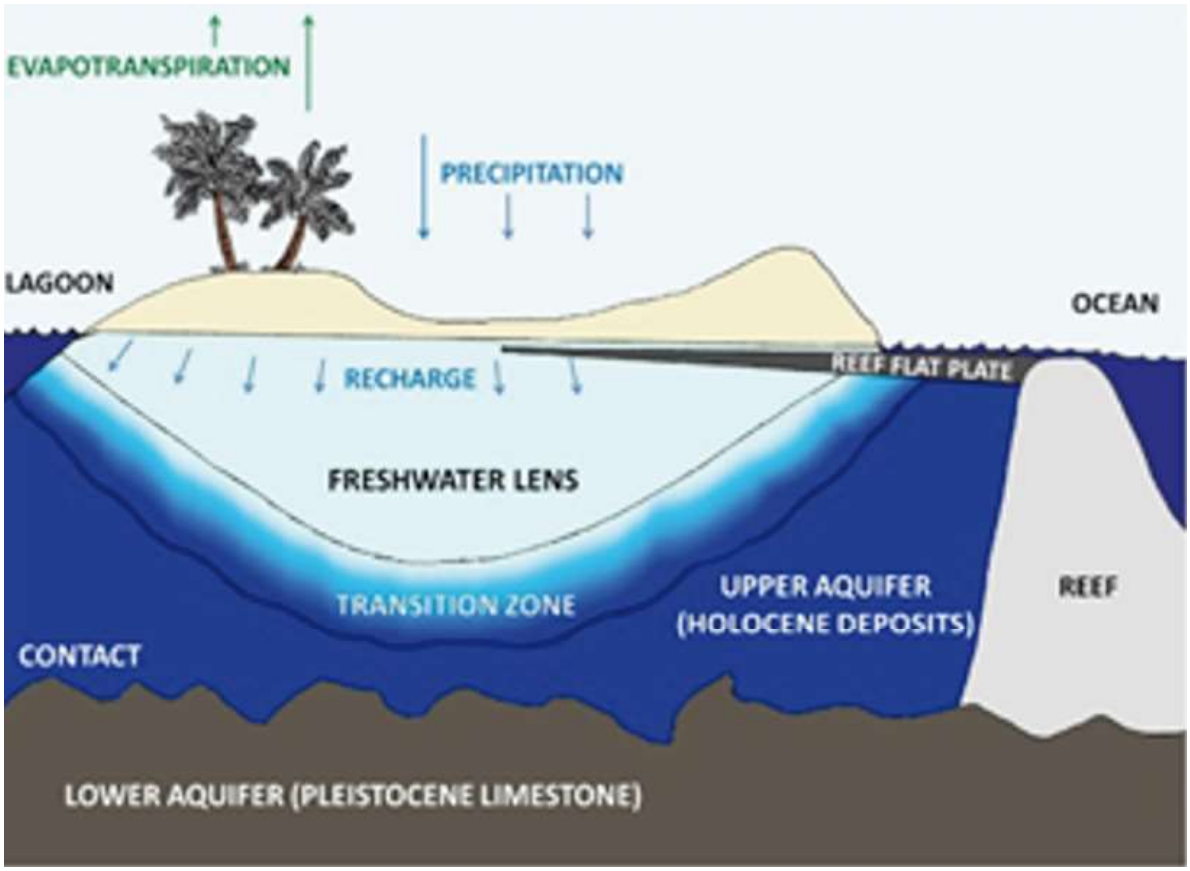
■ Lakshadweep: Part of CLR Ridge



- The **Lakshadweep, Maldives and Chagos archipelagos** form a contiguous mountain ridge in the ocean.
- The **Chagos-Laccadive Ridge (CLR),** also known as **Chagos-Laccadive** is a prominent volcanic ridge extending between the Northern and the Central Indian Ocean.
- This ridge is believed to be a continuation of the Aravalli Mountain range of Rajasthan and Gujarat since the late tertiary times
- The Aravallis formed a great mountain chain in the Precambrian period extending from the Himalayas in the north to Lakshadweep in the South.

■ Hydrogeology of Lakshadweep

- Ground water occurs under phreatic conditions in these islands occurring as a thin lens floating over the seawater (due to difference in densities) and is tapped by open wells
- The water level fluctuation in these islands is significantly controlled by tides when compared to the groundwater recharge and draft



Naturally formed structures leading to Wetlands

■ Coral reefs

- Corals are the most dominating that amounts to 69 % of wetland area in Lakshadweep
- Coral reefs are of three types namely; fringing reefs, barrier reef and atolls.
- The coral reefs of the Lakshadweep islands are mainly atolls except one platform **reef of Androth.**

■ Lagoons

- In Lakshadweep the lagoons are very different from the mainland in the sense that they are actually coral reef lagoons wherein the water body gets enclosed in an atoll or within a barrier reef.

■ Sand Beach

- In Lakshadweep these sandy beaches are characteristically located on windward side. On the other sides the sandy beaches experience the vagaries of monsoon. These beaches comprise vegetation mainly sweet potato, bay-hops, crabgrass and whistling pine tree

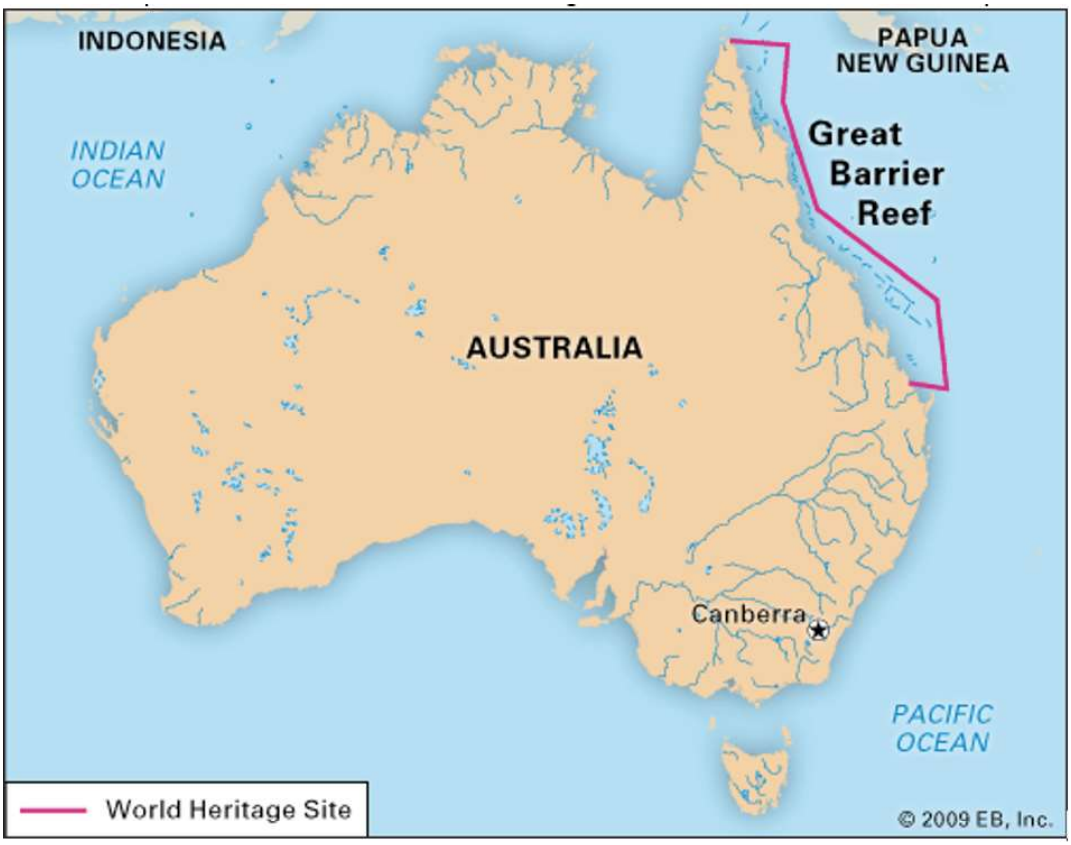
Great Barrier Reef as World Heritage in Danger

Context:

- The UNESCO World Heritage Committee lamented that the Great Barrier Reef of Australia has deteriorated so much that it should be listed as a 'world heritage site in danger'.
- More than 90% of **Great Barrier Reef coral** surveyed this year was bleached in the fourth such mass event in seven years in the world's largest coral reef ecosystem.

About Great Barrier Reef

- The Great Barrier Reef is a site of remarkable variety and beauty on the north-east coast of Australia.
- It contains the world's largest collection of coral reefs, with 400 types of coral, 1,500 species of fish and 4,000 types of mollusc, plus a great diversity of sponges, anemones, marine worms, crustaceans, and other species.
- It also holds great scientific interest as the habitat of species such as the dugong ('sea cow') and the large green turtle, which are threatened with extinction
- No other World Heritage property contains such biodiversity.
- This diversity, especially the endemic species, means the GBR is of enormous scientific and intrinsic importance, and it also contains a significant number of threatened species.



What are the threats to GBR?

■ Climate Change

Rising sea temperatures

- Rising sea temperatures mean the Reef is at greater risk of heat stress and mass coral bleaching, decreasing the capacity for corals to build skeletons

Ocean Acidification

- The more acidic seawater becomes the less calcium carbonate it can hold. Many marine species, including coral, need calcium carbonate to build their protective shells and exoskeletons.

Severe weather events

- Increased frequency of severe weather events, such as cyclones and record rainfall levels can destroy reef structures and send an influx of freshwater and sediment further out from the coast on to the Reef

Coastal Development

Agriculture

- Most land in the Great Barrier Reef catchment is used for grazing, crops, dairy and horticulture, with more than 80 per cent of the catchment supporting some form of agriculture.

Mining

- Historically, extensive small-scale mining operations occurred through much of the Great Barrier Reef catchment.

Urban and industrial development

- Urban and industrial development, excluding mining, in the Great Barrier Reef catchment is not extensive; however future economic projections suggest an increase in these types of land uses.

Heritage erased: How the Kashmir Valley's ancient mound formations are being levelled

Context

Kashmir's highly fertile alluvial soil deposits called 'Karewas' are being destroyed in the name of development.

■ About Karewa:

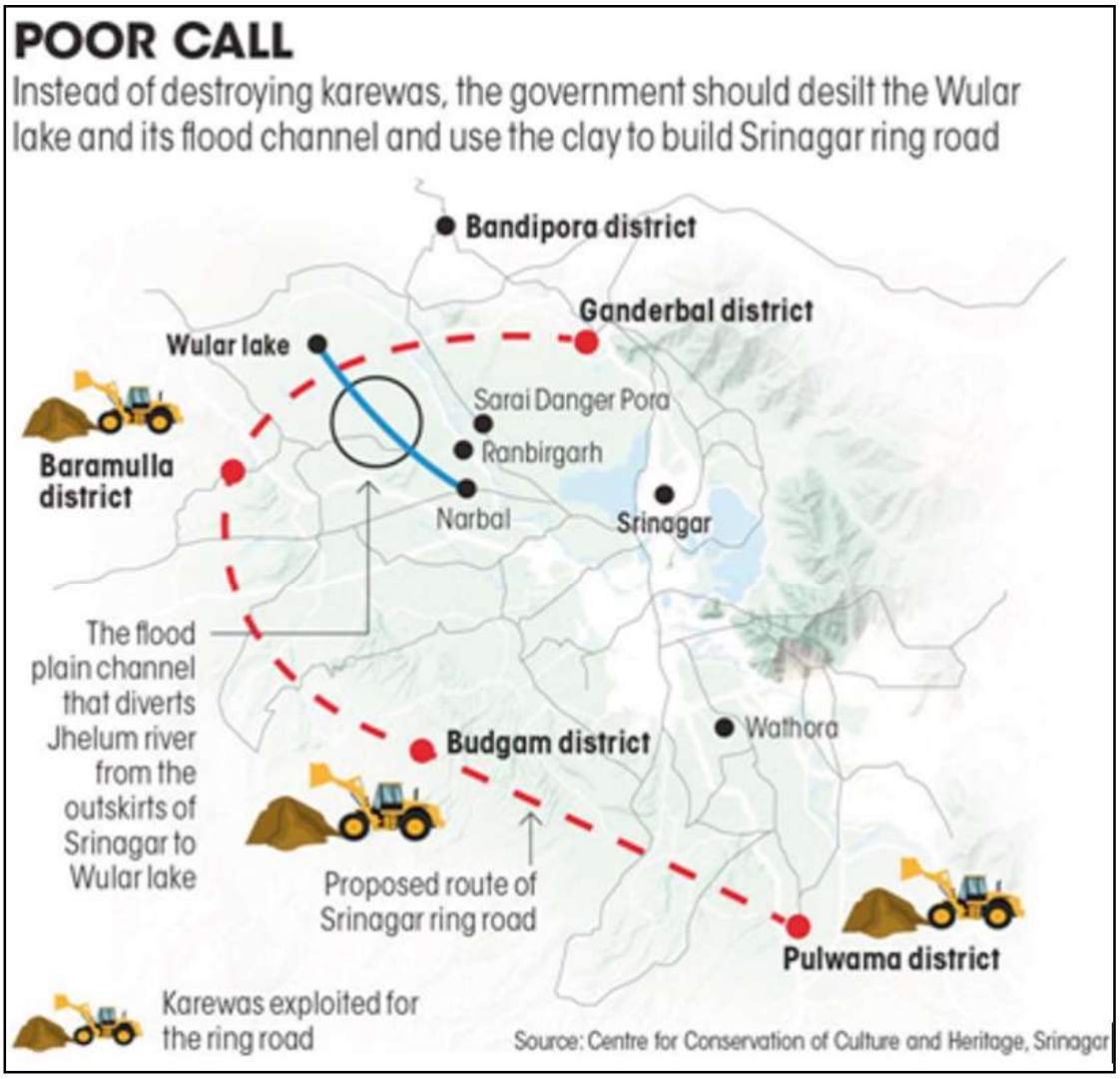
- In the Kashmiri dialect, the term Karewa means "**elevated table land**".
- Firstly, this term was used by **Godwin Austin in 1859** and later on by **Lydekker in 1878** for unconsolidated to semi-consolidated sand clay conglomerate sequence.
- "**Vudr"** is the local name for **Karewas in Kashmiri language**.
- Karewas are the **thick deposits of glacial clay** and other materials **embedded with moraines**.
- These are unconsolidated **lacustrine deposits**. Lacustrine means "associated to lakes".
- Kashmir valley resides between the **Great Himalayas and the Pir Panjal ranges** of the Kashmir Himalayas.
- The depth of **Karewa deposits is about 1400 m** and most of the area lies to the west of the river Jhelum.

■ Significance:

- The **fertility** of these patches is believed to be the result of their **long history of formation**.
- Karewa, these plateaus are 13,000-18,000 metre-thick deposits of alluvial soil and sediments like sandstone and mudstone.
- This makes them **ideal for cultivation of saffron, almonds, apples and several other cash crops.**
- **Kashmir saffron**, which received a **Geographical Indication (GI) tag in 2020** for its longer and thicker stigmas, deep-red colour, high aroma and bitter flavour, is **grown on these karewas**.

■ Destruction of Karewas:

- Despite its agricultural and archaeological importance, karewas are now being excavated to be used in construction.
- Between 1995 and 2005, massive portions of karewas in Pulwama, Budgam and Baramulla districts were razed to the ground for clay for the 125-km-long Qazigund-Baramulla rail line.
- The Srinagar airport is built on the Damodar karewa in Budgam.
- The most recent violation is in 2021 when the Baramulla deputy commissioner gave consent for the excavation of karewas around Pattan village and uses the clay for the construction of the Srinagar ring road.
- Two other karewas—in Pulwama and Budgam districts—are also being excavated for the 58-km-long project.



Himalayan Fault Lines and Seismic Gaps

Context

A series of earthquakes has hit Assam and major parts of the Northeast, causing extensive damage to the infrastructure.

Background

- The Indian Plate has produced three north-dipping fault systems stacked on each other.
- These faults in the Himalayas, namely Main Boundary Thrust (MBT), Main Central Thrust (MCT) and the Himalayan Frontal Thrust (HFT), run along the Himalayan Ranges.
- The precise analysis of the earthquake in Assam shows that the events are located closer to Himalayan Frontal Thrust near **Kopili Fault**.
- This area is extreme seismically active which falls in the highest Seismic Hazard zone V associated with collisional tectonics where Indian plate sub-ducts beneath the Eurasian Plate.

Analysis

■ What is a fault?

- A fault is a fragmentation or zone of fractures between two blocks of rock. Faults allow the blocks to move relative to each other in different directions.
- This movement of blocks of rock can be rapid, in the form of an earthquake or may occur slowly, which is called as creep.
- Range of a fault can be few millimeters to thousands of kilometers.

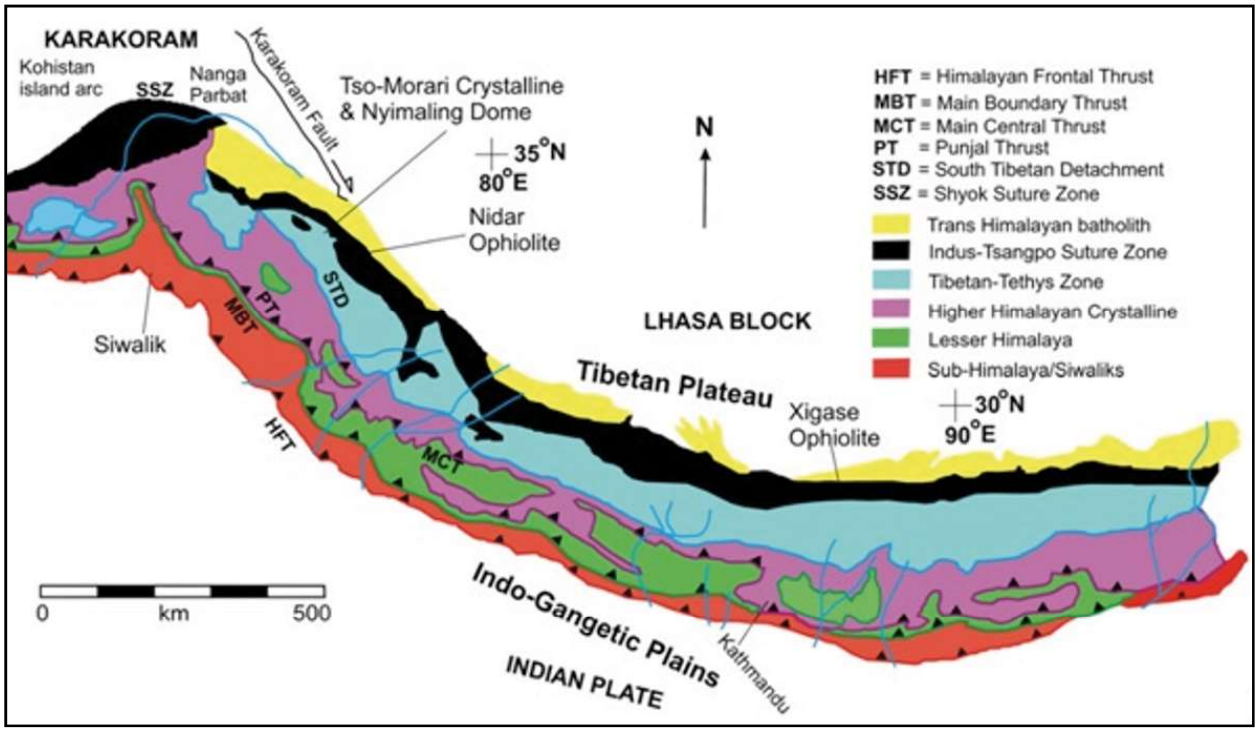
■ How is a fault created?

- A new fault is formed when the stress on the rock is great enough to cause a fracture, and one wall in the fracture moves relative to the other, which is caused by compressional/tensional force by the rising magma from the mantle.

■ Main Himalayan Thrust

- The **Main Himalayan Thrust** follows a North West-South East strike and is a décollement beneath the Himalaya Range, and gently dip towards the north, beneath the Himalayan region.
- MHT is the largest active continental mega-thrust fault in the world.
- Deformation of the crust is also accommodated along splay structures including the
- Himalayan Frontal Thrust (HFT)
- Main Boundary Thrust (MBT)
- Main Central Thrust (MCT)

■ Himalayan Thrust



■ Himalayan Frontal Thrust

- The **Himalayan Frontal Thrust (HFT)**, also known as the **Main Frontal Thrust (MFT)** is a geological fault in the Himalayas that defines the boundary between the Indian and Eurasian Plates.

- As the root décollement, it is a splay branch of the **Main Himalayan Thrust (MHT).**
- **Main Boundary Thrust**
- Occurred during the **Cainozoin period**, the Main Boundary Thrust (MBT) is one of the major Himalayan thrusts, and it is presently incorporated within the Himalayan thrust wedge (Lesser and Outer Himalayas) displaced above the Indian lithosphere
- It shows the faulted contact between the Siwalik and the older Murree /Dharamshala beds in the Himalayas of Jammu-Himachal Pradesh.
- **Main Central Thrust**
- The **Main Central Thrust** is a major fault which is formed where the Indian Plate has pushed under the Eurasian Plate along the Himalaya. The fault is exposed on the surface in a NW-SE direction as it slopes down to the north. It is a 2200km long thrust fault that continues along Himalaya mountain belt.

■ What is seismic gap?

- A seismic gap a section of an active fault which has the potential to produce significant earthquake(s).
- The rocks at the gap have not slipped from their position, compared with other segments along the same structure in a long time.

■ Three main seismic gaps in Himalayas

- **Assam Gap:** between the 1950 Assam and 1934 Bihar–Nepal earthquake ruptures, this has potential to cause at least three great earthquakes.
- **Central Gap:** between the 1905 Kangra and 1934 Bihar–Nepal earth-quakes, this has potential to cause three great earthquakes.
- **Kashmir Gap:** lies west of the1905Kangra earthquake rupture, this has potential to cause at least two great earthquakes.

What is causing the intense heat in north, west, central and east India?

Context

- There is an ongoing heatwave in India that has forced millions of people indoors, with air conditioner sales nearly doubling when compared to the previous year. The driving up temperatures beyond normal in **north, west, central and east India** in the month of **March and April** is a cause of concern for India.
- IMD has said that **April was the hottest** in northwest India in 122 years.

■ What are heatwaves?

- The **India Meteorological Department** qualitatively describes heatwave as a condition of air temperature which becomes fatal to the human body when exposed.
- Quantitatively, it is defined based on the temperature thresholds over a region in terms of actual temperature or its departure from normal.
- **Declaration**
- **Heatwave:** A heatwave is declared when an area logs a maximum temperature of 45 degree Celsius.

- **Severe heatwave:** A severe heatwave is declared if the maximum temperature crosses 47 degrees.
- For coastal regions, heat waves may be described provided the actual maximum temperature is 37 degrees or more.

■ The General Occurrence

- **Months:** Heat waves usually occur in the months of March to June and in some rare cases even in July.
- The peak month of the heat wave over India is May.
- **Regions:** Heat waves generally occur over plains of **northwest India, Central, East and north Peninsular India.**
- It covers **Punjab, Haryana, Delhi, Uttar Pradesh, Bihar, Jharkhand, West Bengal, Odisha, Madhya Pradesh, Rajasthan, Gujarat, parts of Maharashtra and Karnataka, Andhra Pradesh and Telangana.**
- Sometimes it occurs over Tamil Nadu and Kerala also.

■ Understanding the geographical aspect of heatwave

- One of the causes of these extreme heat waves has been the unusual **north-westerly winds.**
- These anomalous north-westerlies overpowered the moist southerly winds that typically come off the water and kept pre-monsoon showers offshore.
- This deviation from normal wind trends allows hot air from desert areas to the northwest to spread over much of the country.
- Heat waves form when high pressure aloft in around 3,000–7,600 metres above the region and remains over a region **for several days** up or
- This is common in summer, both in the **Northern and Southern** Hemisphere as the jet stream **'follows the sun'**. On the equator side of the jet stream, in the upper layers of the atmosphere, is the high pressure area.
- During summer, weather patterns are generally slower to change than in winter. As a result, this upper level high pressure also moves slowly.
- Under high pressure, the air subsides (sinks) toward the surface, warming and drying adiabatically, inhibiting convection and preventing the formation of clouds.
- Reduction of clouds increases shortwave radiation reaching the surface.
- A low pressure at the surface leads to surface wind from lower latitudes that bring warm air, enhancing the warming.
- Alternatively, the surface winds could blow from the hot continental interior towards the coastal zone, leading to heat waves there causing adiabatic warming.

■ What are the favourable conditions of heat wave formation?

- **Transportation / Prevalence of hot dry air over a region**: There should be a region of warm dry air and appropriate flow pattern for transporting hot air over the region.
- **Absence of moisture in the upper atmosphere:** As the presence of moisture restricts the temperature rise.
- **The sky should be practically cloudless**: To allow maximum insulation over the region.
- **Large amplitude anti-cyclonic flow** over the area.

Inter-linking of Rivers

Context:

The Union Budget has finalised five river linking projects.

Background:

- The Union budget has allocated Rs **44,605 crore for the implementation of Ken-Betwa river** link project for irrigation of **Bundelkhand region**, a drought-prone region spreading across 13 districts of Uttar Pradesh and Madhya Pradesh.
- The **Ken-Betwa River Interlinking (KBRIL) Project** aims to **transfer surplus water from the Ken to the Betwa** to irrigate the drought-prone Bundelkhand region. Both, the Ken and Betwa are the tributaries of the Yamuna.
- The KBLP is the **first under the National Perspective Plan (NPP)** for the interlinking of rivers, which was prepared in 1980.
- The **draft detailed project report** of five river links, namely **Damanganga-Pinjal**, **Par-Tapi-Narmada, Godavari-Krishna, Krishna-Pennar, and Pennar-Cauvery** have been finalized.
- Once a consensus is reached among the beneficiary states, the Centre will provide support for implementation.

Interlinking of Rivers

- **Management of water resources:** The **Indian Rivers Inter-link aims to effectively manage water resources** in India **by linking Indian rivers by a network of reservoirs and canals**
- **Flood control:** It main purpose is to enhance irrigation and groundwater recharge, reduce persistent floods in some parts, and water shortages in other parts of India.
- **India accounts for 18% of the world's population and about 4% of the world's water resources.** One of the solutions to solve the country's water woes is to Link Rivers and lakes.
- **Idea behind the interlinking of rivers:** Many parts of the country face problems of drought while many others face the problem of flooding every year.
- **Hence, the National River Linking Project (NRLP) is claimed to be the answer to India's water problem** through conservation, storage, and deliver to areas and over times when water becomes scarce.
- Beyond water security, the project is also seen to offer potential benefits to transport infrastructure through navigation, as well as to broadening income sources in rural areas through fish farming.

Brief history

- The idea of interlinking of rivers in the Indian subcontinent is atleast 150 years old.
- During the British Raj in India, Sir Arthur Cotton, a British general and irrigation engineer, first suggested linking the Ganga and the Cauvery for navigational purposes.
- K.L. Rao's Proposal (1972), which had 2640 km long Ganga – Cauvery link as its main component involved large scale pumping over a head of 550 m.
- The Central Water Commission, which examined the proposal, found it to be grossly under estimated and economically prohibitive.

■ Capt. Dastur Proposal (1977)

It envisaged the construction of two canals:

1. **4200 km Himalayan Canal** at the foot of Himalayan slopes running from the Ravi in the West to the Brahmaputra and beyond in the east
2. **9300 km Garland Canal** covering the central and southern parts

Why is the River-Linking Project important?

- **Hydropower generation:** The river interlinking project claims to generate total power **of 34,000 MW (34 GW).** Out of this, **4,000 MW will come from the peninsular component** while **30,000 MW from the Himalayan component.**
- **Solution to Water Deficits:** The Project is expected to **curb the drinking water woes of millions** and supply water to **industries in drought-prone** and water-scarce cities in south and west India.
- **Irrigation benefits:** The project claims to provide **additional irrigation to 35 million hectares** (m ha) in the water-scarce western and peninsular regions, which includes **25 m ha through surface irrigation** and **10 m ha through groundwater**.
- **Economic Benefits:** Irrigation Benefits will further **create employment, boost crop outputs and farm incomes** and multiply benefits through **backward (farm equipment and input supplies**) and **forward linkages (agro-processing industries).**
- **Means for Inland Waterways:** The project is expected to create several benefits for navigation, which is a cleaner means of transport, aiding the green footprint.
- **Effective Utilization of Monsoon water:** Annual rain fall of only around four month **and uneven distribution of rainfall across India**, indicates the need for effective sharing of rainfall water through inter-linked rivers.

Challenges in River Interlinking

- **Project feasibility:** The project is estimated to cost around Rs.5.6 lakh crores (estimated cost with the base year of 2000).
- **Requires great engineering capability and manpower:** There is also the requirement of huge structures. All this requires a great engineering capacity. So, the cost and manpower requirement is immense.
- **Climate vulnerability:** A report points out that Climate change will cause **a meltdown of 1/3rd of the Hindu Kush Region's glaciers by 2100.** So, the Himalayan Rivers might not have 'surplus water' for a long time.
- **Environmental impact**: The huge project will alter entire ecosystems. The wildlife, flora and fauna of the river systems will suffer because of such displacements and modifications.
- **Impact on society:** Building dams and reservoirs will cause the displacement of a lot of people. This will cause a lot of agony for a lot of people. They will have to be rehabilitated and adequately compensated.
- **Controlling floods:** Some people express doubts as to the capability of this project to control floods. There have been instances where big dams like Hirakud Dam, Damodar Dam, etc. have brought flooding to Odisha, West Bengal, etc.
- **Political Challenges: Water is a state subject** in India. So the implementation of the NRLP primarily depends on Inter-State co-operation. Several states including Kerala, Andhra Pradesh, Assam, and Sikkim have already opposed the NRLP.
- **Inter-state disputes:** Many states like Kerala, Sikkim, Andhra Pradesh, etc. have opposed the river interlinking project.
- **International disputes**: In the Himalayan component of the project, the effect of building dams and interlinking rivers will have an effect on the neighboring countries. For example, Bangladesh has opposed the transfer of water from the Brahmaputra to the Ganga.

Lithium and its Distribution across the Globe

Context:

Argentina, the fourth-largest producer of Lithium meta, is now speeding up the process of mineral exploitation. Till now the extraction was done sluggishly due to high tax rates, red tape and rampant inflation.

Background

- The growing demand for white gold is climbing new height every day due to it being the ultralight battery metal.
- The other reason for the spike has been the global rush towards environmentally friendly modes of transport.

Analysis

■ Increasing demand for lithium metal:

- **Increased applicability:** In order to take advantage of renewable energy, the need for bulk energy storage applications has been increasing. This includes **electric vehicles (EVs)** and backup electric storage systems.
- **Good life:** Lithium-ion based batteries have a good rate of charging and they last longer.
- **Higher energy density:** In addition to this, the energy density of the Li-ion batteries is higher.
- **Wide usage:** Being primarily used in batteries, it also finds its use in glass, ceramics, rocket fuel and lasers.

■ About the Metal

- Lithium is a metal of utmost importance. It is everywhere today.
- A soft, silvery metal, it has the lowest density of all metals.
- It reacts vigorously with water.
- Lithium does not occur as the metal in nature, but is found combined in small amounts in nearly all igneous rocks and in the waters of many mineral springs.
- The metal is produced by the electrolysis of molten lithium chloride and potassium chloride.

■ LITHIUM DISTRIBUTION:

- Lithium reserves have been found in all the continents but **Chile, Argentina and Bolivia** together are referred to as the **"Lithium Triangle"-** holding underneath in its salt flats more than 75 percent of the world supply.

- **Natural salt pans or salt flats** are the large flat area of ground covered with salt and other minerals. They are usually found in deserts, **Salar de Uyuni** in Bolivia is the largest salt flat in the world. They are not like salt evaporation ponds, which are artificial. Wind and water work in tandem to create a flat surface of salt.

■ Lithium reserves in India:

- During 2021-22 **Geological Survey of India (GSI)** has carried out 7 projects on Lithium in Arunachal Pradesh, Andhra Pradesh, Chhattisgarh, Jharkhand, Jammu & Kashmir and Rajasthan.
- However, the resource of lithium has not yet been augmented by GSI.
- Researchers at the **Atomic Minerals Directorate (AMD**)for Exploration and Research, which is a constituent of Department Atomic Energy (DAE) has estimated lithium reserves of 14,100 tonnes in a small patch of land surveyed in Southern Karnataka's Mandya district.

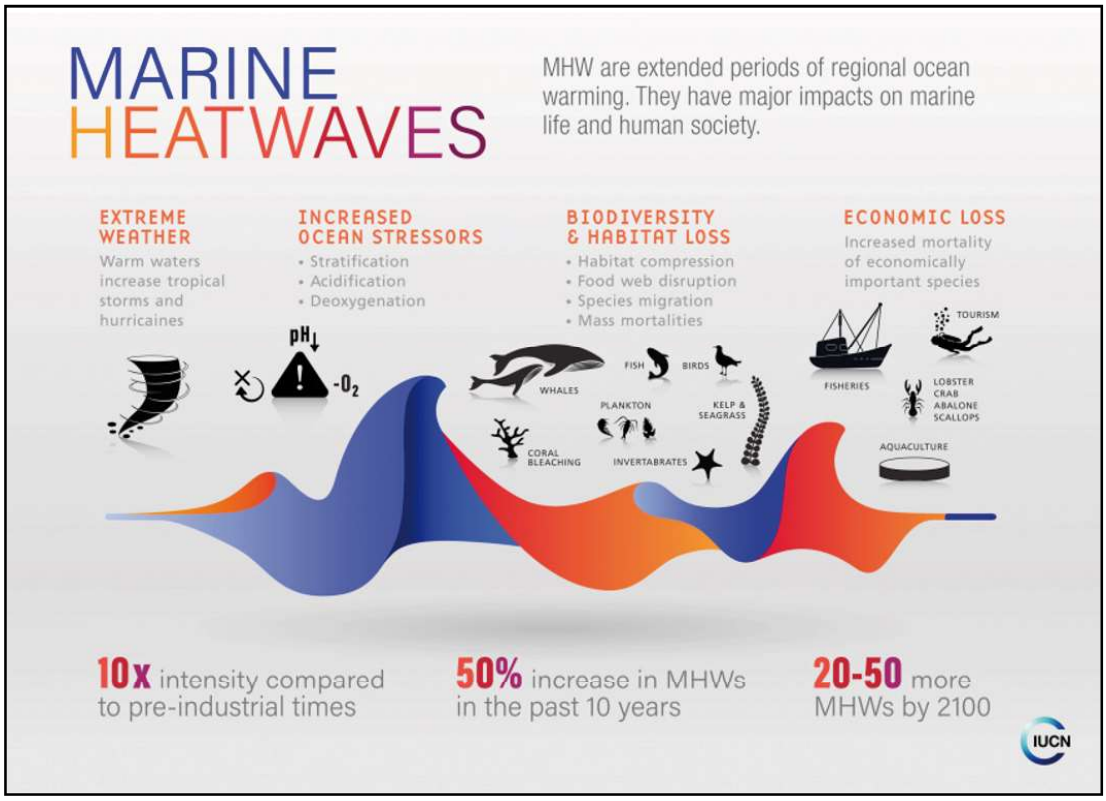
MARINE HEAT WAVES

Context

Heat waves on the land are well known. But marine heat waves — or the ones that form on oceans — have been on the rise in the waters around India, says a study.

■ What is the issue?

- The ocean's average temperature has increased by 1.5°C in the last century, and for the past 10 years average annual ocean temperatures have been the highest ever recorded.
- In addition to this long-term, persistent warming, discrete periods of extreme regional ocean warming called **marine heat waves (MHWs) are becoming more frequent**.



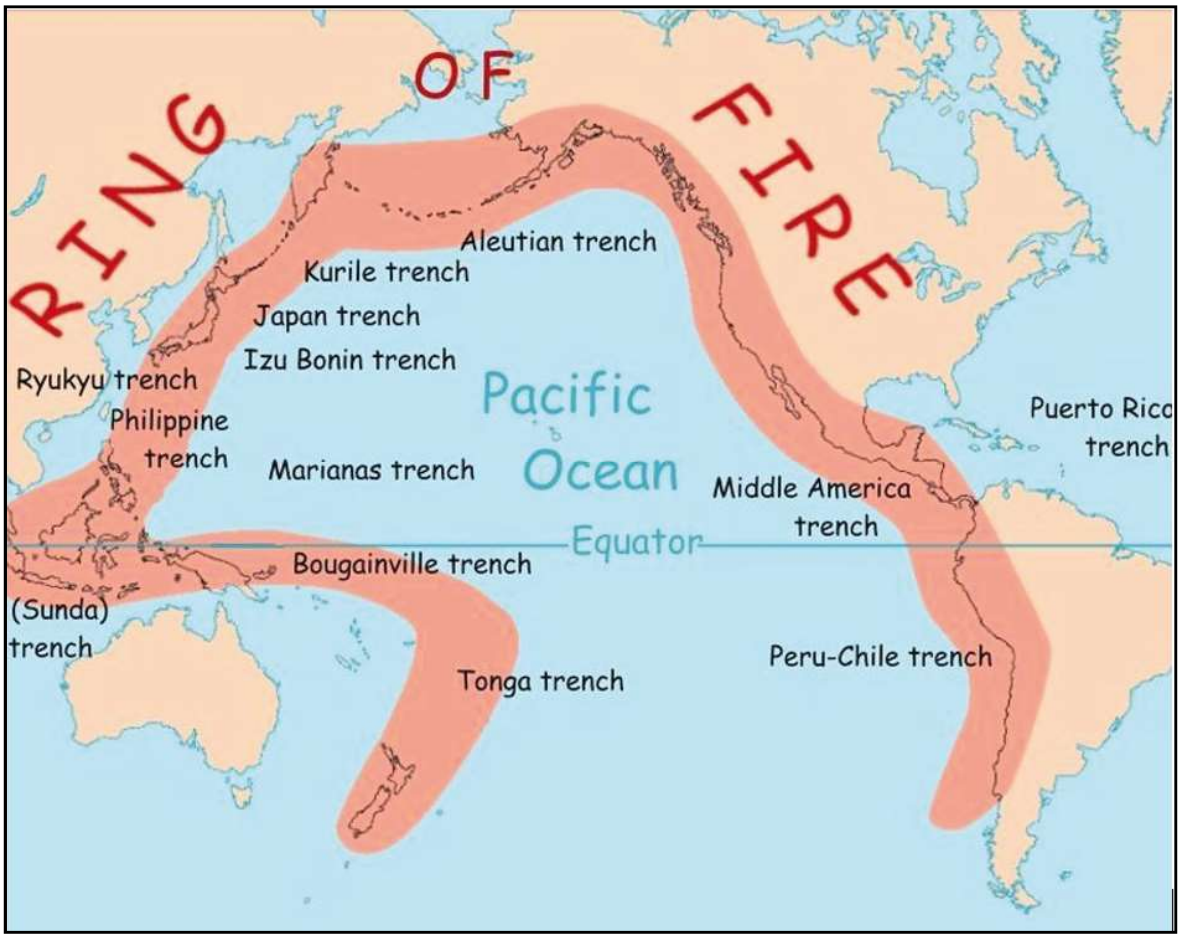
Ring of Fire

Context:

The Pacific 'Ring of fire' is situated just over 60 kilometers from the island nation of Tonga, where recently **Hunga Tonga-Hunga Ha'apai volcano** erupted sending ash and smoke thousands of feet into the air.

Background:

- The **Ring of Fire** (also known as the **Pacific Ring of Fire**) is a region around much of the rim of the Pacific Ocean where many volcanic eruptions and earthquakes occur.
- The Ring of Fire is a horseshoe-shaped belt about 40,000 km (25,000 mi) long and up to about 500 km (310 mi) wide.



- The Ring of Fire is a direct result of plate tectonics: specifically the movement, collision and destruction of lithospheric plates under and around the Pacific Ocean.
- The collisions have created a nearly continuous series of **subduction zones**, where volcanoes are created and earthquakes occur.
- Consumption of oceanic lithosphere at these convergent plate boundaries has formed **oceanic trenches, volcanic arcs, back-arc basins and volcanic belts.**
- The Ring of Fire is not a **single geological structure**. Volcanic eruptions and earthquakes in each part of the Ring of Fire occur independently of eruptions and earthquakes in the other parts of the Ring.

- The Ring of Fire contains approximately 850–1,000 volcanoes that have been active during the last 11,700 years (about two-thirds of the world's total).
- The four largest volcanic eruptions on Earth in the last 11,700 years occurred at volcanoes in the Ring of Fire.
- More than 350 of the **Ring of Fire's volcanoes** have been active in historical times
- Beside and among the currently active and dormant volcanoes of the Ring of Fire are belts of older extinct volcanoes, which were formed long ago by subduction in the same way as the currently active and dormant volcanoes; the extinct volcanoes last erupted many thousands or millions of years ago.
- The Ring of Fire has existed for more than 35 million years but **subduction** has existed for much longer in some parts of the Ring of Fire.

Interesting facts

- The **world's highest active volcano is Ojos Del Salado (6,893 m or 22,615 ft)** is in the Andes Mountains section of the Ring of Fire.
  - It forms part of the border between **Argentina and Chile** and it last erupted in AD 750.
- Another **Ring of Fire Andean volcano** on the **Argentina-Chile border** is **Llullaillaco** (6,739 m or 22,110 ft), which is the world's highest historically active volcano, last erupting in 1877.
- About 76% of the Earth's seismic energy is released as earthquakes in the Ring of Fire
- About 90%of the Earth's earthquakes and about 81%of the world's largest earthquakes occur along the Ring of Fire.
- The Ring of Fire includes the **Pacific coasts of South America, North America and Kamchatka,** and some islands in the **western Pacific Ocean.**

SUBDUCTION:

- Subduction happens when tectonic plates shift, and one plate is pushed under another. This movement of the ocean floor produces a "mineral transmutation", which leads to the melting and solidification of magma i.e., the formation of volcanoes.
- In other words, when a "down going" oceanic plate is pushed into a hotter mantle plate, it heats up, volatile elements mix, and this produces the magma. The magma then rises up through the overlying plate and spurts out at the surface.
- A subduction zone is the biggest crash scene on Earth. These boundaries mark the collision between two tectonic plates.
- When two tectonic plates meet at a subduction zone, one bends and slides underneath the other, curving down into the mantle, the hotter layer under the crust.

WHAT HAS HAPPENED IN RECENT ERUPTION IN TONGA?

- In the case of Tonga, the Pacific Plate was pushed down below the **Indo-Australian Plate** and **Tonga plate**, causing the molten rock to rise above and form the chain of volcanoes.
- Subduction zones are also where most of the violent earthquakes on the planet occur.
- The December 26, 2004 earthquake occurred along the subduction zone where the Indian Plate was sub-ducted beneath the **Burma plate**.

RIGHTS TO NATURE

Context:

Chile is poised to grant rights to nature in its constitution and could become the second such country in the world besides Ecuador in the next few days, according to a statement.

Analysis:

■ What are the "Rights of Nature"?

- According to the "Rights of Nature" doctrine, an ecosystem is entitled to legal personhood status and as such, has the right to defend itself in a court of law against harms, including environmental degradation caused by a specific development project or even by climate change.
- The Rights of Nature law recognizes that an ecosystem has the right to exist, flourish, regenerate its vital cycles, and naturally evolve without human-caused disruption.
- When an ecosystem is declared a "subject of rights," it has the right to legal representation by a guardian — much like a charitable trust designates a trustee — who will act on their behalf and in their best interest. This guardian is typically an individual or a group of individuals well versed in the care and management of said ecosystem.
- The goal of conferring rights to nature is to secure the highest level of environmental protection under which an ecosystem can thrive and whose rights are not violated. These nature rights are very often associated with human rights, especially the right to a clean and healthy environment.

■ What countries have declared rights of nature?

- In 2008, Ecuador became the first country in the world to formally recognize and implement the Rights of Nature, which Ecuadorians refer to as the Rights of Pachamama (Mother Earth).
- In 2011, the first lawsuit using the Rights of Nature provision was filed by the Global Alliance for Rights of Nature (GARN) and others against a construction company for building a road across Ecuador's Vilcabamba River and dumping rubble into the river.
- In 2017, four rivers sought and in some instances won legal rights: the Whanganui River in New Zealand, the Rio Altrato in Colombia, and the Ganga and Yamuna rivers in India.
- Most recently, in February 2021, the Innu Council of Ekuanitshit and the Minganie Regional County Municipality recognized the Canadian Magpie River's legal rights of personhood through the adoption of twin resolutions — one resolution by the Innu and another resolution by the municipality. The river bears nine rights and can be legally represented by guardians responsible for ensuring that these rights are respected.

■ How do the rights of nature fit in the climate crisis?

- Within the context of the climate crisis, the "Rights of Nature" represents one legal theory that can help elevate the urgency of protecting biodiversity in the fight against climate change.
- This year, countries are set to negotiate a global agreement to protect nature under the United Nations Convention on Biological Diversity in Kunming, China. A coalition of more than 50 countries, known as the **High Ambition Coalition for Nature and for People**, has committed to protecting 30% of the Earth's land and waters by 2030 in order to curb biodiversity loss and greenhouse gas emissions — the **30 X 30 target.**

SIBERIAN TUNDRA

Context:

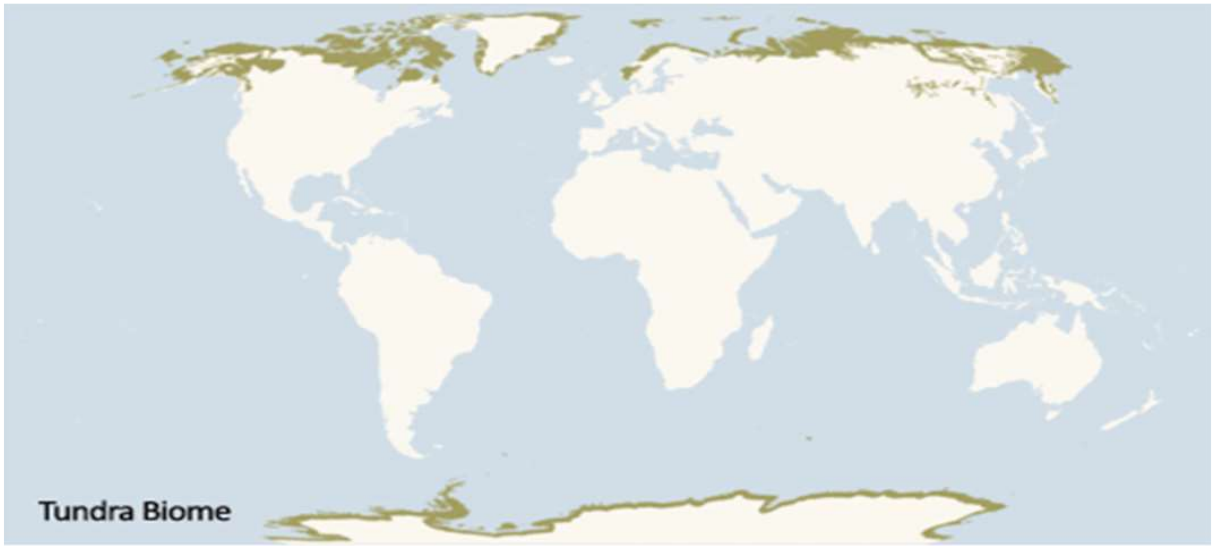
An Arctic temperature record of more than 100 Fahrenheit or 38 Celsius was reached in a Siberia town last year during a prolonged heatwave that cause widespread alarm about the intensity of global warming, a UN agency confirmed recently.

The average temperature

- The average **surface air temperatur**e over the Arctic for this past year (October 2020-September 2021) was the 7th warmest on record.
- This is the 8th consecutive year since 2014 that surface air temperatures were at least 1°C above the long-term average.
- The Arctic continues to warm more than twice as fast as the rest of the globe.

Distribution of Tundra Biome

There are three types of Tundra Regions in the world viz. *Arctic Tundra, Alpine Tundra and Antarctic Tundra*. In Northern hemisphere, the Tundra occurs north of the Taiga belt.



Salient Features of Tundra Biome

- The *most important characteristic of Tundra is the Permafrost*. Permafrost is the permanently frozen soil. Permafrost is consisting mostly of gravel and finer material. The soil is frozen from 25-90 cms down and *very few plants can grow in it*, so the permafrost is plain without many trees. Some parts of the permafrost are bare and support growth of *some lichens*.
- There are *ONLY two seasons in Polar Tundra regions viz. summer and winter*. During winter, it is very cold and dark, while during summer, the temperature rises a bit and the permafrost melts at some points, making the ground soggy.
- The Arctic Tundra is known for its cold, desert-like conditions. In winter the temperature of Arctic Tundra regions may drop as down as -50°C. The average winter temperature is -34° C (-30° F), but the average summer temperature is 3-12° C (37-54° F) which enables this biome to sustain life. Rainfall may vary in different regions of the arctic. Annual precipitation, including melting snow, is 15 to 25 cm.

- In summer, the upper layer of Permafrost gets melted and when water saturates the upper surface, bogs and ponds may form, providing moisture for plants. There are ***no deep root systems*** in the vegetation of the arctic tundra; however, there are still a wide variety of plants that are able to resist the cold climate. There are about 1,700 kinds of plants in the arctic and subarctic, and these include low shrubs, sedges, reindeer mosses, liverworts, and grasses, more than 400 varieties of flowers and crustose and foliose lichen.
- The fauna in the arctic is also diverse. They include herbivorous mammals such as lemmings, voles. Carnivorous mammals such as arctic foxes, wolves, and polar bears. Migratory birds such as ravens, snow buntings, falcons. Insects such as mosquitoes, flies, moths, grasshoppers, black flies. Fishes such as cod, flatfish, salmon, and trout.

Difference between Arctic Tundra and Alpine Tundra

- The major difference between the arctic Tundra and Alpine Tundra is that unlike the arctic tundra, the soil in the alpine is well drained.
- The Alpine Tundra does not have permafrost.
- The *plants of Alpine Tundra are very similar to those of the arctic ones, however there is a major difference in the fauna of Arctic Tundra* and Alpine Tundra.
- Kea parrot, marmot, mountain goats, chinchilla, woodland caribou, and pika are some of the best known species of Alpine Tundra.

CONCERNS:

■ Global Warming & Tundra Climate

Due to global warming, the future of the tundra becomes more uncertain. The global warming has caused spread of more woody plants by the increasing temperatures, and it has been feared that it may endanger moss and lichen species in two fifths of the biome in the years to come.

■ Oil Drilling in Tundra

Oil Drilling is popular in the tundra because it is rich in mineral resources. The pollution caused by Oil drilling would kill the habitats of fish, and animals. The major problem of oil drilling is the risk of oil spills. When a large spill occurs, it can kill many tiny organisms when it comes in contact with it. As a result, plants will die and will not be able to produce oxygen that we need to live. Also, the herbivores in the ecosystem will die because they will have no food to eat. This can cause major damage to the food chain.

SPACE HURRICANE

Context:

Satellite observations have revealed an unprecedented 'space hurricane' in Earth's upper atmosphere, for the first time.

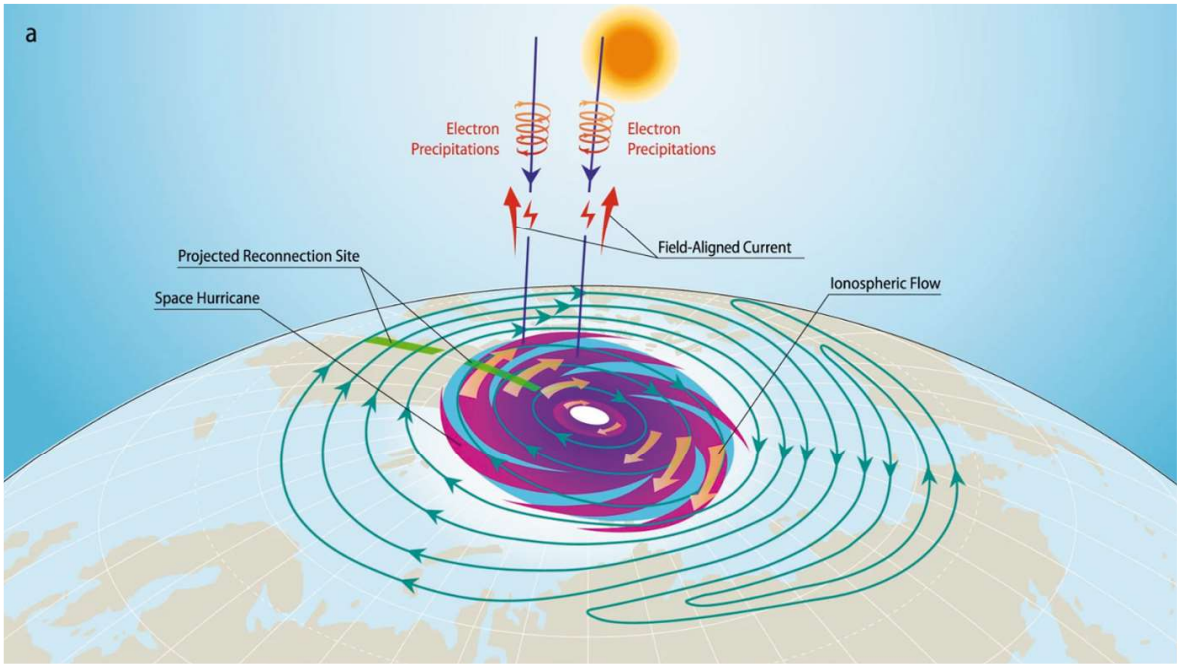
The discovery:

- A 'space hurricane' is a swirling mass of plasma. The space hurricane has been spotted in Earth's ionosphere.
- The whole thing lasted nearly eight hours, depositing vast amounts of energy and momentum into the ionosphere.

- The event was a whirling pattern not in the air, but in plasma, ionized gas that is found throughout the Solar System, including in Earth's upper atmosphere.
- The hurricane was spinning in a counter clockwise direction (like hurricanes do in the Northern Hemisphere), had multiple spiral arms, and lasted almost eight hours before gradually breaking down.
- Like its more mundane counterparts, the space hurricane had a quiet center, multiple spiral arms, and widespread circulation.
- It also featured precipitation, but of energetic electrons rather than water droplets.
- The authors found that a 3D model could reproduce the event's main features and explained its formation.
- Space hurricanes might be universal phenomena at planetary bodies with magnetic fields and plasma across the Universe.
- **Electrons instead of water:** Unlike other hurricanes, however, the space hurricane rained **electrons** into the ionosphere. This had a stunning effect: a huge, cyclone-shaped aurora below the hurricane.

Formation:

- Space hurricanes are caused by plasma unleashed from the sun as the solar wind. These charged particle clouds travel through space and fuel magnetic storms as they interact with magnetic fields.



URBAN GREENING

Context:

- As our cities grow, it's important to consider the impact these spaces have on nature. What was once grassland or forest is now covered in concrete - how does that affect the area's ecosystem?
- The world is learning more about climate change every day, which has led to green spaces being featured more prominently in urban planning.

What exactly is "urban greening"?

- It has been defined as "public landscaping and urban forestry projects that create mutually beneficial relationships between city dwellers and their environments".
- In short, it's making urban spaces green!
- The most common forms of urban greening are installing trees, parks, and landscaped green areas in newly-built urban projects.

AIM OF URBAN GREENERY:

- The aims of urban greening are numerous, but effective; they improve the lives of the people and wildlife in the area, as well as making our cities eco-friendlier and pleasing to the eye.
- Climate change isn't just about rising sea levels; we can see the effects of excessive pollution in urban areas, the smog of Beijing being an extreme example.
- Cities all around the world are using urban greening to protect and improve their skylines and their health.

Benefits of urban greening

- Combat air and noise pollution.
- Soaks up rainwater that may otherwise create flooding.
- Creates a habitat for local wildlife.
- Offsets carbon emissions in the local area.
- It has shown to lift morale in the people who see it, with physical and mental health benefits.
- Calming traffic and lessening urban crime.

As climate change becomes a more prominent issue, architects and city planners alike have been exploring ways to create sustainable urban living.

EXAMPLES:

■ LIVING WALL:

A living wall or tree-lined path exponentially increases a site's positive environmental impact. These installations pump vast amounts of oxygen into the air around them, as well as absorbing equally vast amounts of carbon dioxide which would otherwise harm the people around it.

■ GREEN ROOF:

A green roof or living roof is a roof of a building that is partially or completely covered with vegetation and a growing medium, planted over a waterproofing membrane. It may also include additional layers such as a root barrier and drainage and irrigation systems.

■ How will urban greening be used in the future?

- The urban environment is constantly evolving and growing, as more people move to cities and industries thrive.
- One vital contribution that urban greening makes is combatting climate change, by making the local area more eco-friendly - urban greening helps with local oxygen and floodwater levels, as well as providing habitats for wildlife.
- Urban greening has proven to be a smart way to include greenery into our least environmentally-friendly areas, and could be the way forward for eco-conscious societies.