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IAS 2021

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Contents

1 PHYSICAL GEOGRAPHY

1 Saline Solution: How MGNREGA helped Nagapattinam recover from the 2004 Tsunami

Context: The tsunami of 2004 that claimed over 7,000 lives in the state of Tamil Nadu has changed the fortune of the fertile land of **Nagapattinam**, Tamil Nadu in a land of saline soil with saline groundwater.

About the soil at Nagapattinam (before the tsunami)

- Nagapattinam is located along the coast in the delta region of the **Cauvery River.**
- It had a **rich alluvial soil** profile and a healthy groundwater table.
- The annual average rainfall is high at 1,341 mm which is quite good for farming.

What is Soil salinity?

- It is the condition of the presence of salt content in the soil. The process of increasing the salt content is known as **salinization.**
- Salinization can be caused by natural processes as well as artificial process:
  - **Natural**: Mineral weathering and the gradual withdrawal of an ocean
  - **Artificial:** Irrigation and road salt

Impacts of the Tsunami, 2004

- **Soil Salinity:** The soil salinity level has reached an unprecedented level.
  - The s**oil's electrical conductivity level**, which is a measure of the number of salts in the soil get stripled after the tsunami.
- **Productivity:** The farmlands have **lost productivity up** to 50 percent of what they would before the tsunami.
- **Unemployment:** People involved in fishing and farming has lost their sources of income.

How the MGNREGA helped in regaining the loss?

- The **MGNREGA was introduced in Nagapattinam in 2006** to help people to rebuild their lives slowly.
- The various activities were included under the MGNREGA, such as:
  - The de-silting and deepening of the village pond were started.
  - The rainwater was started to store in the pond which reduced the salinity

- Construction of farm bunds with the deepening of irrigation canals
- employment opportunity to women at the farms to supplement their incomes
- Setting up of plant nurseries
- Plantation of particular coconut tree varieties to reduces the groundwater salinity
- Recreation of parks

Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA)

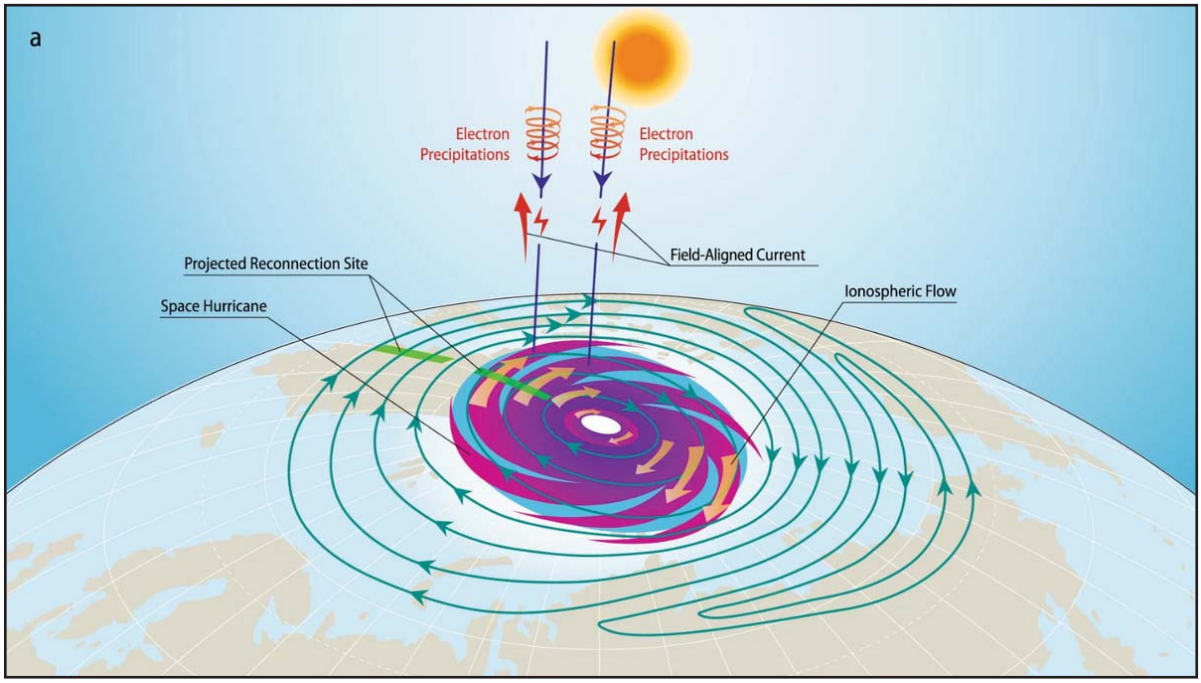
- **Aim**: The act was passed in 2005 which aims to provide the right to work.
- **Objective:** to enhancing livelihood security in rural areas by providing at least 100 days of guaranteed wage.
- **Implementation:** MGNREGA is to be implemented mainly through the gram panchayats (GPs)
- **Legality:** Employment under MGNREGA is a legal entitlement

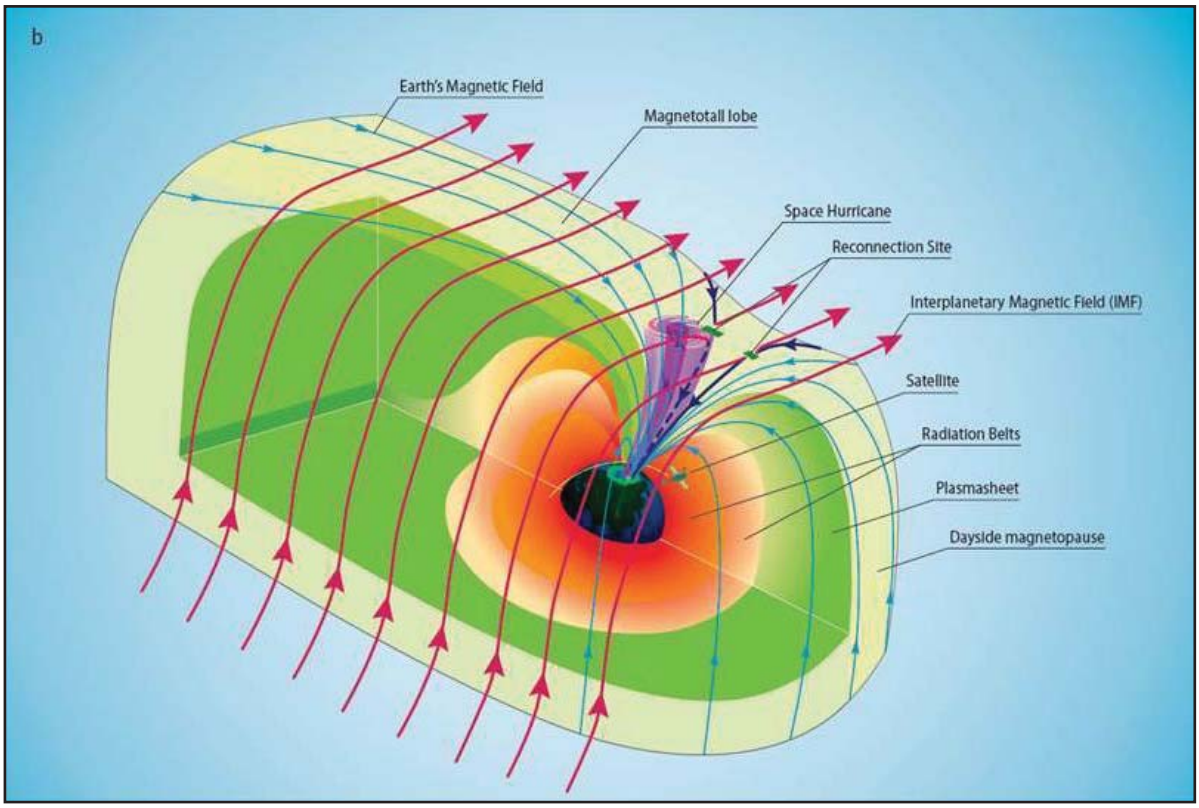
2 The first known 'Space Hurricane' pours 'Electron Rain'

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

What is Space Hurricame (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.





Features of space hurricane:

- 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.
- Like its more mundane counterparts, the space hurricane had a quiet centerand widespread circulation.
- It also featured **precipitation,** but of energetic electrons rather than water droplets.

How is it different and similar to earth hurricanes?

- **Difference**
  - **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.
- **Similarity**
  - The space hurricane — which took place during a period of low geomagnetic activity — had many similar features with that of hurricanes of the Earth that form in Earth's lower atmosphere.
  - **Huge Amount of Energy:** Tropical storms are associated with huge amounts of energy, and these space hurricanes must be created by unusually large and rapid transfer of solar wind energy and charged particles into the Earth's upper atmosphere.

Can they create problem?

- These space hurricanes can, probably, lead to:
  - increased satellite problems

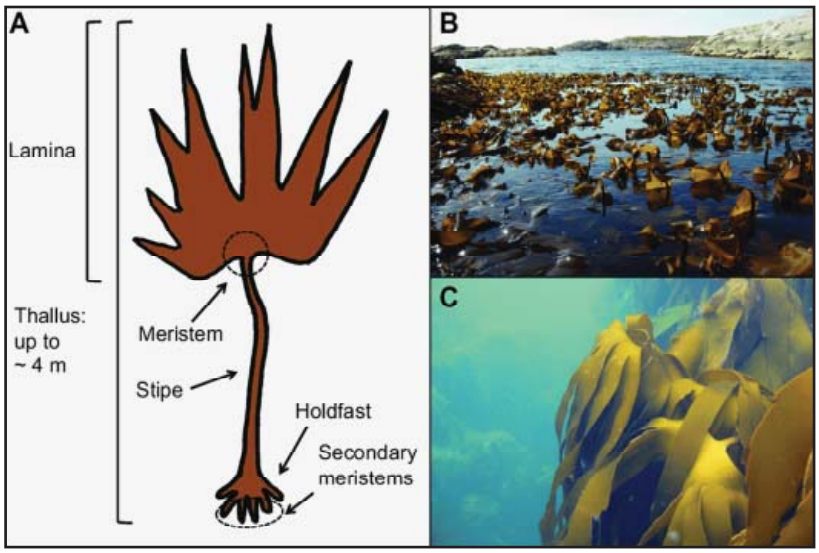
- disturbances in high-frequency radio communications, satellite navigation, communication systems
- increased errors in the over-the-horizon radar location
- grid failure

3 Could kelp help relieve ocean acidification?

Context: A new analysis of **California's Monterey Bay** evaluates kelp's potential to reduce ocean acidification, the harmful fallout from climate change on marine ecosystems and the food they produce for human populations.

What is Kelp?

- Kelp is the largest and fastest-growing marine algae or seaweed.
- It belongs to the brown algae group known as **Phaeophyta.**
- Although kelp may resemble an underwater plant, it is in fact a **protist**, the same family of organisms as moulds and amoebas.
- Kelp forests are found in the temperate and polar coastal regions of the world.



Why does kelp matter?

- Kelp is a keystone organism, which means its role in the ecosystem is so vital, that without it the ecosystem would collapse.
- Kelp forests are among the most productive ecosystems in the world
- Kelp purifies water and removes waste products produced by the animals living within the forests
- Underwater forests provide shelter, food and the ideal habitat for various species
- Commercially, kelp is used in a wide variety of products, from salad dressings, cosmetics, food, vitamin supplements, skin care products, paint, etc.

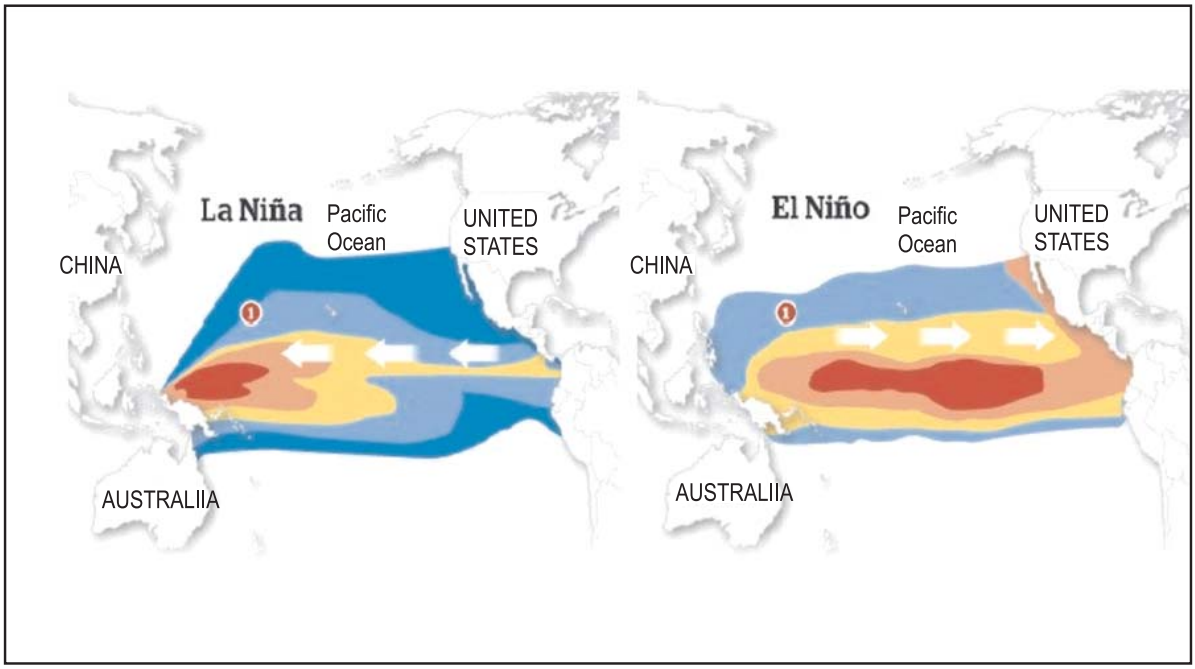
4 La Niña Weather Phenomenon

Context: The **La Niña weather phenomenon** is back in the central and eastern equatorial Pacific Ocean after nearly a decade's absence, the **World Meteorological Organization (WMO)** said in its October 2020 Global Seasonal update.

What is La Niña?

- La Niña means the large-scale cooling of ocean surface temperatures in the central and eastern equatorial **Pacific Ocean**, together with changes in the tropical atmospheric circulation, namely winds, pressure and rainfall.

- It has the opposite impacts on weather and climate as **El Niño**, which is the warm phase of the **El Niño Southern Oscillation (ENSO).**



Reason behind 'no cyclone' developments this year

- **Weak La Nina:** The weak La Nina conditions along the equatorial Pacific Ocean can be the reason behind the no cyclone development.
- Because **Madden Julian Oscillation (MJO)** was positioned in a favourable phase, the low-pressure systems intensified maximum up to a deep depression.
  - MJO is kind of an eastward-moving cyclic weather event along the tropics that influences rainfall, winds, sea surface temperatures and cloud cover.
  - They have a 30 to 60-day cycle.
- The **vertical wind shears**— created due to significant wind speed difference observed between higher and lower atmospheric levels— prevented the low-pressure systems and depression from strengthening into a cyclone.

What causes La Niña?

- **Lower sea surface temperatures**
- **Stronger easterly trade winds**
- **Upwelling:**Unusually strong, eastward-moving trade winds and ocean currents bring this cold water to the surface, a process known as **upwelling.**

What are the effects of La Niña?

- Both El Niño and La Niña affect patterns of rainfall, atmospheric pressure, and global atmospheric circulation.
  - Increased rainfall
  - Catastrophic floods
  - Decreased cloud production
  - Drier than normal condition
  - Improved marine ecosystem

Impact of La Niña in India

- In India, La Niña means the country will receive more rainfall than normal, leading to floods.
- The rare episodes of **"frost in Mahabaleshwar"** and **"cold waves in hilly parts of Tamil Nadu and so on"** can be associated with a La Niña.
- A La Niña can affect India's winter. The winds during the winter are from the northeast near the land surface and this is accompanied by Southwesterly Jet in the upper atmosphere.
- During an El Niño, this jet is pushed southward and this allows more western disturbance to bring rain and snow into northwestern India.
- But a La Niña actually produces a more north-south low pressure system which brings in Siberian air and the cold wave can extend much further south.

5 INCOIS found a method of improving wave forecast

Context: Researchers at the **Indian National Centre for Ocean Information Services (INCOIS)**, Hyderabad, have found a method of improving wave forecasts. They have ascertained that certain phases of boreal summer intra seasonal oscillation or BSISO induce high-wave activity in the northern Indian Ocean and Arabian Sea.

What is Boreal Summer Intra-Seasonal Oscillation (BSISO)?

- **Boreal Summer Intra-Seasonal Oscillation (BSISO)** is the movement of convection (heat) from the Indian Ocean to the western Pacific in roughly every 10–50 days of the monsoon season from June to September.
- BSISOs represent monsoon's 'active' and 'break' periods, in which weeks of heavy rainfall give way to brilliant sunshine before starting all over again.
- The active phase also enhances monsoon winds and hence the surface waves.

Significance of the findings

- **Better forecast:**The finding will help to improve wave forecasts in the Indian coastal region and help mitigate the adverse impacts of high waves such as coastal flooding and erosion. This finding has a great significance in developing seasonal and climate forecast service for waves and coastal erosion for India.
- **Effective planning:**It will also aid better planning of sea navigation routes in the northern Indian Ocean waters.
- **Efficient coastal and marine management:**Wave forecast advisories based on the BSISO would be more useful for efficient coastal and marine management

6 Solar Corona Puzzle Cracked

Context: A solar mystery known for decades may have finally been cracked by three Indian astrophysicists, who solve the puzzle with the help of the available data from **Murchison Widefiled Array (MWA).**

About:

- The Sun's corona is the outermost part of the Sun's atmosphere. The corona is usually hidden by the bright light of the Sun's surface.
- That makes it difficult to see without using special instruments. However, the corona can be viewed during a total solar eclipse.
- The corona reaches extremely high temperatures. However, the corona is very dim. The corona is about 10 million times less dense than the Sun's surface.
- This low density makes the corona much less bright than the surface of the Sun.

How does the corona cause solar winds?

- The corona extends far out into space. From it comes the solar wind that travels through our solar system.
- The corona's temperature causes its particles to move at very high speeds. These speeds are so high that the particles can escape the **Sun's gravity.**

The mystery

- The corona's high temperatures are a bit of a mystery. Astronomers have been trying to solve this mystery for a long time.
- **The corona is in the outer layer of the Sun's atmosphere—far from its surface. Yet the corona is hundreds of times hotter than the Sun's surface.**

Highlights of the observation

- The scientists have likened the flashes to smoking guns of small magnetic explosions, which according to the researchers, is the first evidence of its existence.
- They have discovered tiny flashes of radio light emanating from all over the Sun.
- These radio lights or signals result from beams of electrons accelerated in the aftermath of a magnetic explosion on the Sun.
- These weak radio flashes are 'smoking guns' or the evidence for the same and hence bring us closer to explaining the coronal heating problem.
- These observations were the strongest evidence till date that the tiny magnetic explosions, originally referred to as 'nanoflares' by eminent **American solar astrophysicist Eugene Parker**, can indeed be heating up the corona (the aura of plasma that surrounds the sun and other stars).

About Murchison Widefield Array (MWA)

- The Murchison Widefield Array (MWA) is the world's newest telescope, built in Western Australia as part of the worldwide **Square Kilometre Array (SKA)** network.
- The MWA is located 315km northeast of Geraldton at the Murchison Radio-astronomy Observatory, a **"radio quiet"** area larger than Tasmania.
- Within this area, radio transmissions are strictly restricted and monitored, making it one of the quietest places in the world – perfect for carrying out radio astronomy.
- The main objective of the MWA are to detect neutral atomic Hydrogen emission from the **cosmological Epoch of Reionization (EoR),** to study the sun, the heliosphere, the Earth's ionosphere, and radio transient phenomena, as well as map the **extragalactic radio sky.**

7 WMO certifies Megaflash lightning extremes

Context: A World Meteorological Organization's (WMO) committee of experts has established two new world records for the longest reported distance and the longest reported duration for a single lightning flash in, respectively, Brazil and Argentina.

What are Megaflashes?

- Megaflashes, refers to a name given to lightning discharges that reach hundreds of kilometers in length.
- Ideal conditions for a megaflash occurrence involve large electrified clouds with low flash rates that are attached to more active thunderstorm cells.

The mechanism behind lightning

- Lightning is an electrical discharge caused by imbalances between storm clouds and the ground, or within the clouds themselves. Most lightning occurs within the clouds.
- "Sheet lightning" describes a distant bolt that lights up an entire cloud base. Other visible bolts may appear as bead, ribbon, or rocket lightning.
- During a storm, colliding particles of rain, ice, or snow inside storm clouds increase the imbalance between storm clouds and the ground, and often negatively charge the lower reaches of storm clouds.
- There are three categories of lightning:
  - **intracloud (IC),** which is flashes within a cloud
  - **cloud to cloud (CC),** where lightning jumps from one cloud to another
  - **cloud to ground (CG),** where lightning strikes from the ground. This is the most well understood kind of strike and the riskiest to life.
- Objects on the ground, like steeples, trees, and the Earth itself, become positively charged—creating an imbalance that nature seeks to remedy by passing current between the two charges.
- Lightning is extremely hot—a flash can heat the air around it to temperatures five times hotter than the sun's surface.
- **Thunder:**This heat causes surrounding air to rapidly expand and vibrate, which creates the pealing thunder we hear a short time after seeing a lightning flash.

The new records

- The new records for "megaflashes", verified with new satellite lightning imagery technology, more than double the previous values measured in the United States of America and France.
- The findings were published by the American Geophysical Union's Geophysical Research Letters ahead of **International Lightning Safety Day on 28 June.**
- **WMO's Committee on Weather and Climate Extremes,** which maintains official records of global, hemispheric and regional extremes found that:

- World's greatest extent for a single lightning flash is now 440.6 miles.
- The world's greatest extent for a single lightning flash is a single flash that covered a horizontal distance of 709 ± 8 km (440.6 ± 5 mi) across parts of southern Brazil on 31 October 2018.
  - This is equivalent to the distance between Boston and Washington DC in the United States of America or between London and the border of Switzerland near Basel.
- The greatest duration for a single lightning flash is 16.73 seconds from a flash that developed continuously over northern Argentina on 4 March 2019.

Tracking of lightning events in India

- Occurrences of lightning are not tracked in India, and there is simply not enough data for scientists to work with.
- Just one group of scientists, at the **Indian Institute of Tropical Management (IITM)** in Pune, works full-time on thunderstorms and lightning.

8 Earth's Magnetic Field is Weakening

Context: The Earth's magnetic field is weakening between **Africa** and **South America**, causing issues for satellites and space craft.Scientists studying the phenomenon observed that the South Atlantic Anomaly has grown considerably in recent years, though the reason for it is not entirely clear.

What is the magnetic field of Earth?

- Earth's magnetic field is the magnetic field that extends from the **Earth's interior** out into space exerting a force on the charged particles emanating from the Sun.
- It gets stretched out into a comet-like shape with a tail of magnetism that stretches millions of miles behind the Earth, opposite from the Sun.
- The magnetic field of Earth protects the life of Earth from the harmful cosmic radiation and charged particles emitted from the Sun.

What causes it?

- The magnetic field of the Earth is due to the **metallic and liquid outer core** of the planet, around 3,000 km below our feet.
- It creates electric currents that generate and change our **electromagnetic field.** The outer core of the planet is like a **giant dynamo.**
- The rotation of the Earth creates movements inside the liquid outer core which gives rise to the geomagnetic field.
- The **Northern Lights** in the **Polar Regions** are also caused by the **magnetic field of Earth** – the energy particles emitted by the Sun are channelled by the Earth's magnetic field towards the poles, where they interact with the atmosphere to create the aurora borealis.

What scientists have found?

- The area of the anomaly dropped in strength by more than 8 per cent between 1970 and 2020.
- The magnetic field has lost nearly nine per cent of its strength on a global average in the last 200 years.
- This year, the "minimum field strength" in the South Atlantic Anomaly has seen a drop of around 24,000 nanoteslas to 22,000 from its strength in 1970.
- The area of anomaly has also grown in this period. The patch has also moved farther west at a rate of roughly 12 miles per hour over the last 50 years.
- The last time a "geomagnetic reversal" took place was 780,000 years ago, with some scientists claiming that the next one is long overdue. Typically, such events take place every 250,000 years.

Van Allen radiation belts:

- A radiation belt refers to a layer of charged and energetic particles which is held by the planet's magnetic field around the planet.
- The Van Allen belt specifically refers to the radiation belts around the Earth.
- The main constituents of the belts are believed to come from solar wind and cosmic rays. The belt is divided into two belts - outer and inner.
  - The **inner belt** extends from roughly 600 miles to 3,700 miles, that is, from 1,000 km to 6,000 km above the earth's surface.
  - The **outer belt** extends from 9,200 miles (15,000 km) to 15,600 miles (25,000 km) above the surface.

9 Cyclone Amphan

Context: As Cyclone Amphan approaches close to the **Bay of Bengal,** millions of lives are at risk. Higher than normal temperatures in the Bay of Bengal region is triggering **'super cyclones'.**

What is Amphan?

- **Super cyclone Amphan** is the strongest storm to have formed in the **Bay of Bengal.**
- This is only the second super cyclone to form over the Bay of Bengal in two decades. In 1999, a super cyclone killed about 10,000 people as it slammed into Odisha.
- Amphan, which means "sky" in Thai, currently packs the punch of a **Category 5 hurricane.**
- Cyclone Amphan intensified from a category-1 cyclone to category-5 in 18 hours, an unusually quick evolution.
- Last year **Fani, a category 4 cyclone,** which swept through the Odisha coast, was again fuelled by high temperatures in the BoB.

What is Tropical Cyclone?

- A tropical cyclone is a rapid rotating storm originating over tropical oceans from where it draws the energy to develop.
- It has a low pressure center and clouds spiraling towards the eyewall surrounding the "eye", the central part of the system where the weather is normally calm and free of clouds.
- Its diameter is typically around 200 to 500 km, but can reach 1000 km.
- A tropical cyclone brings very violent winds, torrential rain, high waves and, in some cases, very destructive storm surges and coastal flooding.
- This weather phenomenon is named with different terms depending on the location.
- In the Caribbean Sea, the Gulf of Mexico, the North Atlantic Ocean and the eastern and central North Pacific Ocean, such a weather phenomenon is called **"hurricane"**
  - In the western North Pacific, it is called **"typhoon"**
  - In the Bay of Bengal and Arabian Sea, it is called **"cyclone"**
  - In western South Pacific and southeast India Ocean, it is called **"severe tropical cyclone"**
  - In the southwest India Ocean, it is called **"tropical cyclone"**

Storm Surge:

- The term "storm surge" refers to rising seas whipped up by a storm, creating a wall of water several metres higher than the normal tide level.
- The surge can extend for dozens of kilometres inland, overwhelming homes and making roads impassable.
- A storm surge is shaped by a number of different factors, including storm intensity, forward speed, the size of a storm and the angle of approach to the coast.

10 Earth's seismic Noise

Context: In a latest development, scientists at **the British Geological Survey (BGS)** have reported a change in the **Earth's seismic noise** and vibrations amid the coronavirus lockdown.

What is Seismic noise?

- In geology, seismic noise refers to the relatively persistent vibration of the ground due to a multitude of causes.
- It is the unwanted component of signals recorded by a **seismometer**.

Seismometer is the scientific instrument that records ground motions, such as those caused by earthquakes, volcanic eruptions, and explosions.

- This noise includes vibrations caused due to human activity, such as transport and manufacturing, and makes it difficult for scientists to study seismic data that is more valuable.
- Apart from geology, seismic noise is also studied in other fields such as oil exploration, hydrology, and earthquake engineering.

Why seismic noise levels are reducing now?

- Due to the enforcement of lockdown measures around the world to tackle the novel coronavirus pandemic, the Earth's crust has shown reduced levels of vibration.
- The ground vibrations are incredibly sensitive so they also pick up other sources of vibration, including human activity, such as road traffic, machinery and even people walking past.
- All these things generate vibrations that propagate as seismic waves through the Earth.

11 Extreme Heat Events in India's Cities: A Framework for Adaptive Action Plans

Context: Among the most severe consequences of climate change is the **global rise in average temperatures**, and the resultant **heatwaves.**

What are Heatwaves?

- A heatwave refers to surface temperatures being significantly higher than normal for several days at a time.

- The World Meteorological Organization defines heatwaves as **"five or more consecutive days during which the daily maximum temperature surpasses the average maximum temperature by 5°C (9°F) or more".**
- However, there is no universally accepted definition for heatwaves.
- Heatwaves are measured relative to the usual weather in an area and the normal temperatures for the season, and so definitional differences are reflective of global climatic variations and the geographically variable nature of heatwaves and their impact.

Important Reports

- In its **Fifth Assessment Report (2013),** the **United Nations Intergovernmental Panel on Climate Change (IPCC)** revealed that between 1880 and 2012, the average global temperature rose by **0.85 percent**.
  - The report also stated that a great deal of irreversible damage had already been triggered and most aspects of climate change will persist for centuries, even if emissions are controlled.
- A **2018 IPCC report** concluded that many of the adverse impacts of climate change would come at the 1.5°C mark, including-
  - extreme temperatures in most inhabited regions
  - a rise in mean sea level
  - heavy precipitation in many areas
  - the probability of drought and precipitation deficits in some areas

India and Heatwaves

- India routinely experiences hot summers but, in recent years, several parts of the country have seen abnormally high temperatures—**4°C-5°C (39.2°F-41°F) above normal**—over several days, being defined as heatwaves.
- India's northwest region typically experiences heatwaves between March to June, and in rare cases until July.
- Urban habitats are more prone to disasters than rural areas—cities have frequently been hit by floods and other calamities and bore the brunt of the COVID-19 pandemic worldwide.
- Similarly, cities are more vulnerable to heatwaves due to the 'heat island effect'. Urbanised areas experience higher temperatures due to their built density.

Aren't 'heat waves' and 'loo' same?

- Additionally, during the summer months, north and northwest India also experience the **'loo'—strong, hot, dry winds** that blow during the day and sometimes until late in the evening.
  - On account of its extreme temperature, ranging between 45°C-50°C (115°F-120°F) and very low humidity, the 'loo' zaps the human body dry on exposure, leading to **fatal heatstroke.**
  - However, the 'loo' is a normal weather phenomenon in northern India, and heatwaves are considered to occur above this condition *not* before it.

What are health impacts of Heatwaves?

Heatwaves have several health impacts.

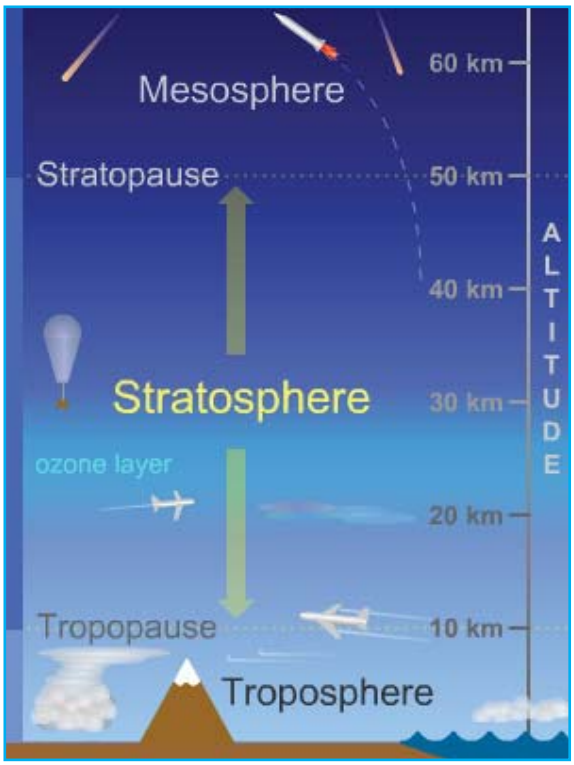
- Dehydration

- Heat cramps
- Heat exhaustion and/or heat stroke

12 Sudden Stratospheric Warming (SSM)

Context: A "sudden stratospheric warming" event took place in early January 2021, according to weather forecasting models.

What is sudden stratospheric warming (SSM)?



- The term **sudden stratospheric warming** refers to what is observed in the **stratosphere**.
- It is a rapid warming (up to about 50 °C in just a couple of days), between 10 km and 50 km above the earth's surface.
- The stratosphere is the layer of the atmosphere from around 10 km to 50 km above the Earth's surface.
- However, usually a few weeks later, knock-on effects on the jet stream can be seen, which in turn effects weather lower down (in the troposphere).
- However, the stratospheric sudden warming doesn't happen every year, and it doesn't always affect weather when it does.
- It was first discovered in **1952**.

How does it occur?

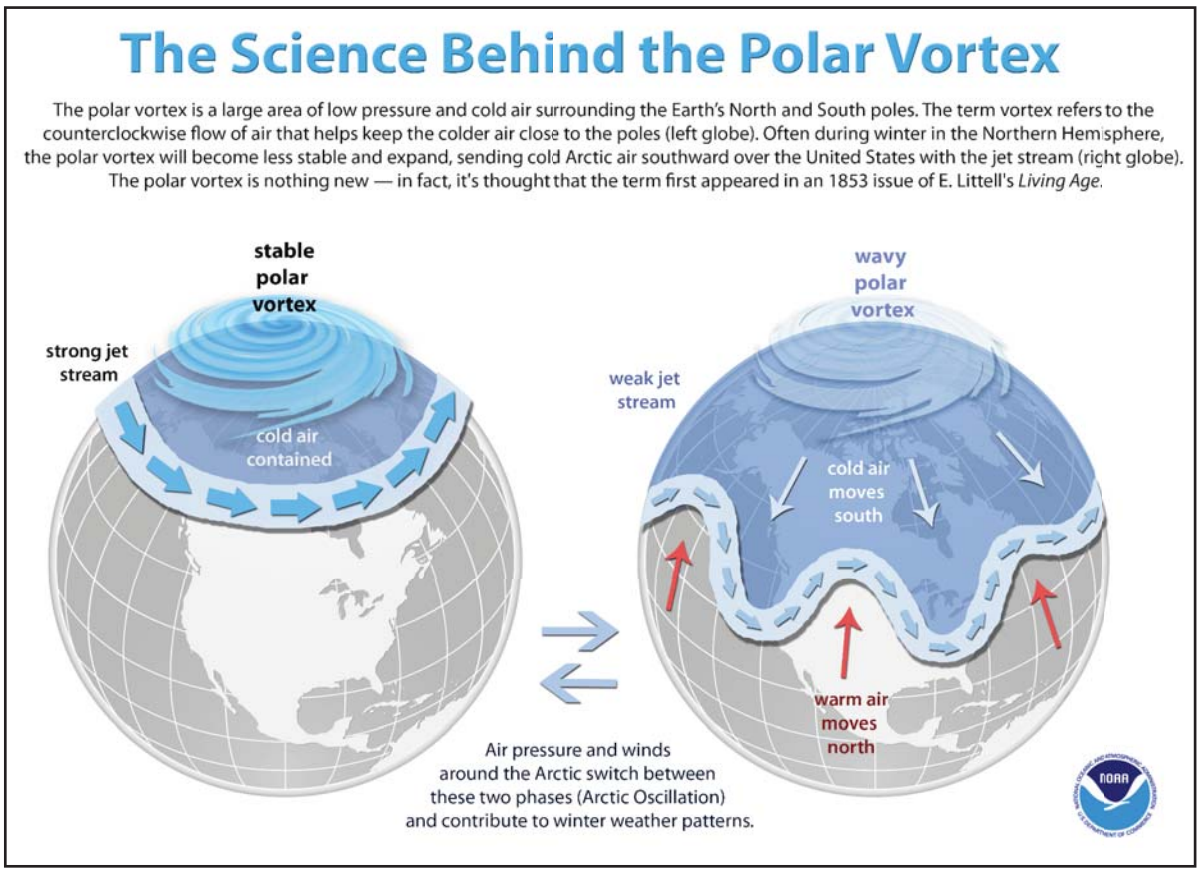
- Every year in winter, **strong westerly winds** circle around the pole high up in the stratosphere.
- This is called the **stratospheric polar vortex** and it circulates around cold air high over the Arctic.
- In some years, the winds in the polar vortex temporarily weaken, or even reverse to flow from east to west.
- The cold air then descends very rapidly in the polar vortex and this causes the temperature in the stratosphere to rise very rapidly, as much as 50°C over only a few days; hence the term sudden stratospheric warming.
- As the cold air from high up in the stratosphere disperses, it can affect the shape of the jet stream as the cold air sinks from the stratosphere into the troposphere.
- It is this change in the jet stream that causes our weather to change.

Any role of climate change?

- Sudden stratospheric warming events are a **natural atmospheric fluctuation**, not caused by climate change.
- So even with climate change, these events will still occur, which means that we need to be adaptable to an even more extreme range of temperatures.

What is Polar Vertex?

- Polar Vertex can refer to one of two different, but related, weather patterns.
- The polar vortex is a large area of **low pressure** and cold air surrounding both of the Earth's poles.
- It ALWAYS exists near the poles, but weakens in summer and strengthens in winter.
- The term "vortex" refers to the **counter-clockwise flow** of air that helps keep the colder air near the Poles.



13 Giant Iceberg A68a

Context: The world's (former) largest iceberg continues to break apart into smaller pieces on the doorstep of a major marine wildlife haven and home to millions of macaroni and king penguins in Antarctica. It has now split into 4 distinct pieces.

What is iceberg A68a?

- A68a became the world's largest iceberg when it split from **Antarctica's Larsen C ice shelf** in July 2017. A68a is an iceberg roughly the size of the state of Delaware.
- The massive chunk of ice has been drifting northward ever since. As recently as April, it measured 2,000 square miles (5,100 square kilometers), or just over the size of the state of Delaware.
- Since then it has been drifting towards the remote island of **South Georgia,** which is a **British Overseas Territory (BOT).**
- On its journey, smaller icebergs have calved from the iceberg and right now, the biggest section of the iceberg is called A68a and spans an area of roughly 2,600 sq. km.

What are icebergs?

- Icebergs are pieces of ice that for are med on land and float in an ocean or lake. Icebergs come in all shapes and sizes, from ice-cube-sized chunks to ice islands the size of a small country.
  - The term **"iceberg"** refers to chunks of ice larger than 5 meters (16 feet) across.
  - Smaller icebergs, known as bergy bits and growlers, can be especially dangerous for ships because they are harder to spot.
- The North Atlantic and the cold waters surrounding Antarctica are home to most of the icebergs on Earth.

14 Moon controls release of methane in Arctic Ocean: Study

Context: As per a latest study lead by University in Tromso (UIT), the moon has a role to play in 'controlling' the amount of **methane gas** released by the **Arctic Ocean.**

How Arctic Ocean leaks methane?

- In the field of methane emission research, the Arctic is one of the most important regions worldwide.

Methane

- Methane (CH_4) is a colorless, odorless, and highly flammable gas.
- It is the main component in natural gas, which is used to generate electricity and heat homes around the world.
- It is currently generated by human activities like fossil fuel production and transportation, livestock agriculture and the decay of organic material in landfills.
- It can be produced naturally and synthetically, and when burned in the presence of oxygen, it produces carbon dioxide and water vapor.
- **Use:** It is used
  - to produce heat and electricity around the world
  - to produce other important gases like hydrogen and carbon monoxide and carbon black, in chemical reactions

- Large quantities of methane are stored in the Arctic in **natural gas deposits**, **permafrost**, and as under sea **clathrates**.
  - Methane deposits in permafrost and hydrates are considered to be very sensitive in the expansive shallow-shelf regions, because with the relatively low pressures it would only take a small temperature change to release large amounts of methane.
- The potential for this gas to escape the ocean, and contribute to the greenhouse gas budget in the atmosphere, is an important mystery that scientists are trying to solve.
- The total amount of methane in the atmosphere has increased immensely over the past decades.
- The Arctic is considered ground zero in the debate about the vulnerability of frozen methane deposits – which have been called the **"sleeping giants of the carbon cycle"** - in the ocean, and if releases were to exceed a tipping point, it could increase the speed of global heating.

What are the sources of methane in Arctic Ocean?

There are two potential sources of methane in the Arctic.

- **Methyl clathrate:** The first source of methane is called methyl clathrate. Methyl clathrates are molecules of methane that are frozen into ice crystals.
- **Presence of organic material**: The other major source of methane in the Arctic is the organic matter frozen in permafrost, which contains a lot of carbon.

How moon controls the release of methane?

- The moon controls one of the most formidable forces in nature—the tides that shape our coastlines.
- Tides, in turn, significantly affect the intensity of methane emissions from the Arctic Ocean seafloor.

What are the major implications of the findings?

The findings have two major implications.

- **Methane emission:** The first concerns the amount of methane the Arctic Ocean may be releasing into the atmosphere.
  - Methane is an extremely potent greenhouse gas. Once released into the atmosphere, it has 86 times the warming potential of carbon dioxide before it decays to the latter after one or two decades.
- **Interaction of global warming with sea level rise:** The second implication has to do with how global warming will interact with sea level rise to influence Arctic Ocean methane release.

Which method is used?

- The observations were made by placing a tool called a **piezometer** in the sediments and leaving it there for four days.

Piezometers

- Piezometers are the **geotechnical** sensors that are used to measure pore water pressure **(piezometric level)** in the ground.
- Piezometers or pore pressure meters are the pressure transducers that are installed beneath the ground to measure the sub-surface piezometric level within groundwater level, soil, or rock.

15 Geminids Meteor Shower

Context: The Geminids meteor shower, believed to be the strongest of the year, was active from December 4-December 20.

What is Geminids Meteor Shower?

- The Geminids Meteor Shower is believed to radiate from the **Gemini constellation**, from where it gets the name.
- The parent of the Geminids is **3200 Phaethon**, which is arguably considered to be either an asteroid or an extinct comet.

- Discovered on **October 11, 1983,** the asteroid is over 5 km in diameter and was named after the **Greek myth of Phaethon,** the son of **Sun god Helios.**

- When the Earth passes through trails of dust, or meteoroids, left by 3200 Phaethon, that dust burns up in Earth's atmosphere, creating the Geminid meteor shower.
  - All meteors associated with a shower have similar orbits, and they all appear to come from the same place in the sky, which is called the **radiant.**
- Geminids travel 35 km/s - which is over 1,000 times faster than a cheetah, about 250 times faster than the swiftest car in the world, and over 40 times faster than a speeding bullet.

Meteor shower

- Meteors are bits of rock and ice that are ejected from comets as they manoeuvre around their orbits around the sun.
- Meteor showers are witnessed when Earth passes through the trail of debris left behind by a comet or an asteroid.
- When a meteor reaches the Earth, it is called a meteorite and a series of meteorites, when encountered at once, is termed a meteor shower.
- As meteors fall towards the Earth, the resistance makes the space rocks extremely hot and, as meteorites pass through the atmosphere, they leave behind streaks of glowing gas that are visible to the observers and not the rock itself.

How it started?

- The Geminids first began appearing in the mid-1800s. However, the first showers were not noteworthy with only 10 - 20 meteors seen per hour.
- Since that time, the Geminids have grown to become one of the most major showers of the year.
- During its peak, 120 Geminid meteors can be seen per hour under perfect conditions.

16 Mountain Measurement

Context: In a new measurement, China and Nepal have announced **Mount Everest is 86 cm taller than the 8,848 m** accepted globally so far.

How the height of a mountain is measured?

- The basic principle that was used earlier uses **only trigonometry.**
- This principle can be applied for measuring the height of any object that does not offer the convenience of dropping a measuring tape from top to bottom, or if you can't climb to the top to use sophisticated instruments.
- So, if the distance from the point of observation to the building is d and the angle of elevation is E, then the height of the building would be d × tan(E).
- Starting in 1952, the **Survey of India** undertook an exercise to measure the height of Mount Everest.
- That exercise measures the **height at 8,848 m (29,028 feet),** which remained the globally accepted standard, until now.

What are the problems with this method of measurement?

- **Confusion over base:** The main problem is that though you know the top, the base of the mountain is not known. The question is from which surface you are measuring the height. Generally, for practical purposes the heights are measured above mean sea level (MSL).

- Moreover, we need to find the distance to the mountain. Now, it is possible with the help of satellite.
- One of the problems is whether the point of observation and the base of the mountain are at the same horizontal level.

- **Gravity:** There is one additional problem is gravity. Gravity is different at different places. In the case of Mount Everest, for example, the concentration of such a huge mass would mean that the sea level would get pulled upwards due to gravity. So, the local gravity is also measured to calculate the local sea level.
- **Refraction Correction:** The variation in air density causes the bending of light rays, a phenomenon known as refraction. Due to the difference in heights of the observation point and the mountain peak, refraction results in an error in measuring the vertical angle. This needs to be corrected. Estimating the refraction correction is a challenge in itself.

What are the present technological solutions?

- These days GPS is widely used to determine coordinates and heights.
- Overhead flying planes equipped with **laser beams (LiDAR)** can also be used to get the coordinates.

What are the problems with the newer technologies?

- GPS do not take gravity into consideration. So, the information obtained through GPS or laser beams is then fed into another model that account for gravity to make the calculation complete.

What could be the reasons behind the increment?

- The techniques used to measure the height.
- It is believed that the height of Mount Everest is increasing at a very slow rate. This is because of the northward movement of the Indian tectonic plate that is pushing the surface up.

17 Curving Waves

Context: Curving waves from Atlantic may be drying up monsoon.

What are curving waves?

- These are the resulting wave of air currents, called a **Rossby wave.**
- This is curved down from the North Atlantic and squeezed in by the Tibetan plateau and hit the Indian subcontinent around mid-August, suppressing rainfall and throwing off the monsoon that was trying to recover from the June slump.
- The wave's usual course is to go from west to east, but not towards the equator.

What affects the monsoon?

- El Nino-Droughts in India have historically been associated with El Nino, an anomalous warming of equatorial Pacific.
- Disturbance from North Atlantic region- Nearly six out of 10 droughts, in non El Nino years, that occurred during the Indian summer, monsoon season may have been driven by atmospheric disturbances from the North Atlantic region.
- The Indian Ocean and Pacific Ocean seem to be at the forefront of all discussions surrounding Indian monsoon droughts.

18 Winter Solstice, which made December 21 the shortest day of the year

Context: December 21, is **Winter Solstice**, the shortest day of the year in the Northern Hemisphere.

What is Winter Solstice?

- Winter Solstice, December 21, is the day when the North Pole is most tilted away from the Sun.
- The **Earth's axis of rotation** is tilted at an angle of 23.5° to its orbital plane.
- This tilt, combined with factors such as **Earth's spin and orbit,** leads to variations in the duration of sunlight that any location on the planet receives on different days of the year.
- The Northern Hemisphere spends half the year tilted in the direction of the Sun, getting direct sunlight during long summer days.
- During the other half of the year, it tilts away from the Sun, and the days are shorter.
- The tilt is also responsible for the different seasons that we see on Earth. The side facing the Sun experiences day, which changes to night as Earth continues to spin on its axis.

19 Drylands are not getting Drier

Context: In a surprising new study, researchers have found that drylands are not getting drier. The researchers discovered that soil moisture exerts a negative feedback on surface water availability in drylands, which offsets some of the anticipated decline.

What are Drylands?

- Drylands are areas which face great water scarcity. They cover over 40% of the earth's land surface, and are home to more than two billion people.

UNEP on drylands

- The United Nations Environment Programme (UNEP) defines drylands according to an aridity index (AI). Drylands are lands with an AI of less than 0.65.
  - Aridity Index is the ratio between average annual precipitation and potential evapotranspiration.
- Drylands are further divided, on the basis of AI, into:
  - hyper-arid lands
  - arid lands
  - semi-arid lands
  - dry sub-humid lands

- **Characteristics:**Drylands are characterised by:
  - low, erratic, and infrequent rainfall
  - limited water resources
  - low soil moisture
  - high evapotranspiration which results in water deficit

- They are highly adapted to climatic variability and water stress, but also extremely vulnerable to damaging human activities such as deforestation, overgrazing and unsustainable agricultural practices, which cause **land degradation.**

Evapotranspiration

- Evapotranspiration is the process of transferring moisture from the earth into the atmosphere.
- Put simply, evaporation occurs when water vapor leaves the soil or a plant's surface.
- Transpiration involves the passage of water through a plant, from its roots through its vascular system.
- The sum of evaporation and transpiration is evapotranspiration (ET).

Distribution of drylands

- Drylands are found on all continents, and include grasslands, savannahs, shrublands and woodlands.
- Geographically dryland agriculture area in India includes:
  - the **north western desert** regions of **Rajasthan**
  - the **plateau region** of **central India**
  - the **alluvial plains** of **Ganga Yamuna river basin**
  - the **central highlands** of **Gujarat, Maharashtra and Madhya Pradesh**
  - the **rain shadow regions** of **Deccan in Maharashtra**
  - the **Deccan Plateau** of **Andhra Pradesh**
  - the **Tamil Nadu highlands**

Key-findings of the Study

- The study discovered that **soil moisture** exerts a negative feedback on surface water availability in drylands, which offsets some of the anticipated decline.
- Soil moisture's influence on evapotranspiration and wind patterns could help to ease the loss of surface water in arid areas.
- The study provides an exception to the "dry-get-drier, and wet-get-wetter" rule.
- This new study is the first to show that long-term soil moisture changes and feedbacks between soil moisture and the atmosphere play an important and previously underestimated role in these predictions about the future of drylands.
- The researchers found that **long-term soil moisture** helps to regulate atmospheric circulation and moisture transport.
- These effects largely ameliorate the potential decline of future water availability in drylands.
- Although drylands will continue to become drier with climate change, the effect would be much worse without the feedbacks (soil moisture).

Why are drylands important?

- Support population
- Support biodiversity
- Food and water provision

- Climate change mitigation and adaptation
- Producer of Important commodities

20 Glacial Lakes

Context: Glacial lakes are thought to be a major reason behind the recent flood at Uttarakhand.

What are Glacial lakes?

- A glacial lake is a body of water with origins from glacier activity.
- They are formed when a glacier erodes the land, and then melts, filling the depression created by the glacier.

Threats from Glacial lakes

- Over the years, the frequency of formation of these lakes has increased.
- But despite that, there are not many **GLOF (glacial lake outburst flood)** events happening in Uttarakhand. This is because Uttarakhand has very steep slopes, and the water manages to find a way out.
- But there are over 1,200 big and small lakes in the high mountains of Uttarakhand. Many of them are increasing in size.
- A lot of them do pose a threat of similar kinds of incidents.
- There are also no storage dams being constructed in this area. This also poses a threat to these lakes.

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2 ECONOMIC GEOGRAPHY

1 Looking for lithium toehold, India finds a small deposit in Karnataka

Context: Preliminary surveys by the **Atomic Minerals Directorate for Exploration and Research (AMD),** are learnt to have shown the presence of 1,600 tonnes of lithium resources in the igneous rocks of the Marlagalla-Allapatna region of Karnataka's Mandya district.

What are the potential sites of Lithium deposition in India?

- The **Marlagalla-Allapatna** area, along the **Nagamangala Schist Belt** in Karnataka
- The brines of **Sambhar and Pachpadra** in Rajasthan
- **Rann of Kachchh** in Gujarat
- The major mica belts in **Rajasthan, Bihar, and Andhra Pradesh**
- The pegmatite belts in **Odisha, Chhattisgarh and Karnataka**, are the other potential geological domains

What are the major global sites of Lithium deposition?

- Bolivia (21 million tonnes), Argentina (17 million tonnes), Australia (6.3 million tonnes), and China (4.5 million tonnes).

Sub-division of Minerals

Mineral Resources are sub-divided, in order of increasing geological confidence:

- **Inferred Mineral Resource:** It is the part of a mineral resource for which quantity, grade (or quality) and mineral content can be estimated with a low level of confidence. It is inferred from geological evidence and assumed but not verified geological or grade continuity.
  - **Lithium is categorised as "inferred".**
- **Indicated resources:** These are simply economic mineral occurrences that have been sampled to a point where an estimate has been made, at a reasonable level of confidence, of their contained metal, grade, tonnage, shape, densities, physical characteristics.
- **Measured resources:** These are indicated resources that have undergone enough further sampling that a 'competent person' usually a geologist has declared them to be an acceptable estimate, at a high degree of confidence, of the grade (or quality), quantity, shape, densities, physical characteristics of the mineral occurrence.

What are the sources of Lithium extraction?

- Solar evaporation ofConventional lithium brine extraction
- Solar evaporation of Hard rock / spodumene lithium extraction
- Hectorite clay
- Seawater
- Recycled brines from energy plants
- Recovered oil field brine
- Recycled electronics

Significance of the recent exploration

- Lithium is a vital ingredient of the lithium-ion rechargeable batteries that power electric vehicles (EVs), laptops and mobile phones.
- India currently imports all its lithium needs.India has stepped up its economic offensive against China, which is a major import nation of India.

2 Tripartite agreement signed for harnessing Potash in Rajasthan

Context: A tripartite agreement was signed between Mineral Exploration Corporation Limited (MECL), Rajasthan State Mines & Minerals Limited (RSMML) and the Department of Mines & Geology (DMG), Govt. of Rajasthan for taking up feasibility studies of **Solution Mining of Potash** in the state of Rajasthan.

Potential sites of Potash in Rajasthan

- Rajasthan has huge Potash and Halite resources spread.
- It is found across the Nagaur – Ganganagar basin in the northwest.
- Most of the potash deposits in Rajasthan are identified in Nagore-Ganganagar basin of Rajasthan covering parts of Sriganganagar, Hanumangarh and Bikaner districts.
- **Storage potential:** Bedded Salt formations in Rajasthan are strategically useful for underground oil storage, repositories for hydrogen, ammonia and helium gas, storage of compresses gas and nuclear waste.
- **Industrial usage:** Potash & Sodium Chloride from the Bedded Salt are extensively used in the Fertiliser Industry and the Chemical Industry respectively.

Significane of the MoU

- **Harnessing the potential**: It will pave the way to undertake feasibility studies for harnessing sub-surface salt deposits through solution mining,
- **Utilization of resources:** It will utilise Rajasthan's rich mineral reserves
- **Economically viable:** It will boost its economy.
- **Hub of solution mining:** It will help in establishing it as a hub of solution mining of potash, the 1st in the country.
- **Self-dependency:** This project will generate employment as well as support the Atmanirbhar Bharat Abhiyan by way of generating import substitution.

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3 HUMAN GEOGRAPHY

1 Megatrends' to affect forests over the coming decade

Context: Researchers from academic, governmental and international organisations have identified five large-scale 'megatrends' that are likely to have a large impact on forests and forest communities over the coming decade.

What are the identified trends?

The five megatrends revealed by the research are:

- **Forest mega-disturbances:** Droughts and excessive precipitation are increasing forests' susceptibility to diseases and human-induced wildfires and floods.
  - This is leading to defoliation, tree mortality and declines in forest productivity at unprecedented scales, with increasing evidence that forest disturbance can result in the emergence of diseases with the ability to spread globally.
- **Changing rural demographics:** Increased migration to urban areas is causing an unprecedented exodus among forest-reliant communities.
  - The effects of these demographic shifts, including forest resurgence on formerly agricultural lands and participation in decision-making, are not well understood.
- **The rise of the middle class:** By 2030 the middle class in low- and middle-income countries will grow to almost 5bn people – around 50% of the global population.
  - The growth in demand that this creates will increase pressure on land and other resources.
- **Use of digital technologies:** Access to digital communication technology has grown exponentially in recent years, with a sevenfold increase in internet and mobile cellular use since 2000.
  - The majority of this growth has come from outside industrialised countries and is likely to have a transformational impact on the forest sector.
- **Infrastructure development:** Large scale infrastructure projects such as **China's Belt and Road initiative** are likely to have transformational impacts on forests and rural communities.
  - By 2050, there is expected to be at least 25 million km of new roads globally to help facilitate commodity flow between transport hubs; governments in the Amazon basin alone are developing 246 new hydroelectric dams, and illegal mining activities are expanding rapidly across the globe.
  - This can lead to forest loss, displaces people, disrupts livelihoods and provokes social conflicts as communities lose access to land and resources.

Status of forest area

- Forest ecosystems are a critical component of the world's biodiversity as many forests are more bio-diverse than other ecosystems.

- **Coverage area:** Forests cover 31 percent of the global land area. Approximately half the forest area is relatively intact, and more than one-third is primary forest (i.e. naturally regenerated forests of native species, where there are no visible indications of human activities and the ecological processes are not significantly disturbed).
- **Total area:** The total forest area is 4.06 billion hectares or approximately 5 000m2 (or 50 x 100m) per person, but forests are not equally distributed around the globe.
  - More than half of the world's forests are found in only five countries (the Russian Federation, Brazil, Canada, the United States of America and China) and two-thirds (66 percent) of forests are found in ten countries.
- **Rate of deforestation:** Between 2015 and 2020, the rate of deforestation was estimated at 10 million hectares per year, down from 16 million hectares per year in the 1990s.
  - The area of primary forest worldwide has decreased by over 80 million hectares since 1990.

Forest in India

- India is home to a diverse range of forests—moist and dry tropical forests, temperate and subtropical montane forests, alpine forests and scrubs forests.
- It is one of the **17 "mega-diverse"** countries and is home to **8% of the world's known flora and fauna.**
- Besides, Indian forests support the livelihood of nearly 275 million people, who are dependent on forests for food, fuelwood, fodder and other forest products.
- Forest cover change data from FSI between 2009 and 2017 shows an increase in the forest of 2 million hectares.
- Increases occurred in India's densest forests (greater than 70% canopy cover) and open forests (between 10% and 40% canopy cover), with slight decreases seen in moderately dense forests (between 40% and 70% canopy cover).
- India has made several commitments to restoring deforested and degraded landscapes including the **Bonn Challenge,** nationally determined contribution and several domestic targets.
  - The Government of Germany and **IUCN (International Union for Conservation of Nature)** launched the voluntary Bonn Challenge in 2011 with the target of restoring 150 million hectares (mha) of degraded and deforested landscapes by 2020 and 350 mha by 2030.
    - India joined the Bonn Challenge in 2015 with a pledge to restore 21 mha of degraded and deforested land.
    - This was raised to the target of 26 mha by 2030 during the United Nations Convention on Combating Desertification Conference held in Delhi in September 2019.

What about Forest species and genetic diversity?

Forest species diversity: Other forest plants, animals, and fungi	
Plants	• About 391 000 species of vascular plants are known to science of which about 94 percent are flowering plants. • Of these, 21 percent are likely threatened by extinction. • Some 60 percent of the total are found in tropical forests.

Fungi	⊙ Some 144 000 species of fungi have been named and classified so far. ⊙ However, it is estimated that the vast majority (over 93 percent) of fungal species are currently unknown to science, indicating that the total number of fungal species on Earth is somewhere between 2.2 and 3.8 million.
Invertebrate species	⊙ Some 1.3 million species of invertebrates have been described. ⊙ However, many more exist, with some estimates ranging from 5 million to 10 million species. ⊙ Most are insects, and the vast majority live in forests.
Vertebrate species	⊙ Close to 70 000 vertebrate species are known and described (IUCN). ⊙ Of these, forests provide habitats for almost 5 000 amphibian species (80 percent of all known species), close to 7 500 bird species (75 percent of all birds) and more than 3 700 different mammals (68 percent of all species)

2 Banana grit from Changalikodan Nendran Banana

Context: Scientists at the CSIR-National Institute for Interdisciplinary Science and Technology (NIIST) at **Pappanamcode** here in Kerala have come up with a new product, banana grit or granules, developed from **raw Nendran bananas**.

The New Product

- The product resembles to **'rava' and broken wheat.**
- Billed as an ideal ingredient for a healthy diet, banana grit can be used for making a wide range of dishes.
- The granules can be used for making upma, or it can be mixed with banana powder for porridge, with milk or coconut milk for use as a health drink.
- The concept was introduced to utilise the presence of resistant starch in bananas, which is reported to improve gut health.
- Hence, the dishes prepared with banana grit and its by-product, banana powder, incline to the new focus on gut health, which the scientific community is widely discussing now to maintain health and well-being.

About Nendran banana

- **Changalikodan Nendran Banana** or famously known as **Changalikodan** is a banana variety originated and cultivated in **Chengazhikodu** village of Thrissur District in Kerala
- Changalikodan are mainly cultivated on the banks of the Bharathapuzhariver.
- Changalikodan got **Geographical indication registration** from the Geographical Indications Registry, Chennai.
- Generally consumed ripe, **Nendran banana** also finds use in typical Kerala dishes such as **avial and thoran.**

3 To what extent does climate change affect Food Insecurity? Case Study of Lesotho

Context: The impact of climate change can be seen in the form of draught and floods which later impacts the four interconnected pillars of food security, which are food availability, food access, food use, and stability. According to FAO, in 2019, around two million people were being subjected to moderate to severe food insecurity.

About the food crisis case study in Lesotho

- The food security situation in Lesotho can be classified as **precarious or uncertain.**
- The country produces only 30 % of its maize (main staple food) and the rest import from neighboring South Africa.
- In 2007, both the countries, which depend on rain-fed farming, were hit badly by drought. The situation was aggravated by the higher prices and lesser imports to Lesotho.

What does the case study suggest?

- **Higher climate impacts:** The Event attribution methodologies were used to study the variability of the events and it was found that the droughts of this level are occurring due to human-induced climate change which has reached by a factor of five.

> Event attribution methodologies are based on observed weather data and climate models, help in estimating that how often a type of extreme event is occurring in the warmer world.

- **Food insecurity**: Food availability in trade-dependent countries and the purchasing power of households also impacts food insecurity.
- **Lesser production**: Agriculture production has been declining for years due to climate change events as well as due to soil erosion, poor land-use practices, and decreasing soil fertility.
- **Impact of inequalities:** It also provides an assessment of the relative importance of inequalities and other drivers of vulnerability in the food.

India and its Drought status

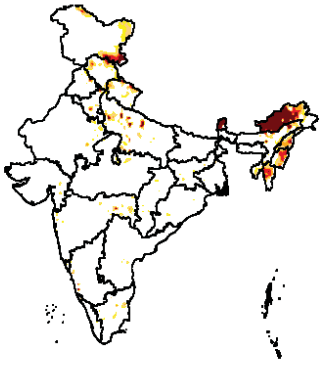
- About 42% of India's land area is facing drought, with 6% exceptionally dry according to the data from Drought Early Warning System (DEWS).
- Andhra Pradesh, Bihar, Gujarat, Jharkhand, Karnataka, Maharashtra, parts of the North-East, Rajasthan, Tamil Nadu, and Telangana which are home to 500 million people are the worst-hit states.

FAO

- The **Food and Agriculture Organization (FAO)** of the United Nations is a specialized agency of the United Nations.
- It leads the international efforts to defeat hunger and improve nutrition and food security.
- Its motto is **"let there be bread".**
- It was founded in October 1945.
- **Initiatives:** Globally Important Agricultural Heritage Systems (GIAHS) and Plant Treaty (ITPGRFA)

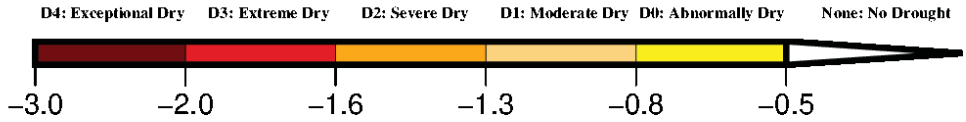
Drought Early Warning System (DEWS) : India

(23/9/2020)



Drought Conditions (percentage Area)

Time	None	D0–D4	D1–D4	D2–D4	D3–D4	D4
Current (23/9/2020)	89.23 %	9.93 %	7.31 %	4.54 %	3.18 %	2.12 %
Last week (16/9/2020)	89.68 %	9.48 %	6.91 %	4.38 %	3.02 %	2.10 %
One month ago (24/8/2020)	91.04 %	8.13 %	5.89 %	3.72 %	2.66 %	1.83 %
Three month ago (25/6/2020)	92.62 %	6.55 %	4.22 %	2.51 %	1.83 %	1.40 %
One year ago (24/9/2019)	77.02 %	22.14 %	15.35 %	7.52 %	4.20 %	2.19 %



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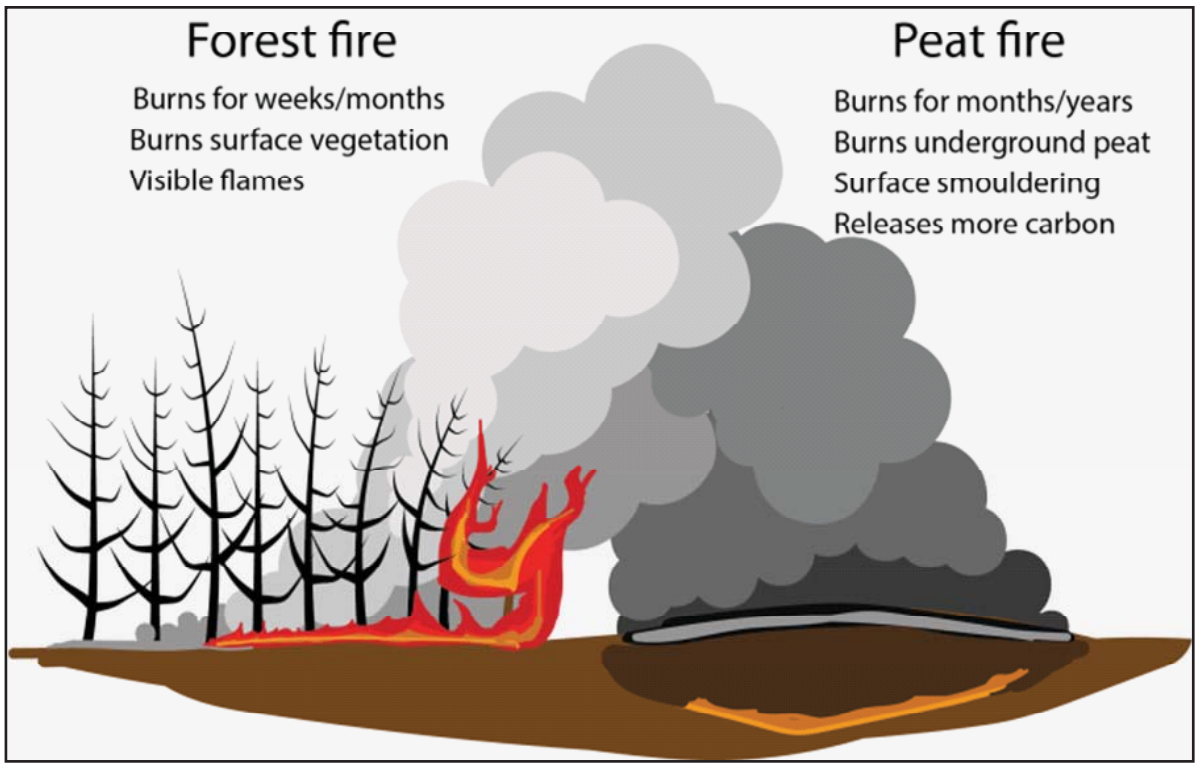
4 PLACES IN NEWS

1 Zombie fires' discovered in Arctic as climate change introduces new fuel

Context: Fire scientists are warning of '*zombie fires*', or holdover fires, in the Arctic, an area not known for large fires or substantial fire fuel.

What are Zombie fires?

- Zombie fires occur when a fire from a previous year smolders in **carbon-rich peat (organic fuel)** underground during the winter, then re-ignite on the surface as the weather warms and the ground thaws the next season.
- This can lead to even more burning the following year.
- The process is made worse as peat and permafrost, both carbon *sinks* which act to hold and store carbon, now become a **carbon source**.
- Emissions increase as both the burning of vegetation *and* burning of peat/permafrost release CO2 into the atmosphere, furthering our planet's warming.



2 World's longest highway tunnel opened in Himachal Pradesh

Context: Prime Minister inaugurated the **Atal Tunnel at Rohtang** at an altitude of above 3,000 metres in Himachal Pradesh to provide new strength to the country's border infrastructure.

About:

- The 9.02 km-long-tunnel, built by the **Border Roads Organisation (BRO)**, is the world's longest highway tunnel and connects Manali to Lahaul-Spiti valley.
  - The **South Portal (SP)** of Atal Tunnel is located at a distance of 25 km from Manali at an altitude of 3,060 metres
  - The **North Portal (NP)** of the tunnel is located near village Teling, Sissu, in Lahaul Valley at an altitude of 3,071 Metres.
- It provides **all-weather connectivity** to the landlocked valley of **Lahaul-Spiti**, which remains cut-off for nearly six months in a year as the **Rohtang Pass** is usually snow-bound between November and April.
- The tunnel is built with ultra-modern specifications in the **PirPanjal range** of Himalayas at an altitude of 3000 metres (10,000 feet) from the Mean Sea Level (MSL).
- The tunnel was constructed using drill and blast NATM (New Austria Tunnelling Method) techniques.

Significance of the development

- Round-the-year connectivity
- Reduction in distance
- Better connectivity to the armed forces
- Boost tourism

3 Glistening 'blue tide' along Mumbai

Context: The tide that produces a **fluorescent blue** hue—**bioluminescence**—made an appearance on Juhu beach in Mumbai and Devgad beach in **Sindhudurg** along Maharashtra's coastline.

About:

- The blue hue, also known as **bioluminescence** is the production and emission of light by a living organism.
- The natural phenomenon is characterised by the emission of light produced by **phytoplanktons** (microscopic marine plants), commonly known as **dinoflagellates**.
- The light is produced through a series of chemical reactions due to **luciferase (oxidative enzymes)** protein.
- Bioluminescence has been an annual occurrence along the west coast since 2016 during the months of November and December.

Factors responsible for its occurrence

- **Eutrophication** – the reduction of oxygen in the water – which makes the phytoplanktons very dominant.
- **High temperature, high quantity of organic material** such as sewage and effluents and increased turbulence/ wave action of the water could be the cause of thisbioluminescence.
- Apart from **man-made causes,** the adverse impact of **climate change** leading to increased seawater temperature could play a major role in such a phenomenon.

Why it is dangerous?

- The fluorescent blue hue may also be a signal of danger.
- Many of the species in this group are toxic. If **dinoflagellates** reproduce rapidly, they may cause so-called 'red tides'.
- During this period all the animals (molluscs, fish, etc.) that feed on dinoflagellates also become toxic due to the accumulation of high amounts of toxins from dinoflagellates.
- It is dangerous to eat such sea animals because the toxins that are contained in them may have various unpleasant effects: some merely irritate the bowel and cause food poisoning, whereas others, being neurotoxins, may even have an effect on memory.
- Some species, such as the sea sparkle (**Noctilucascintillans)** are not as toxic, but may have other unpleasant effects.

Which other countries observe the same phenomenon?

- Bioluminescence has been observed across India's coast as well as the coastline of many beaches in the world such as **Maldives, Vietnam, Indonesia, USA, Australia** and many other countries.

4 Indonesia's Mount Sinabung erupted

Context: Indonesia's Mount Sinabung erupted recently, belching a massive column of ash and smoke 5,000 metres (16,400 feet) into the air and plunging local communities into darkness with a thick layer of debris.

Mount Sinabung

- Mount Sinabung is one of more than 120 active volcanoes in Indonesia, which is prone to seismic activity on the **Pacific "Ring of Fire,"** a ring of volcanoes and moving fault lines that surround the ocean.
- Mount Sinabung had been inactive for centuries until it erupted in 2010.
- It has been active ever since, occasionally erupting.

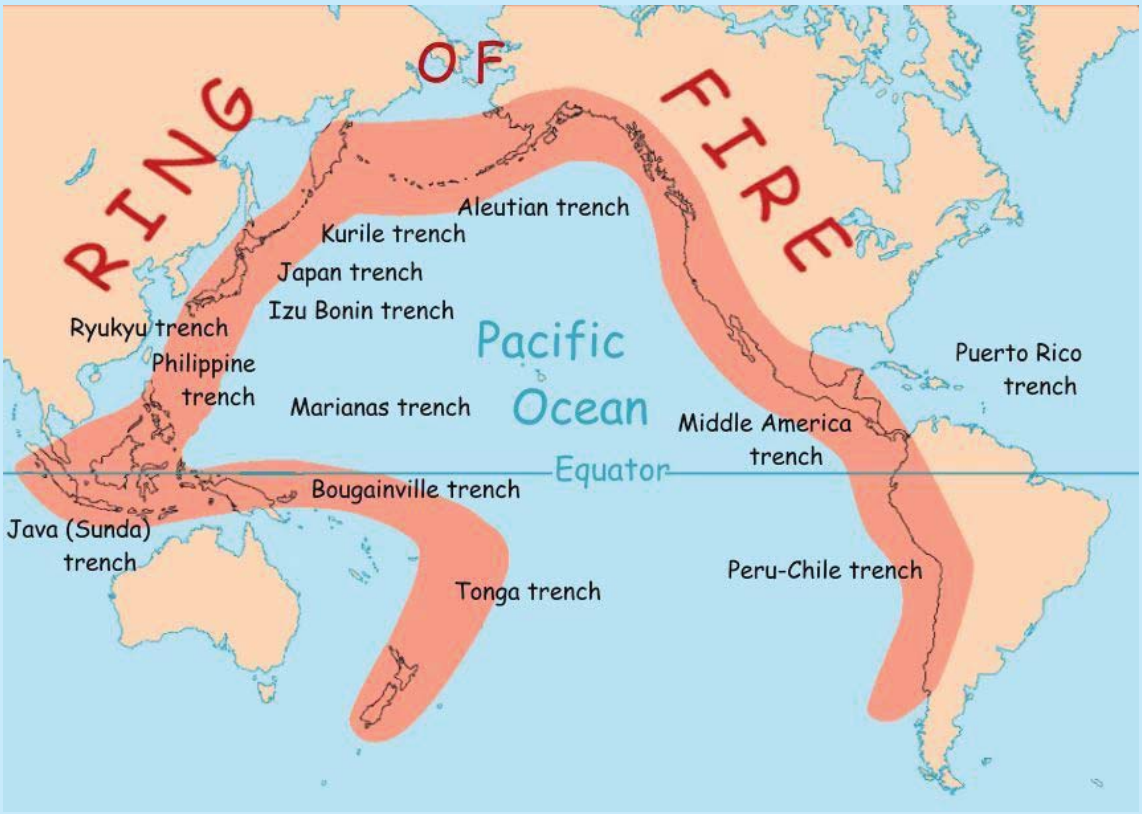
Indonesia and Volcanoes

- Indonesia is home to many active volcanoes, due to its position on the "Ring of Fire", or the Circum-Pacific Belt, which is an area along the Pacific Ocean characterised by active volcanoes and frequent earthquakes.
- The Ring of Fire is home to about 75 per cent of the world's volcanoes and about 90 per cent of its earthquakes.

What is Ring of Fire?

- Also known as the Circum-Pacific Belt, the Ring of Fire traces the meeting points of many tectonic plates, including the Eurasian, North American, Juan de Fuca, Cocos, Caribbean, Nazca, Antarctic, Indian, Australian, Philippine, and other smaller plates, which all encircle the large Pacific Plate.

- The Ring of Fire is home to 75% of the world's volcanoes and 90% of its earthquakes.
- The Ring of Fire is home to the deepest ocean trench, called the Mariana Trench.
  - Located east of Guam, the 7-mile-deep Mariana Trench formed when one tectonic place was pushed under another.

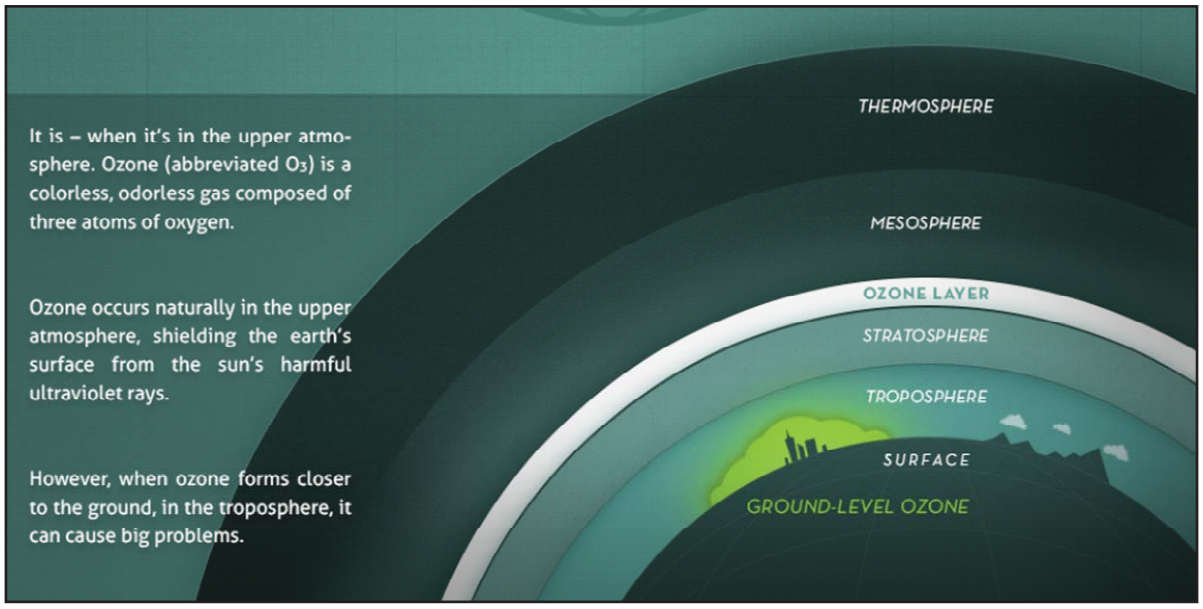


5 Low concentration of Ozone in the Brahmaputra River Valley

Context: Scientists have evaluated the **near-surface ozone** in the **Brahmaputra River Valley** and found a relatively low concentration of ozone over Guwahati compared to the other urban locations in India.

What is Ozone?

- Ozone is a colorless gas made up of three oxygen atoms.
- Ozone is not emitted directly into the air but is formed through chemical reactions between natural and man-made emissions of nitrogen oxides (NOx) and volatile organic compounds (VOCs) in the presence of sunlight.
- **Ozone can be split into two major types:**
  - **Stratospheric Ozone:** Stratospheric ozone or the "ozone layer" forms high in the atmosphere, 6-30 miles above the earth's surface, when intense sunlight causes oxygen molecules (O2) to break up and re-form as ozone molecules (O3).
    - These ozone molecules form the ozone layer and are commonly referred to as "good ozone."
  - **Ground-Level Ozone:** Tropospheric, or ground-level ozone, is created by chemical reactions between:



- oxides of nitrogen (NOx)
- volatile organic compounds (VOC)

Why 'Ground-level ozone' is 'bad ozone'?

- Although ground-level ozone is less concentrated than stratospheric ozone, its impacts on human health and welfare make ground-level ozone "bad ozone."
- Ground-level ozone is an irritant and can negatively affect human health and welfare.
- Weather plays a substantial role in formation of ground level ozone. Ground-level ozone concentrations typically are highest on days warm/hot days with low humidity when wind is light or stagnant.

What Scientists have found?

- Scientists analysed the variability of ozone and other air pollutants over Brahmaputra River Valley region.
- The examination of **nitric oxide, nitrogen dioxide, and ozone concentrations** in this study suggested that this site is well influenced by local sources such as adjacent major national highway.
- During the daylight hours, the site is in or nearly in a **photo-stationary state,** indicating a low impact of organic species on the ozone concentrations.

Brahmaputra Valley Region

- The Brahmaputra Valley has an average width of about 80 Km.
- The main river of the valley, Brahmaputra is one of the largest rivers in the world and rank fifth with respect to its average discharge.
- The river's origin is the **Kanglung Kang glacier** located about 63 km south east of the lake at an altitude of 5300m on Kailash range of Himalayas.
- After flowing through Tibet it enters India through Arunachal Pradesh and flows through Assam and Bangladesh before it joins Bay of Bengal.
- The drainage basin of the Brahmaputra extends to an area of about 580,000 sq km. Of this, 50.51% is in Tibet (China), 7.75% in Bhutan, 33.52% in India and 8.1% in Bangladesh.
- Its basin in India is shared by six states namely, Arunachal Pradesh (41.88%), Assam (36.33%), Nagaland (5.57%), Meghalaya (6.10%), Sikkim (3.75%) and West Bengal (6.47%).

6 Earthquakes hit Mizoram for the fourth day

Context: An earthquake of magnitude 4.1 on the **Richter scale** struck Mizoram, the fourth in the northeastern state in as many days.

Why India's north-east is prone to earthquake?

- Geomorphologically, North East India is located in an earthquake **prone zone (zone V)** of the Indian subcontinent.
- In this region earthquake comes with land sliding flood and along with series of smaller magnitude earthquakes.
- Seismologists consider India's mountainous northeast region as the sixth major earthquake-prone belt in the world.
- The northeast has seen some of the biggest quakes in history.
  - In 1897, a Shillong-epicentred quake measured 8.2 on the Richter scale, while in 1950, an earthquake in Assam measuring 8.7 on the Richter Scale forced the Brahmaputra river to change its course.

Seismic zones in India

Seismic zones in the Indian subcontinent are divided into the following four seismic zones (II, III, IV, and V):

- **Seismic Zone II:**Area with minor damage earthquakes corresponding to intensities V to VI of MM scale (MM – Modified Mercalli Intensity scale). It covers the areas which are not covered by other three seismic zones discussed below.
- **Seismic Zone III:**Moderate damage corresponding to intensity VII of MM scale. It comprises Kerala, Goa, Lakshadweep islands, remaining parts of ***Uttar Pradesh, Gujarat and West Bengal, Parts of Punjab, Rajasthan, Madhya Pradesh, Bihar, Jharkhand, Chhattisgarh, Maharashtra, Orissa, Andhra Pradesh, Tamilnadu and Karnataka.***
- **Seismic Zone IV:** Major damage corresponding to intensity VII and higher of MM scale. It covers remaining parts of ***Jammu and Kashmir and Himachal Pradesh, National Capital Territory (NCT) of Delhi, Sikkim, Northern Parts of Uttar Pradesh, Bihar and West Bengal, parts of Gujarat and small portions of Maharashtra near the west coast and Rajasthan.***
- **Seismic Zone V:**Area determines by pro seismically of certain major fault systems. It is seismically the most active region, and comprises entire northeastern India, parts of ***Jammu and Kashmir, Himachal Pradesh, Uttaranchal, Rann of Kutch in Gujarat, part of North Bihar and Andaman & Nicobar Islands.***

How vulnerable is Mizoram to earthquake?

- Mizoram is one of the North Eastern States of India, located in 21°56' and 24°31' N latitude and 92°16' and 93 ° 26' E longitudes with the geographical area of 21,081 sq. km.
- Mizoram is vulnerable to all-major natural hazards such as Cyclone, Earthquake, and Landslide etc.
- The State forms a part of the most severe seismic zone in the country, namely **Zone V** of **Seismic Zone Map of India** that is referred as **Very High Damage Risk Zone.**
- The seismic risk in the region is growing at an alarming pace with increasing inventory of vulnerable construction.

7 Kerala to start Intercropping

Context: The state government of Kerala would seek the mandate of the **Left Democratic Front (LDF)** to modify specific laws that govern the plantation sector to allow the management to intercrop-food crops with cash crops such as tea, coffee, cardamom and rubber.

Agriculture in Kerala

- The unique features of Kerala agriculture are predominance of cash crops, homestead system of cultivation, inter-cropping of annual and perennial crops, shrinkage of area under rice crop and dominance of small holders.
- During the past three decades the agricultural sector of Kerala has undergone wide-ranging changes in terms of ownership of land, cropping pattern, cultivation practices, productivity and intensity of cultivation.
- The salient features of the agricultural sector in Kerala are:
  - Average holding size- 0.12 ha
  - Predominance of small and marginal farmers (92%)
  - Less area under food crops with low productivity
  - Predominance of perennial and plantations crops like coconut, rubber, tea, coffee, cashew, pepper, spices etc.
  - High cost of production mainly due to high labour cost
  - Highly erratic monsoon rains

Proposed modifications

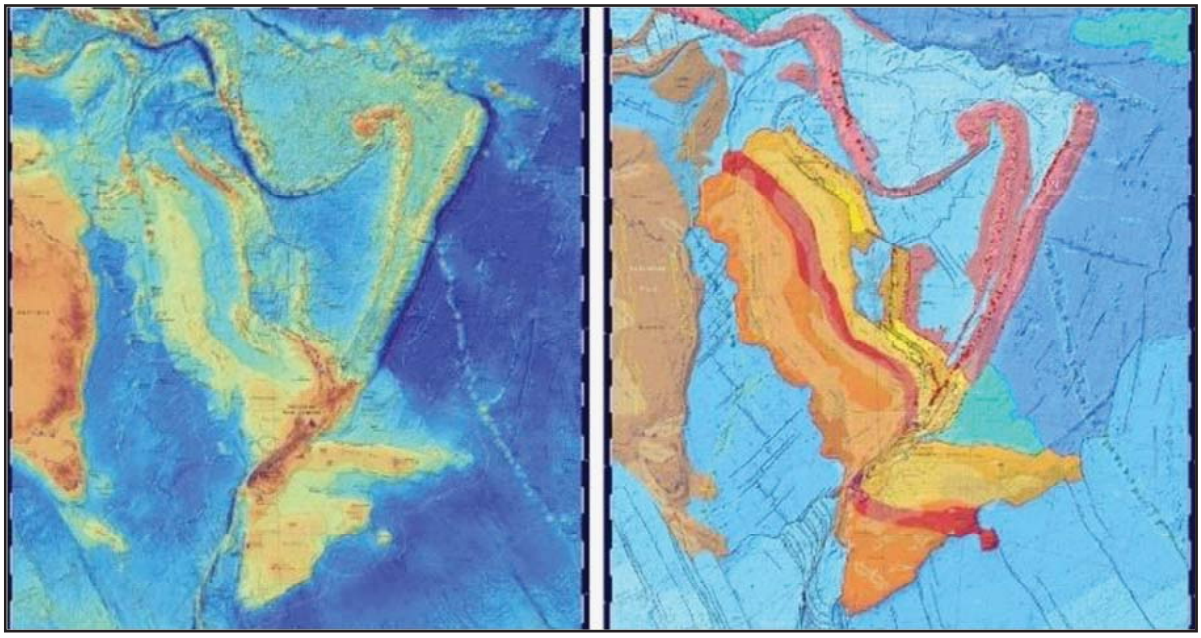
- Some provisions of the **Kerala Land Reforms Act, Kerala Grants and Leases (Modification of Rights) Act and Kerala Land Utilisation Order** might come up for legislative review if the LDF permitted.
- The proposed modification would also permit plantations to diversify into dairy and poultry farming.
- It would spur investment in precision farming characterised by high yield food crops, reduced use of toxic pesticides, chemical fertilisers and water.
- Plantations encompassed 8 lakh hectares in Kerala. An amendment of the law would free up an estimated 2 lakh hectares for inter-cropping.
- The Kerala Agriculture University had zoned Kerala into 23 agro-climatic sectors.
  - It had suggested that oranges, apples, avocados, grapefruit and winter vegetables as ideal intercrop for high altitude tea plantations in regions such as Munnar.
  - In rubber growing regions, it suggested the cultivation of rambutan, mangosteen and other tropical fruits in small plots interspersed among the trees.
  - It had also suggested jack fruit as shade trees in tea, coffee and cardamom plantations. The participants also mooted rejuvenation of cashew plantations and use of cashew mango to produce ethanol.

8 New maps reveal details of the lost continent Of Zealandia

Context: New Zealand recently published two new maps which cover the shape of the ocean floor and **Zealandia's tectonic profile,** which collectively help tell the story of the continent's origins.

About:

- Considered to be a lost 'eighth continent' that got submerged underwater millions of years ago, the land mass is called **Zealandia.**
- Researchers from GNS Science in New Zealand have now mapped the shape and size of the continent with utmost detail.
- For the mapping, the researchers analysed the bathymetry — the shape and depth of the ocean floor — around Zealandia.
- In addition, they studied its tectonic profile to accurately locate Zealandia across tectonic-plate boundaries.
- The newly created maps bring to light previously unknown information about the formation of Zealandia.



Lost eighth continent of earth

- Till 2017, Zealandia was classified as a "microcontinent," much like the island of Madagascar.
- The landmass has "clearly defined boundaries, occupies an area greater than 386,000 square miles (1 million square kilometers), is elevated above the surrounding ocean crust, and has a continental crust thicker than that oceanic crust
- Zealandia's total area has been mapped to be nearly 2 million square miles (5 million square kilometers).
- At this measure, Zealandia is about half the size of Australia, however, only 6% of the continent is above sea level.

How did the continent sink?

- The idea of a potential continent in this area has been around for some time, and the name "Zealandia" was first coined by geophysicist Bruce Luyendyk in 1995.
- The dedicated study of this area, stretching about 5 million square kilometers (about 1.93 million square miles), has since determined it is not just a group of continental islands and fragments, but a continental crust large and separate enough to be officially declared a separate continent.

- Zealandia used to be part of Gondwana, the supercontinent that once held many of the continents such as Africa and South America.
- About 85 million years ago, Zealandia split off from Gondwana. The drifting, shifting land mass, about half the size of Australia, was home to dinosaurs and lush rainforest.
- Then, millions of years later, the world's tectonic plates -- pieces of the Earth's crust -- began reorganizing themselves, in a period of dramatic geological change that also created the Pacific "Ring of Fire," a belt in the Pacific where the world's most active volcanoes are located.
- During this time, the Pacific Plate -- the world's largest tectonic plate -- is believed to have sank below the continental crust of Zealandia.
- This process, called subduction, caused the root of the continent to break off and sink as well

The present scenario

- About 94% of Zealandia is now submerged underwater -- but some parts of the continent are still above land, making up New Zealand and other small islands.
- The highest point of Zealandia is Aoraki--Mount Cook at 3,724 meters (12,218 feet).
- There is still much unknown about the continent and whether the discovery of Zealandia could change historical climate models.
- As more research emerges, the interactive website and maps will be updated to reflect what we know.

9 Chamoli Glacier Break

Context: A major disaster struck the Himalayan state of Uttarakhand recently. A glacier broke after an avalanche in the Joshimath area of the state's Chamoli district.

What is a glacier outburst?

- Glacial lake outburst floods (GLOF) is being considered to be the most likely trigger for this event.
- GLOF is a reference to flooding caused downstream due to a breach in a glacial lake.
- Retreating glaciers, like several in the Himalayas, usually result in the formation of lakes at their tips, called **proglacial lakes**, often bound only by sediments and boulders.
- If the boundaries of these lakes are breached, it can lead to large amounts of water rushing down to nearby streams and rivers, gathering momentum on the way by picking up sediments, rocks, and other material, and resulting in flooding downstream.
- GLOF events are not unusual, but their impact depends on the size of the Proglacial Lake that burst, and its location.
- In the Hindu Kush Himalaya, moraine-dammed glacial lakes are common and numerous GLOF events have been traced back to the failure of moraine dams.

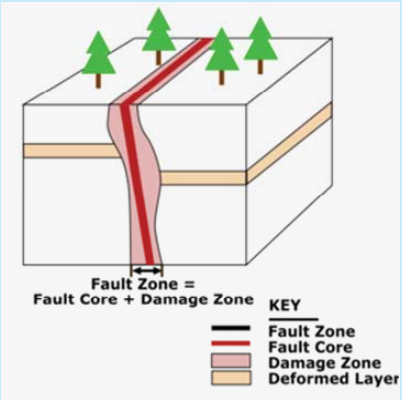
What made the Himalayas so prone to disasters?

- There are four major faults in the Himalayas, including the **Himalayan Frontal Fault** and the **Trans Himadri Fault.** Multiple faults have developed parallel to these four.
- This branching and sub-branching mean that this is a zone of faults. The movement of thousands of years means that all rock formations are broken and crushed.

- Water penetrates deep into the interior and sabotages the rocks from the inside. It washes away the base of the rocks.
- Even if smaller ruptures occur along with short segments of the mountains, stress builds up along the faults. That accumulated stress eventually triggers an enormous earthquake.
- Thus the number of landslides is high in the region. Landslides and earthquakes will continue to happen in the region because of the movement of the plates in the Himalayas.

What is a 'fault'?

- A fault is a fracture or zone of fractures between two blocks of rock. Faults allow the blocks to move relative to each other.
- This movement may occur rapidly, in the form of an **earthquake** - or may occur slowly, in the form of **creep.**
- Faults may range in length from a few millimeters to thousands of kilometers.
- The fault surface can be horizontal or vertical or some arbitrary angle in between.



What can be the reasons behind the recent disaster?

- **Low snowfall:** Reduced snowfall this winter due to climate change may have played a major part in the glacier bursts. The glacial outbursts are also related to global warming.
- **Large hydropower projects:** The entire State of Uttarakhand is categorized as falling **in Zone-IV and V** of the earthquake risk map of India.

10 Caribbean volcanos come alive

Context: Scientists study activity that hasn't been observed in years as Caribbean volcanos come alive.

What are Caribbean Volcanoes?

- The eastern Caribbean is one long chain of active and extinct volcanoes.
- Volcanoes that have been quiet for decades are rumbling to life in the eastern Caribbean.
- Tremors, strong gas emissions, formation of a new volcanic dome and changes to its crater lake are observed.
- The Caribbean Disaster Emergency Management Agency said that scientists observed an "effusive eruption within the crater, with visible gas and steam".
- La Soufriere, located near the northern tip of the main island of St Vincent, last erupted in 1979, and a previous eruption in 1902 killed some 1,600 people.

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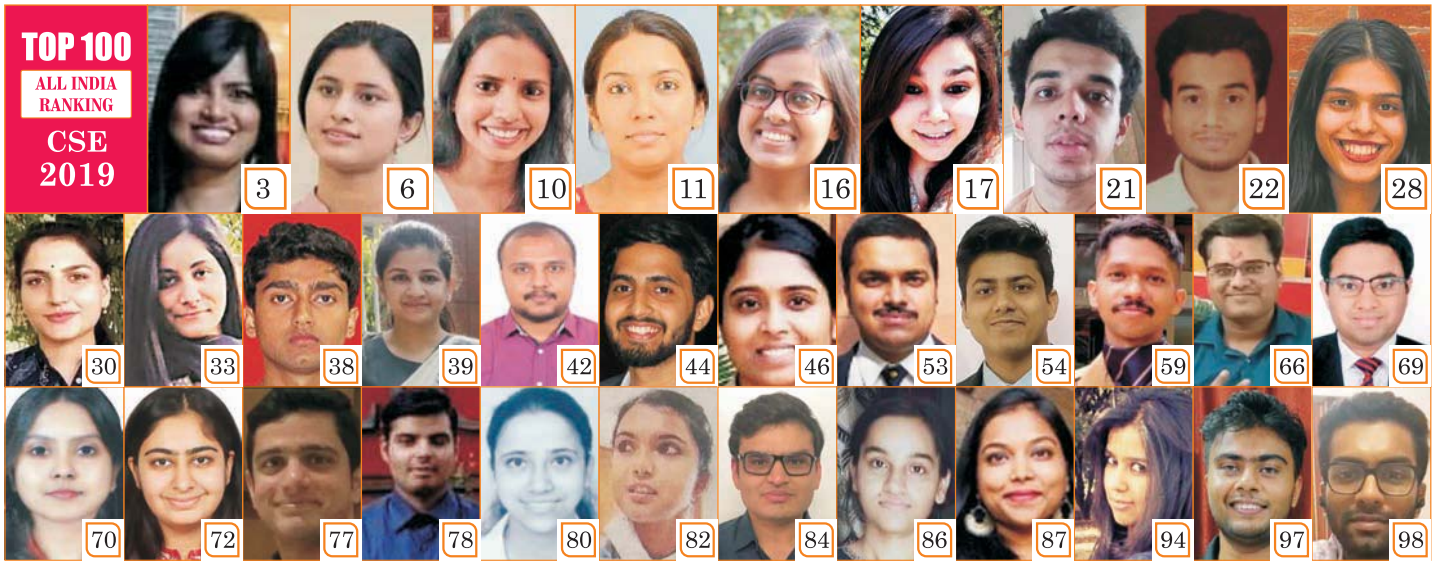

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