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for Prelims - 2021

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Geography and Environment

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RAPID REVISION BOOK-2
Geography and Environment

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- **Curation of content** as per relevance with the coming examination.
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- **Covers relevant current affairs.**
- **Easy to understand.**
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From

Shield IAS

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GEOGRAPHY AND LOCATION

CYCLONES

India witnessed severe cyclonic activity both in the Arabian Sea (Tauktae) and in the Bay of Bengal (Yaas).

- Tropical cyclones are one of the biggest threats to life and property even in the formative stages of their development.
- They include a **number of different hazards** that can individually cause significant impacts on life and property, such as **storm surge, flooding, extreme winds, tornadoes and lighting**. Combined, these hazards interact with one another and substantially increase the potential for loss of life and material damage.

Characteristics of tropical cyclones

- 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 centre 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.
- The winds blow **counterclockwise in the Northern Hemisphere** and **clockwise in the Southern Hemisphere**. Tropical cyclones above certain strength are given names in the interests of public safety.
- About 85 tropical storms form annually over the warm tropical oceans of the globe. Among these, a little more than half (45) become tropical cyclone/hurricane/typhoon.
- Out of the 85 tropical storms, 72% form in the northern hemisphere, and 28% in the southern hemisphere.

The different terminologies

- In the Caribbean Sea, the Gulf of Mexico, the North Atlantic Ocean and the eastern and central North Pacific Ocean, it 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 Indian Ocean, it is called “severe tropical cyclone”
- In the southwest Indian Ocean, it is called “tropical cyclone”

Classification of tropical cyclones

- **Tropical depression** is when the maximum sustained wind speed is less than 63 km/h.
- **Tropical storm** is when the maximum sustained wind speed is more than 63 km/h. It is then also given a name.
- **Hurricane, typhoon, tropical cyclone**, very severe cyclonic storm - depending on the basin - when the maximum sustained wind speed **exceeds 116 km/h or 63 knots**.

Naming of cyclones

The **WMO/ Economic and Social Commission for Asia and the Pacific (ESCAP) Panel** on Tropical Cyclones at its twenty-seventh Session held in 2000 in Muscat, agreed in principal to assign names to the tropical cyclones in the Bay of Bengal and Arabian Sea. The naming of the tropical cyclones over north Indian Ocean commenced from September 2004, with names provided by eight Members. Since then, five countries have joined the Panel.

- The Panel Member's names are **listed alphabetically** country wise.
- The names will be **used sequentially column wise**.
- The **first name will start from the first row of column one** and continue sequentially to the last row in the column thirteen.
- The **names of tropical cyclones over the north Indian Ocean will not be repeated**, once used it will cease to be used again. The name should be new. It should not be there in the already existing list of any of the RSMCs worldwide including RSMC New Delhi.

Annexure-I

New list of tropical cyclone names adopted by WMO/ESCAP Panel Member Countries in April 2020 for naming of tropical cyclones over North Indian Ocean including Bay of Bengal and Arabian Sea
(To be used after the name 'Amphan' from the previous list is utilised)

WMO/ESCAP Panel Member countries	Column 1		Column 2		Column 3		Column 4	
	Name	Pron'	Name	Pron'	Name	Pron'	Name	Pron'
Bangladesh	Nisarga	Nisarga	Biparjoy	Biporjoy	Arnab	Omab	Upakul	Upokul
India	Gati	Gati	Tej	Tej	Murasu	Murasu	Aag	Aag
Iran	Nivar	Nivar	Hamoon	Hamoon	Akvan	Akvan	Sepand	Sepand
Maldives	Burevi	Burevi	Midhili	Midhili	Kaani	Kaani	Odi	Odi
Myanmar	Tauktae	Tau'Te	Michaung	Migjaum	Ngamann	Ngaman	Kyarthit	Kjathi
Oman	Yaas	Yass	Remal	Re-Mal	Sail	Sail	Naseem	Naseem
Pakistan	Gulab	Gul-Aab	Asna	As-Na	Sahab	Sa-Hab	Afshan	Af-Shan
Qatar	Shaheen	Shaheen	Dana	Dana	Lulu	Lulu	Mouj	Mouj
Saudi Arabia	Jawad	Jowad	Fengal	Feinjal	Ghazeer	Razeer	Asif	Aasif
Sri Lanka	Asani	Asani	Shakhti	Shakhti	Gigum	Gigum	Gagana	Gagana
Thailand	Sitrang	Si-Trang	Montha	Mon-Tha	Thianyot	Thian-Yot	Bulan	Bu-Lan
United Arab Emirates	Mandous	Man-Dous	Senyar	Sen-Yaar	Afoor	Aa-Foor	Nahhaam	Nah-Haam
Yemen	Mocha	Mokha	Ditwah	Ditwah	Diksam	Diksam	Sira	Sira

- The name of a tropical cyclone from south China Sea which crosses Thailand and emerge into the Bay of Bengal as a Tropical cyclone will not be changed.

The **RSMC New Delhi Tropical Cyclone Center** is responsible to name the tropical cyclones that have formed over the Bay of Bengal and the Arabian Sea when they have reached the relevant intensity.

ICEBERG

*A huge ice block has broken off from western Antarctica into the Weddell Sea, becoming the largest iceberg in the world and earning the name **A-76.** It separated from the **Ronne Ice Shelf.***

What is an iceberg?

- Icebergs are pieces of ice that formed 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.

How do icebergs form, and where do they go?

- Icebergs form when chunks of ice calve, or break off, from glaciers, ice shelves, or a larger iceberg. Icebergs travel with ocean currents, sometimes smashing up against the shore or getting caught in shallow waters.
- When an iceberg reaches warm waters, the new climate attacks it from all sides.
- On the iceberg surface, warm air melts snow and ice into pools called **melt ponds** that can trickle through the iceberg and widen cracks. At the same time, warm water laps at the iceberg edges, melting the ice and causing chunks of ice to break off. On the underside, warmer waters melt the iceberg from the bottom up.

Why are icebergs important?

- Icebergs pose a danger to ships traversing the North Atlantic and the waters around Antarctica. After the Titanic sank near Newfoundland in 1912, the United States and twelve other countries formed the **International Ice Patrol** to warn ships of icebergs in the North Atlantic.

- The International Ice Patrol uses airplanes and radars to track icebergs that float into major shipping lanes. The **U.S. National Ice Center** uses satellite data to monitor icebergs near Antarctica. However, it only tracks icebergs larger than 500 square meters (5,400 square feet).
- Icebergs can also serve as tools for scientists, who study them to learn more about climate and ocean processes.

Why do scientists study icebergs?

- Climate scientists study icebergs as they break up for clues to the processes that cause ice shelf collapse. Scientists have noticed that the way icebergs break up when they reach warmer waters mirrors the disintegration of Antarctic ice shelves. By studying the factors that cause icebergs to break up, researchers hope to better understand the influences that lead to ice shelf breakup, and to better predict how ice shelves will respond to a warming climate.
- Oceanographers follow icebergs because the cold freshwater they contribute to the sea can influence currents and ocean circulation far away from their origins.
- Biologists study icebergs to find out how they influence ocean life. As icebergs melt, they leak nutrients into the ocean around them. Recent studies have shown that the water surrounding icebergs teems with plankton, fish, and other sea life.

VOLCANO

Mount Nyaragongo, an active volcano which overlooks the Goma city in Congo erupted. The Indian Army contingent under the United Nations peace keeping mission (MONUSCO) assisted in protecting civilians.

What is a volcano?

- Volcanoes are **openings, or vents** where lava, tephra (small rocks), and steam erupt on to the Earth's surface. Many mountains form by folding, faulting, uplift, and erosion of the Earth's crust.
- **Volcanic terrain, however, is built by the slow accumulation of erupted lava**.
- The vent may be visible as a small bowl shaped depression at the summit of a cone or shield-shaped mountain. Through a series of cracks within and beneath the volcano, the vent connects to one or more linked storage areas of molten or partially molten rock (magma). This connection to fresh magma allows the volcano to erupt over and over again in the same location. In this way, the volcano grows ever larger, until it is no longer stable. Pieces of the volcano collapse as rock falls or as landslides.

How do volcanoes erupt?

- Molten rock below the surface of the Earth that rises in volcanic vents is known as **magma,** but after it erupts from a volcano it is called **lava.**
- Magma is made of molten rock, crystals, and dissolved gas. The molten rock is made of the chemicals oxygen, silicon, aluminum, iron, magnesium, calcium, sodium, potassium, titanium, and manganese. After cooling, liquid magma may form crystals of various minerals until it becomes completely solid and forms an igneous or magmatic rock.
- Originating many tens of miles beneath the ground, magma is lighter than surrounding solid rock. It is driven towards Earth's surface by buoyancy, it is lighter than the surrounding rock, and by pressure from gas within it. Magma forces its way upward and may ultimately break though weak areas in the Earth's crust. If so, an eruption begins.
- Magma can be erupted in a variety of ways. Sometimes molten rock simply pours from the vent as fluid lava flows. It can also **shoot violently** into the air as dense clouds of rock shards (tephra) and gas. Larger fragments fall back around the vent, and clouds of tephra may move down the slope of the volcano under the force of gravity. Ash, tiny pieces of tephra the thickness of a strand of hair, may be carried by the wind only to fall to the ground many miles away. The smallest ash particles may be erupted miles into the sky and carried many times around the world by winds high in the atmosphere before they fall to the ground.

What are the main types of volcanoes?

- **Cinder cones** are the simplest type of volcano. They are made of **small pieces of solid lava, called cinder**, that are erupted from a vent.
- The ground shakes as magma rises from within the Earth. Then, a powerful blast throws molten rocks, ash, and gas into the air. The rocks cool quickly in the air and fall to the earth to break into small pieces of bubbly cinder that pile up around the vent.
- They accumulate as a small cinder cone that can be as high as a thousand feet above the surrounding ground. If the wind is blowing during the eruption, cinder is carried downwind before its deposited into an oval shape. Eruptions that form cinder cones also feed lava flows that spread outward from the eruptive vent. When you climb a cinder cone you can usually find the bowl-shaped crater marking the location of the vent.
- If eruptions of cinder and lava flows happen repeatedly from the same vent, the overlapping layers can form a **composite volcano (stratovolcano).**
- Thousands of cinder cones exist in western North America and in other volcanic areas of the world.
- **Composite Volcano (Stratovolcano)**
- Some of the Earth's grandest mountains are composite volcanoes—sometimes called **stratovolcanoes**.
- They are usually tall with steep even sides and are made out of repeating layers of lava flows, volcanic ash, cinders, blocks, and volcanic bombs. Some composite volcanoes rise over 8,000 feet above their surroundings, but they reach much higher elevations when compared to the level of the sea (called above sea level).
- **Ojos del Salado** in Chile is the tallest composite volcano on Earth with a summit elevation (height above sea level) of 22,615 feet; the tallest in the U.S. is **Mount Rainier** in Washington State with a summit elevation of 14,410 feet. Some of the most famous and beautiful mountains in the world are composite volcanoes, including Mount Fuji in Japan, Mount Cotopaxi in Ecuador, Mount Shasta in California, Mount Hood in Oregon, and Mount St. Helens in Washington.
- **Stratovolcanoes can erupt with great violence**. Stratovolcanoes are considered the most violent.

Other volcanic landforms

Besides well-known symmetrical volcanoes such as Mount Fuji in Japan and Kilimanjaro in Tanzania, volcanic activity is responsible for several other distinctive landforms.

- **Calderas:** A caldera is a bowl-shaped depression formed when a **volcano collapses into the void** left when its magma chamber is emptied. There are three types:
  - The first type is a **crater lake caldera**. This is the result of a stratovolcano collapsing into its magma chamber during a violent eruption.
  - **Basaltic calderas** have a concentric ring pattern resulting from a series of gradual collapses rather than a single event. They are often found at the summit of shield volcanoes such as the craters at the tops of Mauna Loa and Kilauea.
  - **Resurgent calderas** are the **largest volcanic structures** on Earth. They are the result of catastrophic eruptions that dwarf any eruptions ever recorded. Yellowstone caldera, sometimes called a "super volcano," is one example.
- **Volcanic plugs:** When magma solidifies in the fissure of a volcano the hard dense rock may form a "neck" that remains when softer surrounding rock has been eroded away.
- **Tuff cones:** also known as **maars,** tuff cones are shallow, flat-floored craters that scientists think formed as a result of a violent expansion of magmatic gas or steam. Maars occur geologically young volcanic regions of the world such as the western United States and the Eifel region of Germany.
- **Lava plateaus:** Shield volcanoes may erupt along lines of fissures rather than a central vent spilling liquid lava in successive layers. Over time, these layers form broad plateaus such as the Columbia Plateau. These plateaus are often cut by deep canyons that expose the layers of rock.

EARTHQUAKE

An earthquake occurred in the state of Assam.

- An earthquake happens when **two blocks of the earth suddenly slip past one another.**
- The surface where they slip is called the **fault or fault plane.**
- The location below the earth's surface where the earthquake **starts is called the hypocenter**, and the location directly above it on the surface of the earth is called the **epicenter.**
- Sometimes an earthquake has **foreshocks.** These are smaller earthquakes that happen in the same place as the larger earthquake that follows. Scientists can't tell that an earthquake is a foreshock until the larger earthquake happens. The largest, main earthquake is called the **mainshock**.
- Mainshocks always have **aftershocks** that follow. These are smaller earthquakes that occur afterwards in the same place as the mainshock. Depending on the size of the mainshock, aftershocks can continue for weeks, months, and even years after the mainshock.

What causes earthquakes and where do they happen?

- The earth has **four major layers: the inner core, outer core, mantle and crust.** The crust and the top of the mantle make up a thin skin on the surface of our planet.
- But this skin is not all in one piece – it is made up of many pieces like a puzzle covering the surface of the earth. Not only that, but these puzzle pieces keep slowly moving around, sliding past one another and bumping into each other.
- These pieces are called **tectonic plates**, and the edges of the plates are called the **plate boundaries**.
- The plate boundaries are made up of many **faults,** and most of the earthquakes around the world occur on these faults.
- Since the edges of the plates are rough, they get stuck while the rest of the plate keeps moving. Finally, when the plate has moved far enough, the edges unstick on one of the faults and there is an earthquake.

Why does the earth shake when there is an earthquake?

- While the edges of faults are stuck together, and the rest of the block is moving, the energy that would normally cause the blocks to slide past one another is being stored up. When the force of the moving blocks finally overcomes the friction of the jagged edges of the fault and it unsticks, all that stored up energy is released.
- The **energy radiates outward from the fault in all directions in the form of seismic waves** like ripples on a pond. The seismic waves shake the earth as they move through it, and when the waves reach the earth's surface, they shake the ground and anything on it, like our houses and us!

How are earthquakes recorded?

- Earthquakes are recorded by instruments called seismographs.
- The recording they make is called a **seismogram.** The seismograph has a base that sets firmly in the ground, and a heavy weight that hangs free. When an earthquake causes the ground to shake, the base of the seismograph shakes too, but the hanging weight does not. Instead the spring or string that it is hanging from absorbs all the movement.
- The **difference in position** between the shaking part of the seismograph and the motionless part is what is recorded.

How can scientists tell where the earthquake happened?

- Seismograms come in handy for locating earthquakes too, and being able to see the **P wave and the S wave** is important.
- P waves are also faster than S waves, and this fact is what allows us to tell where an earthquake was. To understand how this works, let's compare P and S waves to lightning and thunder. Light travels faster than sound, so during a thunderstorm you will first see the lightning and then you will hear the thunder. If you are close to the lightning, the thunder will boom right after the lightning, but if you are far away from the lightning, you can count several seconds before you hear the thunder. The further you are from the storm, the longer it will take between the lightning and the thunder.
- **P waves are like the lightning, and S waves are like the thunder**. The P waves travel faster and shake the ground where you are first. Then the S waves follow and shake the ground also. If you are close to the earthquake, the P and S wave will come one right after the other, but if you are far away, there will be more time between the two.

- **P Waves alternately compress and stretch the crustal material parallel to the direction they are propagating**.
- **S Waves cause the crustal material to move back and forth perpendicular to the direction they are travelling.**
- By looking at the amount of time between the P and S wave on a seismogram recorded on a seismograph, scientists can tell how far away the earthquake was from that location. However, they can't tell in what direction from the seismograph the earthquake was, only how far away it was. If they draw a circle on a map around the station where the radius of the circle is the determined distance to the earthquake, they know the earthquake lies somewhere on the circle.

But where?

- Scientists then use a method called **triangulation** to determine exactly where the earthquake was.
- It is called triangulation because a triangle has three sides, and it takes **three seismographs to locate an earthquake.** If you draw a circle on a map around three different seismographs where the radius of each is the distance from that station to the earthquake, the intersection of those three circles is the epicenter.

LANDSLIDES

- Landslide is rapid movement of rock, soil and vegetation down the slope under the influence of gravity. These materials may move downwards by falling, toppling, sliding, spreading or flowing. Such movements may occur gradually, but sudden sliding can also occur without warning. They often take place in conjunction with earthquakes, floods and volcanic eruptions.
- The extent and intensity of landslide depends upon number of factors- S**teepness of the slope, amount of vegetation cover, tectonic activity, bedding plane of the rocks etc**.

Landslide Prone areas in India: The major landslide prone areas in India include:-

1. Western Ghats and Konkan Hills (Tamil Nadu, Kerala, Karnataka, Goa and Maharashtra);
2. Eastern Ghats (Araku region in Andhra Pradesh);
3. North-East Himalayas (Darjeeling and Sikkim);
4. North West Himalayas (Uttarakhand, Himachal Pradesh, Jammu and Kashmir).

- The **Himalayan mountain ranges** and hilly tracts of the North-Eastern region are highly susceptible to slope instability due to the **immature and rugged topography, fragile rock conditions, high seismicity** resulting from proximity to the plate margins, and high rainfall. Extensive anthropogenic interference, as part of developmental activities, is another significant factor.
- Similarly, the **Western Ghats**, though located in a relatively stable domain, experiences landslides due to number of factors- **steep hill slopes, high intensity rainfall and anthropogenic activities**. The Nilgiris hills located at the convergence zone of the Eastern Ghats and the Western Ghats experiences a number of landslides due to high intensity and protracted rainfall.

Types of Landslides

- **Falls:** Abrupt movements of materials that become detached from steep slopes or cliffs, moving by free-fall, bouncing, and rolling.
- **Creep:** Slow, steady downslope movement of soil or rock.
- **Debris flow**: Rapid mass movement in which loose soils, rocks, and organic matter combine with water to form slurry that then flows down slope. Usually associated with steep gullies
- **Mudflow**: Rapidly flowing mass of wet material that contains at least 50 percent sand-, silt-, and clay-sized particles.
- **Flows**: General term including many types of mass movement, such as creep, debris flow, mudflow etc.

Causes of Landslides

- **Geological Causes**: Weak, Sensitive and Weathered material, Sensitive material, Presence of Joints and Fissures, Variation in physical properties such as Permeability.
- **Morphological Causes**: Tectonic or volcanic uplift, Erosion due to Wind and Water, Higher deposition of load on the slope or its crest, Removal of Vegetation.
- **Physical Causes**: Intense rainfall, Earthquake/Volcanic eruption, Rapid snow melt/freeze
- **Human Causes**: Excavation of the slope or its toe, Deposition of load on the slope, Drawdown of Reservoir, Deforestation, Mining, Irrigation and artificial vibration.

Impact of Landslides

- **Short run:** Loss and damage to property, loss of lives, Destruction to agricultural crops, Damages to Vegetation, Obstruction of vehicular movement leading to Traffic jam, temporary loss of livelihood for the poor people etc.
- **Long-run:**
- Increase in the sediment load of the river which can lead to floods.
- Reduce the effective life of hydroelectric and multipurpose projects by adding an enormous amount of silt load to the reservoirs.
- Loss of cultivable land
- Environmental impact in terms of erosion and soil loss
- Demographic Impact in terms of relocation of population towards other areas
- Frequent disruption of transportation networks leads to geographical isolation and hence perpetuates under-development

NDMA Guidelines for Landslide Disaster Management

- **Landslide Hazard, Vulnerability and Risk Assessment**: This includes delineating areas susceptible to landslide hazards in different areas and to assess the resources at risk.
- **Early Warning Systems for Landslides:** This includes the continuous monitoring of movements, development of stresses and the transmission of this data at regular time intervals.
- **Investigations for Landslide Risk Assessment:** Multi-disciplinary investigations of landslide risk assessment leading to formulation of Standards to mitigate impact of landslides.
- **Landslide Risk Mitigation and Remediation:**
- Restricting Development in Landslide-Prone Areas through Land use planning.
- Laying down standards to be followed for Excavation and Construction
- Protecting Existing Developments through restraining walls and rock anchors
- Slope Stabilisation measures: Generally, include works involving modification of the natural landslide conditions such as topography, geology, ground water, and other conditions that indirectly control portions of the entire landslide movement. These include drainage improvement works, soil/debris removal works etc.
- Landslide Insurance and Compensation for Losses
- **Regulation and Enforcement:**
- The state governments/SDMAs will adopt the model techno-legal framework for ensuring compliance with land use zoning and landslide safety issues in all development activities and plans.
- Awareness and Preparedness: Comprehensive awareness campaigns targeting different groups of people living in landslide prone areas should be carried out systematically
- **Capacity Development (Including Education, Training and Documentation):**
- Introduction of curriculum related to Disaster Management, including Landslides in the Schools
- Training of the Administrators to plan, respond and mitigate the impact of Landslides
- Technical institutes located in vulnerable areas should develop adequate technical expertise on the various subjects related to landslide management.

- **Immediate Response:**

- Put in place Standard Operating Procedure (SoP) which should ensure coordinated and sustained action from various agencies in the aftermath of landslides
- Research and Development: Government should encourage, promote, and support R&D activities to address current challenges, offer solutions, and develop new investigation techniques, with the application of the latest developments in remote sensing, communications, and instrumentation technologies.

MONSOON

- The southwest monsoon is so powerful that its performance from June to September decides the state of agricultural productivity in India, which in turn, decides the state of the economy.
- The monsoon affects a region comprising nearly 25 countries and its influence stretches across a distance of 18,000 kilometres (from east to west) and 6,000 kilometres (from south to north).

Five special conditions

- The Earth System Science Organisation (ESSO) and the India Meteorological Department (IMD) take into account five conditions while making forecasts about the monsoon in April every year.

  These special conditions are as follows:

1. The Sea Surface Temperature (SST) gradient between the north Atlantic and the north Pacific (conditions during December of the previous year and January of present year)
2. SST of the equatorial south Indian Ocean (conditions during February and March of the present year)
3. Mean Sea Level pressure in east Asia (conditions during February and March of the present year)
4. The surface air temperature over northwest Europe (conditions during January of the present year)
5. The warm water volume of the equatorial Pacific Ocean (conditions during February and March of the present year)

Here are some friends of the Indian monsoon which are responsible for its existence and good performance over the years.

Mascarene High: monsoon's best buddy

- The southwest monsoon derives its name from winds which blow from a **south-westerly direction** in the Indian subcontinent. These come from a powerhouse located more than 4,000 kilometres from India. This powerhouse is known as the **Mascarene High**. This high-pressure region is located between **25°S-35°S and 40°E-90°E** near the Mascarene Islands in the southern Indian Ocean.
- Normally, this high-pressure region starts forming by **mid-April** and its strength is an important factor which determines the intensity of monsoon in India.
- A stronger high pressure will produce stronger winds or monsoon current. If there is a delay in the formation of Mascarene High, there is also the possibility of a delay in the onset of monsoon in India. Mascarene High has been a subject of research for many years. Most research says that its strength is determined by the happenings in the Antarctic region.
- But overall, this factor is not often held responsible for delays and poor performance of the monsoon in India. As a result of its punctuality, Mascarene High is considered its best buddy.

Coriolis Force: monsoon's trusted lieutenant

- Winds from Mascarene High head in a north-westerly direction towards the east coast of Africa (Somalia).
- Here, the topography of Somalia deflects the winds towards the east. Also, after crossing the equator, these winds experience the **Coriolis Effect**.
- Coriolis Force is a pseudo force which exists only because of the Earth's rotational effect. Rotational motion observed in a tropical cyclone is also due to this force. Hence, these monsoon winds get deflected eastwards and now

they blow from south-west to the north-east direction. They split into two branches—**the Arabian Sea branch** and the **Bay of Bengal** branch.

Indian summer: monsoon's guide

- A mechanism is needed to attract the monsoon winds from the Arabian Sea or the Bay of Bengal. We keep reading about tropical cyclones or troughs or low pressure regions which are great attractors of winds in the Earth's weather system.
- **Winds flow from high pressure to low pressure areas.** The Himalayan range plays a vital role in summer heating by restricting the intrusion of cold air from the north and allowing heating to occur. It is during this season that the land of India, particularly Rajasthan and surrounding areas (Gujarat and also Pakistan) heat up extensively. The seas surrounding the country also see a temperature rise. As a result of the differential heating rates and capacities of air over the sea and the land, we observe a **gradient between air pressure over the sea and that over India**. The air pressure over India is lower than that over the southern part of the Arabian Sea and the Bay of Bengal. This acts as an attractor mechanism for the monsoon winds.
- Thus, the summer season of India acts as the monsoon's guide.

El Nino Southern Oscillation: the undependable friend

- El Nino Southern Oscillation (ENSO) refers to the oscillatory mode of the sea surface temperatures near the **equatorial Pacific Ocean** in which a warming (El Nino or cooling (La Nina) or neutrality is observed. Due to its mostly unpredictable nature, ENSO has been a big challenge for forecasters since a long time. Even trusted models have failed many a time.
- ENSO has been a driver of global weather (particularly in countries surrounding the Pacific Ocean) as it affects atmospheric circulation.
- The El Nino concept became more popular in the Indian media after the drought of 2009.
- Thus, ENSO is monsoon's undependable friend.

Indian Ocean Dipole: monsoon's latest friend

- In 1999, N H Saji of Japan's University and others discovered an ENSO-like phenomenon in the Indian Ocean which they named the Indian Ocean Dipole (IOD).
- Like ENSO, IOD also has three phases—**positive, negative and neutral**. During the positive phase of IOD, sea surface temperatures are warmer in the western Indian Ocean (which gives a boost to monsoon winds) as compared to the eastern Indian Ocean—hence a dipole nature.
- **The reverse happens during IOD negative and no gradient** is observed during the IOD neutral period.
- It has been observed that during the period of positive IOD, the Indian summer monsoon rainfall is considerably good as compared to the negative IOD period. Despite 1994 and 2006 being El Nino years, India did not witness a drought as IOD was significantly positive. Thus, in some ways a strong positive phase of IOD tries to counter the negative effects of El Nino. But the relation between IOD and monsoon rainfall is still being debated and has not been fully comprehended.
- Compared to the roles of Mascarene High, Coriolis Force, India's summer season and ENSO, IOD's role has been discovered recently.
- It will be interesting to see how these parameters evolve in the ongoing pre-monsoon period.

INDIAN OCEAN DIPOLE

- IOD measures d**ifferences in sea surface temperatures between the western and eastern parts of the Indian Ocean**. Sustained changes in the difference between sea surface temperatures of the tropical western and eastern Indian Ocean are known as the Indian Ocean Dipole or IOD.
- Indian Ocean Dipole (IOD) is **basically similar to the El Nino weather system** that develops in the Pacific Ocean.

- Indian Ocean sea surface temperatures impact rainfall and temperature patterns over Australia. Warmer than average sea surface temperatures can provide more moisture for frontal systems and lows crossing Australia.
- The IOD is one of the key drivers of Australia's climate and can have a significant impact on agriculture. This is because events generally coincide with the winter crop growing season.
- The IOD has **three phases**: **neutral**, **positive** and **negative**. Events usually start around May or June, peak between August and October and then rapidly decay when the monsoon arrives in the southern hemisphere around the end of spring.
- **Neutral IOD phase:** Water from the Pacific flows between the islands of Indonesia, keeping seas to Australia's northwest warm. Air rises above this area and falls over the western half of the Indian Ocean basin, blowing westerly winds along the equator.
- **Positive IOD phase**: Westerly winds weaken along the equator allowing warm water to shift towards Africa. Changes in the winds also allow cool water to rise up from the deep ocean in the east.
- This sets up a temperature difference across the tropical Indian Ocean with cooler than normal water in the east and warmer than normal water in the west.
- During the positive phase of Indian Ocean dipole the water over western Indian Ocean is warmer than normal leading to formation of troughs (low pressure regions) and thus enhanced rainfall.
- On the other hand, cooler waters develop off Indonesia resulting in less rainfall and high temperatures in Australia.
- **Negative IOD phase:** Westerly winds intensify along the equator, allowing warmer waters to concentrate near Australia. This sets up a temperature difference across the tropical Indian Ocean, with warmer than normal water in the east and cooler than normal water in the west.
- A negative IOD typically results in above-average winter–spring rainfall over parts of Australia as the warmer waters off northwest Australia provide more available moisture to weather systems crossing the country.

WESTERN DISTURBANCE

- A western disturbance is an **extratropical storm** originating in the Mediterranean region that brings sudden winter rain to the north western parts of the Indian subcontinent. It is a non-monsoonal precipitation pattern driven by the westerlies.
- The moisture in these storms usually originates over the **Mediterranean Sea, the Caspian Sea and the Black Sea**.

Formation

- Western disturbances originate in the Mediterranean region.
- A high-pressure area over Ukraine and neighbourhood consolidates, causing the intrusion of cold air from polar regions towards an area of relatively warmer air with high moisture.
- This generates favourable conditions for cyclogenesis in the upper atmosphere, which promotes the formation of an eastward-moving extratropical depression.
- Traveling at speeds up to 12 m/s (43 km/h; 27 mph), the disturbance moves towards the Indian subcontinent until the Himalayas inhibits its development, upon which the depression rapidly weakens.
- The western disturbances are embedded in the mid-latitude subtropical westerly jet stream.

Impact of Western Disturbances on Indian climate

- Western disturbances are usually associated with cloudy sky, higher night temperatures and unusual rain.
- Western disturbances, specifically the ones in winter, bring moderate to heavy rain in low-lying areas and heavy snow to mountainous areas of the Indian Subcontinent.
- They are the cause of most winter and pre-monsoon season rainfall across northwest India.
- Precipitation during the winter season has great importance in agriculture, particularly for the rabi crops.
- Wheat among them is one of the most important crops, which helps to meet India’s food security.

Are there any ill-effects of Western Disturbances?

- Excessive precipitation due to western disturbances can cause crop damage, landslides, floods and avalanches.
- Over the Indo-Gangetic plains, they occasionally bring cold wave conditions and dense fog. These conditions remain stable until disturbed by another western disturbance.
- When western disturbances move across northwest India before the onset of monsoon, a temporary advancement of monsoon current appears over the region.

ARCTIC REGION

- The Arctic region, or the Arctic, is a geographic region spreading around the North Pole. There is no single correct definition of the region as the southern boundary varies.

Key ways to define the Arctic:

- The **Arctic Circle (66 ° 33'N) delimits the Arctic in terms of solar radiation**.
- In theory, areas north of the Arctic Circle have at least one day without daylight in the winter and at least one nightless night in the summer. In practice, this does not happen everywhere because the surface of the earth is uneven, and the light refracts in the atmosphere.
- Based on temperature, the **monthly average temperature in the Arctic is below + 10 ° C throughout the year**, even in summer.
- The forest line follows a **temperature-defined area**. The forest line is not a narrow line but a zone tens of kilometres wide between the northern coniferous forest and the tundra. In this demarcation, the Arctic is predominantly wooded tundra and glaciers.
- **Permafrost increases the area of Russian Arctic** compared to the other delimitations. Permafrost is soil that stays frozen for at least two consecutive years.
- The ice cover determines the Arctic nature of marine areas.
- **Sea ice is highest in February-March** and **lowest in September**. The surface of the Arctic ice is monitored almost in real time by satellites.
- **Culturally defined**, the Arctic covers the **homelands of northern indigenous peoples**.
- **Political delimitations** vary according to how they serve, for example, the interests of states or international cooperation.
- As the climate warms, the Arctic shrinks if defined by temperature, forest line, permafrost, or ice cover. Cultural and political boundaries also vary. The Arctic Circle is the most permanent of the delimitations, although also the polar circle moves very slowly due to the variation of the Earth's axial tilt.

Interesting facts and figures about the Arctic

1. The Arctic is regarded as containing some of the last physically undisturbed marine spaces on earth.
2. Shipping (unique ships) within the Arctic Polar Code area has increased by 25% over 6 years from 2013-2019. A majority of these vessels are fishing vessels.
3. The central feature of the Arctic is the Arctic Ocean. The **Arctic Ocean has the widest continental shelf of all the oceans.**
4. The Arctic sea ice has **diminished from 6,1 million sq.km. in 1999 to 4,3 million sq.km. in 2019.**
5. Boreal forests of the Arctic cover about 17% of the global land area, representing the largest natural forests in the world.
6. Together with the Antarctic, the Arctic contains the largest freshwater resource on Earth.
7. **Seven of the world's ten largest wilderness** areas are located in the Arctic region.
8. The total catch of wild fish in the Arctic mounted to 10% of the world catch .
9. The Arctic as an area is essentially an ocean surrounded by the land north of the Arctic circle (66032' N) that covers a region of 33 million Km2 , larger than Africa or Asia.

10. The United States Geological Survey (USGS) estimates that 30 per cent of the world's undiscovered natural gas is in the Arctic, mostly on the continental shelves beneath the Arctic Ocean.

11. More than 70 per cent of the undiscovered oil resources are estimated to occur in northern Alaska, the Amerasian Basin, the eastern side of Greenland, the eastern Barents Sea region, and the Davis Strait of Greenland and Canada.

12. An estimated 84 per cent of the undiscovered oil and gas in the Arctic occurs offshore.

13. The Arctic region is characterized by some of the largest continuous intact ecosystems on the planet, but is facing increasingly larger threat

LITTLE ANDAMAN ISLAND

- Recently, a plan named the **Sustainable Development of Little Andaman Island Vision Document** by NITI Aayog for the sustainable and holistic development of the 680 sq. km, fragile Little Andaman Island in the Andaman and Nicobar island group has raised alarm among conservationists.
- This island is part of the **Little Andaman Group** (Little Andaman is the counterpart of Great Andamans). This island is the fourth largest island in Andamans.
- It is famous by the name of its main village and the largest settlement –**Hut Bay** (rarely known by its other name Kwate-tu-kwage).

Tribes:

- At a distance of about 120 Kilometers by sea from the capital town of Port Blair, this island has become a tribal reserve from sometime near to 1957.
- This is considered home to the **Onge Tribes**, even though there are multilingual settlers of Bengali, Tamil, Telugu, and Ranchi communities.

Location and Transport:

- Lying at the southern end of the archipelago, Hut Bay Jetty is the only harbor for ships or boats coming into this island from the capital town –Port Blair.
- Little Andamans is less explored due to the limited mode of connection with the capital town of Port Blair.
- **Purpose:** To leverage the strategic location and natural features of the island. The islands are critical for India's security because of their strategic location in the Indian Ocean Region (IOR). Better infrastructure and connectivity will help India enhance its military and naval strength in the islands.
- **Plan:** Building a new greenfield coastal city, that will be developed as a free trade zone and will compete with Singapore and Hong Kong. Three Zones: It has divided the development in three zones:

1. **Zone 1**: Spread over 102 sq. km alongside the east coast of Little Andaman. It would be the monetary district and metropolis and can embody an aerocity, and a tourism and hospital district.
2. **Zone 2:** Spread over 85 sq. km of pristine forest. It is the leisure zone, can have a movie metropolis, a residential district and a tourism Special Economic Zone (SEZ).
3. **Zone 3**: Spread over 52 sq. km of pristine forest. It shall be a nature zone, additional categorized into three districts: a unique forest resort, a nature therapeutic district and a nature retreat, all on the western coast.

Transport Development:

- A worldwide airport able to deal with all varieties of plane is central to the plan as a global airport is vital for growth.
- The solely jetty on the island might be expanded and a marina might be developed subsequent to the tourist entertainment district.
- A 100 km greenfield ring highway might be constructed parallel to the shoreline from east to west and might be supplemented with a mass fast transit community with stations at common intervals.

GREAT NICOBAR

- Great Nicobar is the **southernmost island of the Nicobar Islands Archipelago**. It covers 103 870 hectares of unique and threatened tropical evergreen forest ecosystems. It is home to a very rich ecosystem, including species of angiosperms, ferns, gymnosperms, bryophytes, among others. In terms of fauna, there are over 1800 species, some of which are endemic to this area.
- The Great Nicobar Biosphere Reserve harbours a wide spectrum of ecosystems comprising **tropical wet evergreen forests**, mountain ranges reaching a height of 642 m (Mt. Thullier) above sea level, and coastal plains. The region is noted for its rich biodiversity. It houses 650 species of angiosperms, ferns, gymnosperms, bryophytes and lichens among others. The tract is rich in plant diversity and fosters a number of rare and endemic species, including Cyathea albosetacea (tree fern) and Phalaenopsis speciosa (orchid).
- A total of 14 species of mammals, 71 species of birds, 26 species of reptiles, 10 species of amphibians and 113 species of fish have been reported. The region also harbours a large number of endemic and endangered species of fauna. Of these, the well-known **Crab-eating Macaque, Nicobar Tree Shrew, Dugong, Nicobar Megapode, Serpent Eagle, salt water crocodile, marine turtles** and **Reticulated Python** are endemic and/or endangered.
- The **Mongoloid Shompen Tribe**, about 200 in number, live in the forests of the biosphere reserve particularly along the rivers and streams. They are hunters and food gatherers, dependent on forest and marine resources for sustenance. Another Mongoloid Tribe, **Nicobarese,** about 300 in number, used to live in settlements along the west coast. After the tsunami in 2004, which devastated their settlement on the western coast, they were relocated to Afra Bay in the North Coast and Campbell Bay. They survive on fish caught from the sea. The settlers and mainlanders, which number over 8 000, live along the southeast coast of the island, practising agriculture, horticulture and fishing.
- The Shompens move between the Core and Buffer Zones, while the settlers and Nicobarese live in settlements spread along the coast in the Transition zone.

HIMALAYAN CATCHMENT

- The Himalayas are drained by 19 major rivers, of which the Indus and the Brahmaputra are the largest, each having catchment basins in the mountains of about 100,000 square miles (260,000 square km) in extent.
- Five of the 19 rivers, with a total catchment area of about 51,000 square miles (132,000 square km), belong to the **Indus system—the Jhelum, the Chenab, the Ravi, the Beas, and the Sutlej**—and collectively define the vast region divided between Punjab state in India and Punjab province in Pakistan. Of the remaining rivers**, nine belong to the Ganges system**—the Ganges, Yamuna, Ramganga, Kali (Kali Gandak), Karnali, Rapti, Gandak, Baghmati, and Kosi rivers—draining roughly 84,000 square miles (218,000 square km) in the mountains, and **three belong** to the Brahmaputra system—the Tista, the Raidak, and the Manas—draining another 71,000 square miles (184,000 square km) in the Himalayas.
- The major Himalayan rivers rise north of the mountain ranges and flow through deep gorges that generally reflect some geologic structural control, such as a **fault line**.
- The rivers of the **Indus system** as a rule follow **northwesterly courses**, whereas those of the **Ganges-Brahmaputra systems generally take easterly courses** while flowing through the mountain region.
- To the north of India, the **Karakoram Range, with the Hindu Kush** range on the west and the **Ladakh Range on the east, forms the great water divide**, shutting off the Indus system from the rivers of Central Asia. The counterpart of that divide on the east is formed by the Kailas Range and its eastward continuation, the **Nyainqêntanglha (Nyenchen Tangla) Mountains**, which prevent the Brahmaputra from draining the area to the north. South of that divide, the Brahmaputra flows to the east for about 900 miles (1,450 km) before cutting across the Great Himalaya Range in a deep transverse gorge, although many of its Tibetan tributaries flow in an opposite direction, as the Brahmaputra may once have done.
- The Great Himalayas, which normally would form the main water divide throughout their entire length, function as such only in limited areas. That situation exists because the major Himalayan rivers, such as the Indus, the Brahmaputra, the Sutlej, and at least two headwaters of the Ganges—the Alaknanda and the Bhagirathi—are probably older than the mountains they traverse.

- It is believed that the Himalayas were uplifted so slowly that the old rivers had no difficulty in continuing to flow through their channels and, with the rise of the Himalayas, acquired an even greater momentum, which enabled them to cut their valleys more rapidly. The elevation of the Himalayas and the deepening of the valleys thus proceeded simultaneously.
- As a result, the **mountain ranges emerged with a completely developed river system cut into deep transverse gorges** that range in depth from 5,000 to 16,000 feet (1,500 to 5,000 metres) and in width from 6 to 30 miles (10 to 50 km). The earlier origin of the drainage system explains the peculiarity that the major rivers drain not only the southern slopes of the Great Himalayas but, to a large extent, its northern slopes as well, the water divide being north of the crest line.
- The role of the **Great Himalaya Range as a watershed, nevertheless, can be seen between the Sutlej and Indus valleys** for 360 miles (580 km); the drainage of the northern slopes is carried by the north-flowing Zaskar and Dras rivers, which drain into the Indus.
- Glaciers also play an important role in draining the higher elevations and in feeding the Himalayan rivers. Several glaciers occur in Uttarakhand, of which the largest, the Gangotri, is 20 miles (32 km) long and is one of the sources of the Ganges. The **Khumbu Glacier** drains the Everest region in Nepal and is one of the most popular routes for the ascent of the mountain. The rate of movement of the Himalayan glaciers varies considerably; in the neighbouring Karakoram Range, for example, the **Baltoro Glacier** moves about 6 feet (2 metres) per day, while others, such as the Khumbu, move only about 1 foot (30 cm) daily. Most of the Himalayan glaciers are in retreat, at least in part because of climate change.

ARAVALLI

- Aravalli Range, also spelled **Aravali Range** is a hill system of northern India.
- It is running northeasterly for 350 miles (560 km) through Rajasthan state. Isolated rocky offshoots continue to just south of Delhi.
- The series of peaks and ridges, with breadths varying from 6 to 60 miles (10 to 100 km), are generally between 1,000 and 3,000 feet (300 and 900 metres) in elevation.
- The system is divided into two sections: The **Sambhar-Sirohi ranges**, taller and including Guru Peak on Mount Abu, the highest peak in the Aravalli Range (5,650 feet [1,722 metres]); and the **Sambhar-Khetri ranges**, consisting of three ridges that are discontinuous.
- The Aravalli Range is rich in natural resources (including minerals) and serves as a **check to the growth of the western desert.**
- It gives rise to several rivers, including the Banas, Luni, Sakhi, and Sabarmati. Though heavily forested in the south, it is generally bare and thinly populated, consisting of large areas of sand and stone and of masses of **rose-coloured quartzite**.

CONSERVATION AND BIODIVERSITY

IUCN

- **International Union for Conservation of Nature** (IUCN), in full **International Union for Conservation of Nature and Natural Resources** was formerly called **World Conservation Union**.
- It is a network of environmental organizations founded as the **International Union for the Protection of Nature in October 1948 in Fontainebleau, France**, to promote nature conservation and the ecologically sustainable use of natural resources.
- It changed its name to the International Union for Conservation of Nature and Natural Resources (IUCN) in 1956 and was also known as the World Conservation Union (IUCN) from 1990 to 2008. The IUCN is the world's oldest global environmental organization.
- Its headquarters are in **Gland, Switz**.

- Through its member organizations, the IUCN supports and participates in environmental scientific research; promotes and helps implement national conservation legislation, policies, and practices; and operates or manages thousands of field projects worldwide.
- The IUCN's activities are organized into **several theme-based programs** ranging from business and biodiversity to forest preservation to water and wetlands conservation. In addition, a smaller number of special initiatives draw upon the work of different programs to address specific issues, such as climate change, conservation, and poverty reduction.
- The volunteer work of more than 10,000 scientists and other experts is coordinated through special commissions on education and communication; environmental, economic, and social policy; environmental law; ecosystem management; species survival; and protected areas.
- All of the IUCN's work is guided by a global program, which is adopted by member organizations every four years at the IUCN World Conservation Congress.
- The IUCN maintains the **IUCN Red List of Threatened Species**, a comprehensive assessment of the current risk of extinction of thousands of plant and animal species. The organization also publishes or coauthors hundreds of books, reports, and other documents each year.
- The IUCN has been **granted observer status at the United Nations General Assembly.**
- The IUCN's membership includes more than 1,000 governmental and nongovernmental organizations from more than 140 countries.
- It is governed by a **democratically elected council**, which is chosen by member organizations at each World Conservation Congress. The IUCN's funding comes from a number of governments, agencies, foundations, member organizations, and corporations.

CITES

- The Convention on International Trade in Endangered Species of Wild Fauna and Flora, often referred to as CITES, is an agreement between governments that **regulates the international trade of wildlife and wildlife products**—everything from live animals and plants to food, leather goods, and trinkets.
- It **came into force in 1975** with the goal of ensuring that international trade does not threaten the survival of wild plants and animals.
- There are about 5,800 species of animals and 30,000 species of plants protected by CITES currently. They're categorized into one of three appendices, depending on how at risk from trade they are.
- As of June 2019, CITES had 183 party governments, which must abide by CITES regulations by implementing legislation within their own borders to enforce those regulations.
- CITES was **first conceived of at a 1963 meeting** of the International Union for the Conservation of Nature (IUCN), the global authority on the conservation status of wild animals and plants.

What are CITES appendices?

There are three appendices: Appendix I, II, and III. Each denotes a different level of protection from trade.

- **Appendix I** includes species that are in **danger of extinction because of international trade**. Permits are required for import and export, and trade for commercial purposes is prohibited.

  Trade may be allowed for research or law enforcement purposes, among a few other limited reasons, but first the source country must confirm that taking that plant or animal won't hurt the species' chance of survival. (This is known as a **"non-detriment finding."**)

  The **Asiatic lion** and **tigers** are two species listed as Appendix I.
- **Appendix II** includes species that **aren't facing imminent extinction but need monitoring to ensure that trade doesn't become a threat**.

  Export is allowed if the plant, animal, or related product was obtained legally and if harvesting it won't hurt the species' chance of survival.

American alligators are listed on Appendix II, for example. They were overhunted through the 1960s for their skin, but their numbers are now on the rise.

CITES Appendix II listing helps ensure the alligator skin trade doesn't become a threat again.

- **Appendix III** includes **species that are protected in at least one country**, **when that country asks others for help in regulating the trade**.

  Regulations for these species vary, but typically the country that requested the listing can issue export permits, and export from other countries requires a certificate of origin.

CONVENTION ON BIOLOGICAL DIVERSITY

- The Convention on Biological Diversity (CBD), known informally as the Biodiversity Convention, is a **multilateral treaty**.
- The Convention on Biological Diversity (CBD) was adopted at the Earth Summit, in Rio de Janeiro, in 1992.
- It has three main objectives:

a. To conserve biological diversity;
b. To use its components in a sustainable way;
c. To share fairly and equitably the benefits arising from the use of genetic resources.

- The CBD was negotiated under the guidance of the United Nations. It was signed by more than 150 government leaders at the Rio Earth Summit (which official denomination is the 'United Nations Conference on Environment and Development').
- The convention is now one of the most widely ratified international treaties on environmental issues, with 194 member countries.
- Unlike other international agreements that set compulsory targets and obligations, the CBD takes a flexible approach to implementation.
- It identifies general goals and policies, and countries are free to determine how they want to implement them.

The Convention on Biological Diversity has adopted two supplementary protocols they are:

1. **The Cartagena Protocol on Bio-safety** - The Cartagena Protocol on Bio-safety to the Convention on Biological Diversity is an international treaty governing the movements of living modified organisms (LMOs) resulting from modern biotechnology from one country to another. It was adopted in 2000 as a supplementary agreement to the Convention on Biological Diversity and entered into force in 2003.
2. **Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization** - The Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization to the Convention on Biological Diversity is a supplementary agreement to the Convention on Biological Diversity.

- It provides a transparent legal framework for the effective implementation of one of the three objectives of the CBD: **the fair and equitable sharing of benefits arising out of the utilization of genetic resources.** The Protocol was adopted in 2010 in Nagoya, Aichi Province, Japan, and entered into force in 2014.
- Its objective is the fair and equitable sharing of benefits arising from the utilization of genetic resources, thereby contributing to the conservation and sustainable use of biodiversity. The Strategic Plan consists of 20 new biodiversity targets, termed the **'Aichi Biodiversity Targets'**

Aichi Biodiversity Targets

- **The 20 Aichi Targets are divided into 5 sections**

- **Strategic Goal A:** Address the underlying causes of biodiversity loss by mainstreaming biodiversity across government and society
- **Strategic Goal B:** Reduce the direct pressures on biodiversity and promote sustainable use.
- **Strategic Goal C:** To improve the status of biodiversity by safeguarding ecosystems, species and genetic diversity.

- **Strategic Goal D:** Enhance the benefits to all from biodiversity and ecosystem services.
- **Strategic Goal E:** Enhance implementation through participatory planning, knowledge management and capacity building.

PROTECTED AREAS OF INDIA

- **National Parks** - An area, whether within a sanctuary or not, can be notified by the state government to be constituted as a National Park, by reason of its ecological, faunal, floral, geomorphological, or zoological association or importance, needed to for the purpose of protecting & propagating or developing wildlife therein or its environment. No human activity is permitted inside the national park except for the ones permitted by the Chief Wildlife Warden of the state under the conditions given in the wildlife protection Act 1972.
- **Wildlife Sanctuaries**- Any area other than area comprised with any reserve forest or the territorial waters can be notified by the State Government to constitute as a sanctuary if such area is of adequate ecological, faunal, floral, geomorphological, natural or zoological significance, for the purpose of protecting, propagating or developing wildlife or its environment. Some restricted human activities are allowed inside the Sanctuary area details of which are given in wildlife protection Act 1972.
- **Conservation reserves and community reserves**- These are terms denoting protected areas of India which typically act as buffer zones to or connectors and migration corridors between established national parks, wildlife sanctuaries and reserved and protected forests of India. Such areas are designated as conservation areas if they are uninhabited and completely owned by the Government of India but used for subsistence by communities and community areas if part of the lands is privately owned. These categories were added because of reduced protection in and around existing or proposed protected areas due to private ownership of land, and land use.
- **Marine Protected Areas** - A marine protected area (MPA) is essentially a space in the ocean where human activities are more strictly regulated than the surrounding waters - similar to parks we have on land. These places are given special protections for natural or historic marine resources by local, state, territorial, native, regional, or national authorities.

PROJECT TIGER

- India is now home to almost 75% of the world's Wild Tigers. The relative transparency in the estimation process and the dedication to the project in India of Saving the Tiger is unparalleled.
- A previous estimation by the data collected, and number of Tigers shot for sport – it was estimated that, at the beginning of the 20th Century, there likely could have been upwards of 50,000 Tigers in India alone. The continued hunting, poaching and habitat destruction has decimated their populations and by the 1960's, wildlife in India had hit rock bottom. They were treated like vermin, and nearly exterminated.
- It was around 1970, that, a group of conservationists and researchers applied sustained pressure on the Indian Government. Notable Conservationist **Dr.Kailash Sankhla** made a personal appeal to then Prime Minister Mrs. Indira Gandhi, who turned out to be empathetic and understanding towards the need to protect India's Natural Heritage – the oldest heritage of India.
- **Wildlife Protection Act was drawn up in 1972** as a result, and it ended legally, all hunting in India – and protected individual species by Law.
- Project Tiger was launched subsequently, in 1973, and **Dr.Kailash Sankhla** was appointed the 1st Director of Project Tiger in India.
- **Jim Corbett Tiger Reserve in Uttarakhand was the 1st Tiger Reserve in India**. A further 8 Tiger Reserves were established with around 9115 sq.km of forests under the wing of Project Tiger.
- This figure stands today at 71,000 sq.km – a stark improvement from its initial days but nearly not enough forest cover for a burgeoning country such as India with a beautiful and rich Natural Heritage.
- Today, there are **50 Tiger Reserves** established in India.

Each Tiger Reserve is divided into 02 areas: **Core Area and Buffer Area**

Core Area /Critical Tiger Habitat

- This is the critical habitat of surviving Tigers and prey species which can support or already support Tiger populations in the landscape due to favourable ecological conditions having potential for improving existing habitat to ensure long-term success of the species.
- No human activity save for conservation-related or Park-management related activities are permitted here. Everyday tasks of wood collection, grazing and utilisation of forest produce is banned.
- Tourism is permitted, however **according to NTCA guidelines, only upto 20% of the Core Area** is available for Wildlife Tourism.
- These areas usually have a legal status of National Park or Wildlife Sanctuary.

Buffer Area

- Demarcated areas adjoining or surrounding the Core Area have been given the status of the Buffer Area.
- These are peripheral areas of the Core or newly created habitat for wildlife which inevitably spills over from the declared Core Area.
- However, activities such as livestock grazing, controlled collection of firewood and minimal use of forest produce for the sake of livelihood by the locals are permitted.
- Forest Check-Posts and Patrolling Camps have been strategically established across Tiger Reserves in the Core and Buffer Areas to mitigate poaching threats and ensure management of the reserve and swift action in case of emergency situations.

Village Relocation

- One of the most difficult and herculean of all tasks has been the ongoing Village Relocation Programmes in Tiger Reserves, ongoing since 1973.
- Voluntary relocation of people and settlements has been one of the major tasks and a massive challenge ineffective establishment and management of Tiger Reserves across India in addition to reducing poaching threats and preserving the habitat.
- Many villages were/are situated in the identified Critical Tiger Habitats in India, as well as in the newly identified Critical Tiger Habitats for the future establishment of Tiger Reserves. The need to educate the local people of the benefits of relocating/moving away from their present homes in the Tiger Reserve. Compensatory land or money is provided as aid from the government along with logistical assistance.
- The challenge of Human Rights, Political pressure and vested interest groups has definitely ensured that this task be a Herculean effort – however, relatively good governance practices and diligence of the various Forest Departments has resulted in various positive breakthroughs for Project Tiger.

Tiger Task Force

- In light of heavy poaching and formation of strong poaching networks by smugglers within India, a need for greater monitoring and an additional layer of protection was included in the year 2005.
- Following the exposure by the media and ground-level conservationists on the sudden disappearance of Tigers in the notable plight of Sariska Tiger Reserve in Rajasthan, the then Prime Minister of India Dr. Manmohan Singh set up the Tiger Task Force to strengthen the conservation of the National Animal of India.
- The guiding principles for all the Tiger Reserves in the country by the Tiger Task Force include : –

- Looking into the various problems of Tiger Conservation and suggesting methods for its improvement.
- Improving methods to check-poaching of tigers and illegal practices followed in the wildlife sanctuaries.
- To improve the method of counting and forecasting Tigers.
- To educate the local indigenous population inhabitant in the Reserves towards the conservation of tigers and preservation of habitat.

NTCA

The National Tiger Conservation Authority (NTCA) is the Apex body that administers Project Tiger.

Powers and functions of the National Tiger Conservation Authority as prescribed under Section 38 of the Wildlife (Protection) Act, 1972 are as under:-

- To **approve the Tiger Conservation Plan** prepared by the Individual State Governments.
- To **evaluate and assess the various aspects of sustainable ecology**.
- **Disallowing unsustainable land use** for projects such as Mining, Industry and other such projects within Tiger Reserves.
- Establishment of **Standards for Tourism Guidelines** within the Tiger Reserves has to be set by the NTCA. It encapsulates those in the Core as well as the Buffer Area of the Tiger Reserve.
- To focus on **addressing inevitable Human-Animal Conflict scenarios**. To ensure due processes are established on the areas surrounding the National Park, Sanctuaries or Tiger Reserve to enable co-existence around forest areas.
- To provide **information on Protection Measures** including the Future Conservation Plan, Estimation of Tiger Population and its Natural Prey Species, Status of Habitats, Disease Surveillance, Mortality Survey, Patrolling, reports on any Untoward Happenings and such Management Aspects as deemed fit in the Future Conservation Plan.
- To **approve and co-ordinate Research and Monitoring** on ecological aspects of the Tiger, Prey, Habitat as well as related ecological and socio-economic parameters and their evaluation.
- To **ensure that Tiger Reserves and areas linking a protected area with another, are not diverted** for ecologically unsustainable use, except in absolute public interest; with approval from the National Board for Wildlife and the advice of the NTCA.
- To **facilitate Eco-development and People's Participation in Biodiversity Conservation** Initiatives as per the approved management plans. Additionally, to support similar initiatives in adjoining areas consistent with State and Central Laws.
- To **ensure critical support** including Scientific, Information Technology and Legal Support for ideal implementation of the Future Conservation Plan.
- To ensure **Training and Development of Officers and Staff** of Tiger Reserves through Capacity – building Programs.
- To perform any such other functions to carry out purposes of the Project with regards to protecting the Tiger and its Habitat.

PROJECT RHINO

- Launched in 2005, Indian Rhino Vision 2020 is an ambitious effort to attain a wild population of at least 3,000 greater one-horned rhinos spread over seven protected areas in the Indian state of Assam.
- **International Rhino Fund has partnered with the Assam Forest Department, the Bodoland Territorial Council, the World Wide Fund for Nature (WWF), and the US Fish & Wildlife Service** to address the threats facing Indian rhinos.
- They are moving rhinos from overcrowded areas, like Kaziranga National Park and Pabitora Wildlife Sanctuary, to other protected areas where they can breed. Along with continuing strict protection and community engagement, spreading Indian rhinos out among more protected areas will create a larger, safer and more stable population.
- IRF and Indian Rhino Vision 2020 partners worked with local communities and park and government authorities to improve protection and monitoring of existing populations, constructing guard posts, patrol roads, and bridges.

PROJECT ELEPHANT

- Project Elephant was launched by the Government of India in the year **1992** as a Centrally Sponsored Scheme.
- The Ministry of Environment, Forest and Climate Change provides the financial and technical support to major elephant range states in the country through Project Elephant.

- The Project is being implemented in **16 States / UTs** , viz. Andhra Pradesh, Arunachal Pradesh, Assam, Chhattisgarh, Jharkhand, Karnataka, Kerala, Maharashtra, Meghalaya, Nagaland, Orissa, Tamil Nadu, Tripura, Uttarakhand, Uttar Pradesh, West Bengal.

Project Elephant - Objectives

- To protect elephants, their habitat & corridors.
- To address issues of man-animal conflict.
- Welfare of captive elephants.

Project Elephant - Activities

- Main activities under Project Elephant are as follows:
  - Research on Elephant management related issues;
  - Public education and awareness programmes;
  - Eco-development;
  - Veterinary care;
  - **Elephant Rehabilitation/Rescue Centers**;
  - **Ecological restoration** of existing natural habitats and migratory routes of elephants;
  - **Development of scientific and planned management** for conservation of elephant habitats and viable population of Wild Asiatic elephants in India;
  - Promotion of **measures for mitigation of man-elephant conflict** in crucial habitats and moderating pressures of human and domestic stock activities in crucial elephant habitats;
  - Strengthening of measures for the protection of Wild elephants from poachers and unnatural causes of death.

MIKE

- The **Monitoring the Illegal Killing of Elephants (MIKE) programme is an international collaboration** that measures the levels, trends and causes of elephant mortality, thereby providing an information base to support international decision-making related to conservation of elephants in Asia and Africa.
- The MIKE Programme was established by the **Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) by Resolution 10.10** adopted at the tenth Conference of the Parties in 1997.
- There are currently **28 sites participating in the MIKE programme in Asia**, distributed across 13 countries: India has 10 sites, followed by two sites each in Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar and Thailand, and one site each in Bangladesh, Bhutan, China, Nepal, Sri Lanka and Viet Nam.
- In 2017, IUCN was engaged by CITES to implement the MIKE Asia programme in two sub-regions: **South Asia** (via the IUCN India Country Office in New Delhi); and **Southeast Asia** (through the IUCN Asia Regional Office in Bangkok). This forms part of the wider Asia Wildlife Law Enforcement and Demand Reduction Management Project funded by the European Union.
- The main objective of the **MIKE Asia programme** is to identify spatial, temporal and other trends in elephant mortalities by collating and analysing data on elephant carcasses (which are collected by management agencies). Other objectives include support for law enforcement activities, capacity-building for front-line field staff and limited provision of field equipment to sites. The program's analytical outputs and field activities support international decision-making related to elephant conservation in Asia.

Expected outputs:

- Collation and quality control of annual records of elephant carcasses from MIKE sites in Asia.
- Data analysis to identify patterns at the level of site, local region and country.

BIRD LIFE INTERNATIONAL

- Bird Life International is the world's largest nature conservation Partnership.
- Together they are 120 BirdLife Partners worldwide.
- Bird Life International strives to conserve birds, their habitats and global biodiversity, working with people towards sustainability in the use of natural resources.
- Bird Life International is the official Red List authority for birds, for the International Union for Conservation of Nature.
- It identifies the sites known/referred to as **'Important Bird and Biodiversity Areas'.**

TRAFFIC

- The Wildlife Trade Monitoring Network (TRAFFIC)
- Found in 1976, TRAFFIC is a **non-governmental organization** working globally on trade in wild animals and plants in the context of both biodiversity conservation and sustainable development.
- TRAFFIC is a joint programme of **World Wide Fund for Nature (WWF)** and IUCN.
- Traffic is complementary to Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).
- TRAFFIC's mission is to ensure that trade in wild plants and animals is not a threat to the conservation of nature.
- It investigates and analyses wildlife trade trends, patterns, impacts and drivers to provide the leading knowledge base on trade in wild animals and plants.

NTCA

- The National Tiger Conservation Authority, a statutory body under the Environment Ministry, is constituted under enabling provisions of the Wildlife (Protection) Act 1972, for strengthening tiger conservation, as per powers and functions assigned to it under the said Act.
- The **objectives** of NTCA are:
  - Providing statutory authority to Project Tiger so that compliance of its directives becomes legal.
  - Fostering accountability of Centre-State in management of Tiger Reserves, by providing a basis for MoU with States within our federal structure.
  - Providing for an oversight by Parliament.
  - Addressing livelihood interests of local people in areas surrounding **Tiger Reserves.**
- **Functions:** Its functions are to assist in population assessment of tigers, law enforcement, wildlife forensics, infrastructural development and mitigation, smart patrolling and advisory role in policy formulation.
- 'Project Tiger' is a centrally sponsored scheme of the Ministry of Environment, Forests and Climate Change, providing funding support to tiger range States, for in-situ conservation of tigers in designated tiger reserves.

GREAT INDIAN BUSTARD

- The great Indian bustard or Indian bustard is a bustard found on the Indian subcontinent.
- It is a large bird with a horizontal body and long bare legs, giving it an ostrich like appearance, this bird is among the heaviest of the flying birds.
- **Range** - Once common on the dry plains of the Indian subcontinent, as few as 150 individuals were estimated to survive in 2018 (reduced from an estimated 250 individuals in 2011).
- **Conservation status:** This species is **critically endangered.** It is protected under Wildlife Protection Act 1972 of India.

- Main threats include hunting and loss of its habitat, which consists of large expanses of dry grassland and scrub**.** Alleged hunting of GIB in Pakistan is believed to be one of the reasons for the plummeting numbers of the bird species.

LEATHERBACK TURTLE

- Proposals for tourism and port development in the Andaman and Nicobar (A&N) Islands have conservationists worried over the fate of some of the most important nesting populations of the Giant Leatherback turtle in this part of the Indian Ocean.
- The **leatherback is the largest turtle in the world**. They are the only species of sea turtle that lack scales and a hard shell and are named for their tough rubbery skin and have existed in their current form since the age of the dinosaurs.
- Leatherbacks are **highly migratory**, some swimming over 10,000 miles a year between nesting and foraging grounds. They are also accomplished divers with the deepest recorded dive reaching nearly 4,000 feet—deeper than most marine mammals.
- The **leatherback turtle has the widest distribution of any reptile** with a global range with nesting mainly on tropical or subtropical beaches. Once prevalent in every ocean except the Arctic and Antarctic, the leatherback population is rapidly declining in many parts of the world. They face threats on both nesting beaches and in the marine environment. The greatest of these threats worldwide are incidental capture in fishing gear (or bycatch), and hunting of adults and collection of eggs for human consumption.
- **Conservation status:** Within the Indian Ocean, they nest only in Indonesia, Sri Lanka and the Andaman and Nicobar Islands and are also listed in **Schedule I of India's Wildlife Protection Act, 1972**, according it the highest legal protection. **IUCN: Vulnerable.**

BENGAL FLORICAN

- The Bengal florican is a type of bustard found in the Indian subcontinent.
- It has two disjunct populations, one in the Indian subcontinent, another in Southeast Asia.
- The Indian range is from Uttar Pradesh (India) through the Terai of Nepal to Assam (where it is called ulu mora) and Arunachal Pradesh in India, and historically to Bangladesh.
- **South East Asian -** The South East Asian population occurs in Cambodia and perhaps adjacent southern Vietnam. This species is mostly resident on its breeding grounds; around Tonlé Sap in Cambodia however, the birds use grasslands near the lake to breed, and move away from the water in the wet season when the breeding grounds are flooded. Similarly, the Terai population seems to move to warmer lowland locations in winter. Migrations are not long-distance, however, and probably are restricted to a few dozen kilometres.
- **Conservation status:** This species is **critically endangered.** It is protected under Wildlife Protection Act 1972 of India.
- **Threats:** *Main* threats include hunting and loss of its habitat, which consists of large expanses of dry grassland and scrub.

IRRAWADDY DOLPHIN

- Map showing distribution of Irrawaddy Dolphin
- It is a variety of Oceanic Dolphin.
- **Habitat**: Shallow oceans, River and Estuaries
- Since they inhabit the shallow regions of the oceans, they go through maximum confrontation with humans
- **Threats**: Fishing nets, Dam construction, Gold mining leads to toxic effluent discharge into the ocean.
- **IUCN Status**: Endangered

PROJECT DOLPHIN

- The Project Dolphin will be **on the lines of Project Tiger, which has helped increase the tiger population**. Special Conservation program needs to be taken up for Gangetic Dolphin which is **national aquatic animal and also indicator species for the river Ganga spread over several states**.
- So far, the National Mission for Clean Ganga (NMCG), which implements the government's flagship scheme Namami Gange, has been taking some initiatives for saving dolphins. Now, Project Dolphin is expected to be implemented by the Ministry of Environment, Forest and Climate Change.

Gangetic dolphin

- The Gangetic river system is home to a vast variety of aquatic life, including the Gangetic dolphin.
- The Gangetic dolphin is one of five species of river dolphin found around the world. It is found mainly in the Indian subcontinent, particularly in Ganga-Brahmaputra-Meghna and Karnaphuli-Sangu river systems.
- The Conservation Action Plan for the Ganges River Dolphin, 2010-2020, describes male dolphins as being about 2-2.2 metres long and females as a little longer at 2.4-2.6 m. An adult dolphin could weigh between 70 kg and 90 kg. The breeding season of the Gangetic dolphin extends from January to June. They feed on several species of fishes, invertebrates etc.

Importance for saving dolphins

- The construction of dams and barrages, and increasing pollution have led to a decline in the population of aquatic animals in the rivers in general and of dolphins in particular.
- Aquatic life is an indicator of the health of river ecosystems. As the Gangetic dolphin is at the top of the food chain, protecting the species and its habitat will ensure conservation of aquatic lives of the river.

Although efforts to save them were started in the mid-1980s, but the estimates suggest the numbers have not risen as a result. **The Gangetic dolphin remains listed as endangered by the IUCN.** The actions taken so far for conservation are:

- **WILDLIFE ACT PROTECTION:** After the launch of Ganga Action Plan in 1985, the government on November 24, 1986 **included Gangetic dolphins in the First Schedule of the Indian Wildlife (Protection), Act 1972**. This was aimed at checking hunting and providing conservation facilities such as wildlife sanctuaries. For instance, **Vikramshila Ganges Dolphin Sanctuary** was established in Bihar under this Act.
- **CONSERVATION PLAN:** The government also prepared the Conservation Action Plan for the Ganges River Dolphin 2010-2020, which identified threats to Gangetic Dolphins and impact of river traffic, irrigation canals and depletion of prey-base on Dolphins populations.
- **NATIONAL AQUATIC ANIMAL:** On October 5, 2009, the then Prime Minister , while chairing the **maiden meeting of the National Ganga River Basin Authority, declared the Gangetic river dolphin as the national aquatic animal.** A notification was issued by the Ministry of Environment and Forests the following year.
- Now, the National Mission for Clean Ganga celebrates October 5 as National Ganga River Dolphin Day.

SIMILIPAL TIGER RESERVE

- Similipal, which derives its name from **'Simul' (Silk Cotton) tree**, is a national park and a Tiger Reserve situated in the northern part of Orissa's Mayurbhanj district.
- The tiger reserve is spread over 2750 sq km and has some beautiful waterfalls like Joranda and Barehipani. The park is surrounded by high plateaus and hills, the highest peak being the **twin peaks of Khairiburu and Meghashini** (1515m above mean sea level).
- At least twelve rivers cut across the plain area, all of which drain into the Bay of Bengal. The prominent among them are Burhabalanga, Palpala Bandan, Salandi, Kahairi and Deo.

- An astounding 1078 species of plants including 94 species of orchids find their home in the park. The vegetation is a mix of different forest types and habitats, with **Northern tropical moist deciduous** dominating some semi-evergreen patches. **Sal is the dominant tree species** here. The park also has extensive **grasslands** that are grazing grounds for many of the herbivores. These forests boast of many plants that have medicinal and aromatic properties.
- The park is known for the **tiger, elephant and hill mynah**. It holds the highest tiger population in the state of Orissa. 55 species of mammals, 304 species of birds, 60 species of reptiles, 21 species of frogs, 38 species of fish and 164 species of butterflies have been recorded from the Park.
- Apart from the tiger, the major mammals are leopard, sambar, barking deer, gaur, jungle cat, wild boar, four-horned antelope, giant squirrel and common langur. Grey hornbill, Indian pied hornbill and Malabar pied hornbill are also found here. The park also has a sizeable population of reptiles, which includes the longest venomous snake, the King cobra and the Tricarinate hill turtle. The **Mugger Management Programme** at Ramatirtha has helped the mugger crocodile to flourish on the banks of the Khairi and Deo Rivers.

History and current status:

- The Tiger Reserve originated as a hunting ground for the surrounding royalty. It was formally designated a tiger reserve under Project Tiger in May 1973. The Government of Orissa declared **Similipal as a wildlife sanctuary in 1979** with an area of 2750 sq. km.
- Later in 1980, Government of Orissa proposed 303 sq. km of the sanctuary as National Park. Further in 1986, the area of the National Park was increased to 845.70 sq. km.
- The Government of India declared it as a biosphere reserve in 1994. UNESCO added this National Park to its list of Biosphere Reserves in May 2009.
- This tiger reserve also comes under **Mayurbhanj Elephant Reserve** that includes the adjacent Hadgarh and Kuldiha Wildlife Sanctuaries.
- Apart from its biodiversity, the region around Similipal forests is home to a variety of tribes. Prominent among these are **Kolha, Santhala, Bhumija, Bhatudi, Gondas, Khadia, Mankadia and Sahara**. Most of them are settled agriculturists, supplementing their income by collecting firewood and timber except for the last three who are indigenous hunter-gatherer communities living primarily off the forest, collecting forest produce. While the tribes earlier followed a number of traditional conservation practices like closed seasons, hunting taboos on specific species, maintenance of sacred groves (Jharia) etc., of late, these practices have been on the decline due to the increasing influence of modern civilization, increasing human population and decreasing wildlife availability.

KAZIRANGA NATIONAL PARK

- Kaziranga National Park is a national park in the **Golaghat, Karbi Anglong and Nagaon districts** of the state of Assam, India.
- The sanctuary hosts **two-thirds of the world's great one-horned rhinoceroses.**
- In the year **1985,** the park was declared as a **World Heritage Site** by UNESCO.
- Kaziranga is home to large density of tigers.
- The park is home to large breeding populations of elephants, wild water buffalo, and swamp deer.
- Kaziranga is recognized as an **Important Bird Area by BirdLife International** for conservation of avifaunal species. When compared with other protected areas in India, Kaziranga has achieved notable success in wildlife conservation. Located on the edge of the Eastern Himalaya biodiversity hotspot, the park combines high species diversity and visibility.
- Kaziranga is a **vast expanse of tall elephant grass**, marshland, and dense tropical moist broadleaf forests, criss-crossed by four major rivers, including the Brahmaputra, and the park includes numerous small bodies of water. Kaziranga has been the theme of several books, songs, and documentaries. The park celebrated its centennial in 2005 after its establishment in 1905 as a reserve forest.
- It was formed on the recommendation of **Mary Curzon**, the wife of the Viceroy of India – Lord Curzon.

- **Flora:** Due to the difference in altitude between the eastern and western areas of the park, here one can see mainly four types of vegetation' like **alluvial inundated grasslands**, **alluvial savanna woodlands**, **tropical moist mixed deciduous forests**, and **tropical semi-evergreen forests**.
- Kumbhi, Indian gooseberry, the cotton tree, and elephant Apple are amongst the famous trees that can be seen in the park. Also, a good variety of aquatic flora can be seen in lakes, ponds, and along the river shores.
- **Fauna:** The forest region of Kaziranga Park is home to world's largest population of Indian Rhinoceros. Other animals that can be seen are Hoolock Gibbon, Tiger, Leopard, Indian Elephant, Sloth Bear, Wild water buffalo, swamp deer, etc. With increase in tiger population every year, the government authorities declared Kaziranga as a Tiger Reserve in the year 2006. Also here one can find good number of migratory bird species from Central Asia.

RAIMONA NATIONAL PARK

- Raimona in **Kokrajhar district** has become **Assam's sixth national park.**
- The five national parks that existed prior to the 422 sq. km Raimna are **Kaziranga, Manas, Nameri, Orang and Dibru-Saikhowa**.
- The Raimona National Park is within the **Bodoland Territorial Region**. The area of the park includes the northern part of the notified **Ripu Reserve Forest** (508.62 sq. km), which forms the western-most buffer to the Manas National Park that straddles the India-Bhutan border.
- Raimona was bounded on the west by the **Sonkosh river** along the Assam-West Bengal border running southward from the India-Bhutan border and the **Saralbhanga river** on the east till it touched the India-Bhutan border on the north and the southern part of the Ripu Reserve Forest.
- The Pekua river defines Raimona's southern boundary.
- Raimona also shares contiguous forest patches of the **Phipsoo Wildlife Sanctuary** and the **Jigme Singye Wangchuk National Park** in Bhutan (total area of 1,999 sq. km) creating a transboundary conservation landscape of more than 2,400 sq. km.
- Raimona is an integral part of the 2,837 sq. km Manas Biosphere Reserve and the Chirang-Ripu Elephant Reserve.

DIHING PATKAI NATIONAL PARK

- Dihing Patkai has been created as the **seventh National Park in Assam.**
- It was declared a **wildlife sanctuary in 2004**.
- The 234.26-sq. km Dihing Patkai straddling eastern Assam's **Dibrugarh and Tinsukia districts** is a major **elephant habitat** and 310 species of butterflies have been recorded there.
- The Dehing Patkai Wildlife Sanctuary was declared as **Dehing-Patkai Elephant Reserve under Project Elephant**.
- The park has 47 species each of reptiles and mammals, including the tiger and clouded leopard.
- Dihing Patkai, in focus a year ago for **illegal coal mining** in the vicinity, encompasses the erstwhile Dehing Patkai Wildlife Sanctuary, the Jeypore Reserve Forest and the western block of the Upper Dihing Reserve Forest.
- Short stretches of the **Dirak and Buri Dihing rivers** have been included in the park.
- The newly-notified national park will be administered by the Soraipung Range of Digboi Forest Division and Jeypore Range of Dibrugarh Forest Division. Additional anti-poaching camps and manpower are being provided for intensive patrolling and conservation of the new park.

PAKKE TIGER RESERVE

More than 200 contingency workers of the Pakke Tiger Reserve in Arunachal Pradesh went on an indefinite strike over non-payment of wages since December 2020.

- The 862 km2 (333 sq mi) reserve is protected by the Department of Environment and Forest of Arunachal Pradesh.
- Pakke Tiger Reserve (declared in 1999 - 2000) lies in the foothills of the eastern Himalaya in Arunachal Pradesh's **Pakke Kessang District.**
- It is also known as **Pakhui Tiger Reserve**.

- It falls within the **Eastern Himalaya Biodiversity Hotspot.**
- It is home to over 2000 species of plants, 300 species of birds, 40 species of mammals, 30 species of amphibians and 36 species of reptiles. Many species of the flora and fauna are globally threatened, and PTR is one of the last remaining strongholds left for these species.
- It is known for its amazing sightings of four resident **hornbill species**.
- This Tiger Reserve has won **India Biodiversity Award 2016** in the category of **'Conservation of threatened species'** for its **Hornbill Nest Adoption Programme.**
- Towards the south and south-east, the sanctuary adjoins reserve forests and Assam's **Nameri National Par**k. To the west, it is bounded by **Doimara Reserve Forest** with an area of 216 km2 (83 sq mi) and **Eaglenest Wildlife Sanctuary**; and to the north by **Shergaon Forest Division**.
- The main perennial streams in the area are the Nameri, Khari and Upper Dikorai.

MANAS NATIONAL PARK

Captive-bred pygmy hogs, the world's rarest and smallest wild pigs, were released in the Manas National Park of western Assam. This is the second batch to have been reintroduced into the wild under the ***Pygmy Hog Conservation Programme (PHCP)*** *in a year.*

The PHCP is a collaboration among ***Durrell Wildlife Conservation Trust of UK, Assam Forest Department, Wild Pig Specialist Group of International Union for Conservation of Nature*** *and* ***Union Environment Ministry*** *and is currently being implemented by* ***NGOs Aaranyak and EcoSystems India.***

- Manas, at the base of **foot hills of the Bhutan-Himalayas** in the state of Assam, with unique biodiversity and landscape is one of the first reserves included in the network of tiger reserve under Project tiger in 1973.
- In **1985, the Manas Wildlife Sanctuary was inscribed as World Heritage Site.**
- In **1989, Manas acquired the status of a Biosphere reserve**.
- It extends over an area of 2837 Sq. Km from **Sankosh river in the west to Dhansiri river** in the east, with a core area of 500 Sq. Km. of the National park, which declared in 1990. The average elevation of the area is 85 m above mean sea level. The river Manas flows into the national Park from the gorges of Bhutan and split into two major streams of which the main water course comes out of the National Park about 30 km downstream is known as 'Beki".
- About the half of the Park is covered by Grasslands of Terai and Bhabar type, the riparian areas have colonizing grasslands and woodlands of several species. The thick woodlands are called Eastern Moist Deciduous Forests of various types. The undergrowths are very thick. There are more than 650 species of Angiosperms alone. The commonly seen trees are the Simul, Oxi, Sissoo, Khaie, Gamari, etc.
- Manas is the **only landscape in the world where pristine Terai Grasslands are seen merging with the Bhabar grasslands** interspersed with diverse habitats ascending to Semi-Evergreen forests and then to Bhutan Himalayas. The Biodiversity is very rich here. The last population of the Pygmy Hog survive in the wilds of Manas and nowhere else in the world.

PANGOLIN

- Pangolins are actually **mammals.** They are the only mammals wholly-covered in scales and they use those scales to protect themselves from predators in the wild. If under threat, a pangolin will immediately curl into a tight ball and will use their sharp-scaled tails to defend themselves.
- Pangolins **eat ants, termites and larvae** and are often known as **"the scaly anteater.**" Because they have no teeth, pangolins pick up food with their sticky tongues, which can sometimes reach lengths greater than the animal's body.
- pangolins are increasingly victims of illegal wildlife crime—mainly in Asia and in growing amounts in Africa—for their meat and scales.
- **Eight species** of pangolins are found on two continents. They range from **Vulnerable to Critically Endangered**.
- In 2016, a treaty of over 180 governments announced an agreement that would end all legal trade of pangolins and further protect the species from extinction.

- The **Indian pangolin (Manis crassicaudata),** also called thick-tailed pangolin and scaly anteater is a pangolin native to the Indian subcontinent.
- Like other pangolins, it has large, overlapping scales on its body which act as armour. The colour of its scales varies depending on the colour of the earth in its surroundings. It is an insectivore, feeding on ants and termites, digging them out of mounds and logs using its long claws, which are as long as its fore limbs. It is nocturnal and rests in deep burrows during the day.

SKINK SPECIES

An Asian gracile skink was recently found in the Western Ghats.

- Named **Subdoluseps nilgiriensis**, after the Nilgiris, the reptile has a slender body of just about 7 cm and is sandy brown in colour.
- Based on genetic studies, the new species is closely related to Subdoluseps pruthi that is found in parts of the Eastern Ghats.
- The new species was found in a **dry deciduous area**, showing that even the dry zones of our country are home to unrealised skink diversity which needs to be further explored.
- Most skinks are **diurnal** and are usually secretive in their habits. Because of their elusiveness, not much is known about their natural and evolutionary history. Most of the species are placed under the data-deficient category.
- Though skinks are non-venomous, they resemble snakes because of the often-inconspicuous limbs and the way they move on land. Such resemblance has led to confusion often resulting in humans killing this lowly harmless creature.
- Subdoluseps nilgiriensis is currently considered a vulnerable species as there are potential threats from seasonal forest fires, housing constructions and brick kiln industries in the area. Rapid urbanisation, which has increased the road networks in the area, has also threatened the small geographical range of the species.

BAMBOO FLOWERING

- The flowering of a bamboo is an intriguing phenomenon. A phenomenon not because bamboo produces any spectacular flowers... but a phenomenon because it is a unique and very rare occurrence in the plant kingdom. Most bamboos flower once every 60 to 130 years depending on the species!! The long flowering intervals are largely a mystery and still astounds many botanists today with no definitive explanation.
- However, not all bamboos exhibit the same flowering characteristics or patterns. Depending on the species, a bamboo can exhibit either gregarious flowering, sporadic flowering or annual flowering.
- **Gregarious flowering** is the most impressive pattern of bamboo flowering. Gregarious flowering is **when all populations of a particular species of bamboo flowers all at once.** For most species of bamboo, this can happen at intervals anywhere between 60 to 130 years. This **flowering cycle is genetically pre-programmed into each species.**
- Once a species reaches its life expectancy, the bamboo will flower and produce seeds. When a bamboo flowers gregariously, it expends a tremendous amount of energy producing flowers and seeds. The mass flowering stresses the bamboo to such an extent that it will die. A particular species can flower and die worldwide, regardless of the geographic location. This means that the same plant in North America will flower and die at roughly the same time (for the most part) as the same plant in Asia!! Most bamboos are simply divisions taken from a mother plant at some point (unless if grown from seed). These divisions are re-divided over time and shared across the world. Although the divisions are geographically in different locations, they still carry the same genetic makeup. That means your bamboo can pretty much be older than you!!
- **Sporadic flowering** is when bamboo flowers sporadically or intermittently. **Sporadic flowering is typically brought on by environmental factors rather than genetics**. Unlike Gregarious flowering, Sporadic flowering does not happen on a mass scale and the bamboo seldom dies after flowering. It typically occurs on an individual or a group of plants from a localized area. Some species (ie. Phyllostachys Elegans in the U.S.) have been noted to flower sporadically every year for over 10 years.

- Although not the norm, it must be noted that there are a few species of bamboo (mostly Schizostachyums) that do indeed flower annually. With these particular species, the bamboo can flower annually with no effect on the parent plant itself. This flowering cycle is known as **Annual flowering**.

ENVIRONMENTAL DNA

- All living organisms, regardless of their size or ecology, **leave traces of DNA in their environments**, reflecting their current or past presence. This DNA can be released into the environment **through faeces, urine, gametes, mucus, etc**. It can also result from the **decomposition of dead organisms**.
- eDNA is characterized by a **complex mixture of nuclear, mitochondrial or chloroplast DNA**, and can be intracellular (from living cells) or extracellular. It enables the detection of a species regardless of its life stage or gender.
- Once released in the environment, DNA can be degraded by biotic (bacteria, fungi, endonucleases, etc.) and abiotic factors (UV radiation, acidity, temperature, etc.), or persist in the environment, adsorbed on organic or inorganic particles.
- In general, **cold and dry conditions** slow down eDNA degradation. For example, in permafrost, eDNA can be stored for hundreds of thousands of years.
- In **contemporary soils or in lacustrine or marine sediments**, the persistence of eDNA varies from months to thousands of years depending on environmental conditions.
- In **aquatic environments**, the DNA released by an organism can be detected for only a few days.

Use of eDNA for Inventory and Monitoring

- **Improved Detection of Native Species**: Protocols using eDNA may allow for rapid, cost-effective, and standardized collection of data about species distribution and relative abundance. For small, rare, secretive, and other species that are difficult to detect, eDNA provides an attractive alternative for aquatic inventory and monitoring programs.
- **Early Detection of Invasive Species**: eDNA may also be an effective tool for early detection of aquatic invasive species. Application of eDNA methods for invasive species monitoring may include periodically collecting water samples and screening them for several invasive species at once. Some intensive eradication programs for invasive species fail when a few surviving individuals recolonize the ecosystem. eDNA methods may provide a means of confirming eradication of all invaders.

CHEETAH

The Supreme court had lifted seven year stay on a proposal to introduce African cheetahs from Namibia into the Indian habitat on an experimental basis.

- Reintroduction of the cheetah in India involves the re-establishment of a population of cheetahs into areas where they had previously existed. A part of the reintroduction process is the identification and restoration of their former grassland scrub forest habitats.

- **Causes which led to the extinction of Cheetahs**

- **Hunting:** They were hunted into extinction during and after the Mughal Period, largely by Rajput and Maratha Indian royalty and later by British colonialists, until the early 20th century when only several thousand remained.
- **Captive (help in hunting):** Trapping of large numbers of adult Indian cheetahs, who had already learned hunting skills from wild mothers, for assisting in royal hunts is said to be another major cause of the species rapid decline in India as they never bred in captivity with only one record of a litter ever.

Ways to revive Cheetah population

- **Biotechnology: Cloning**

- India first proposed this method during last decade but it didn't work.

- During the early 2000s, Indian scientists from the Centre for Cellular and Molecular Biology (CCMB), Hyderabad, proposed a plan to clone Asiatic cheetahs obtained from Iran.
- Indian scientists requested Iran to allow them to collect some live cells of the cheetah pair in Iran itself, which can then be made into living cell lines. They planned to use the nucleus from these cells to manually reproduce their own cheetahs, over a significantly long amount of time.
- Iran refused to cooperate (would neither send any cheetahs to India nor would allow Indian scientists to collect their tissue samples)
- It is said that Iran wanted an Asiatic lion in exchange for a cheetah and that India was not willing to export any of its lions.

- **Reintroducing live Cheetahs**
- So it was decided that African Cheetah would be introduced in protected areas in India.

Issues with the reintroduction

- **Clash with lion conservation**
- As the habitat for Asiatic lion as well as the Cheetah is similar, many sites identified for Cheetah reintroduction clash with lion conservation. As we know that there is only a single population of Lion in India in Gir and that has become unsustainable due to rapid growth in their population and there is a need to relocate many lions from Gir.
- An expert panel formed by the government shortlisted a number of protected areas where cheetahs could be relocated. These were **Kuno-Palpur** and **Nauradehi Wildlife Sanctuary** in Madhya Pradesh, **Velavadar National Park** in Gujarat and the **Shahgarh bulge** in Rajasthan.
- **The Kuno reintroduction plan ran into trouble**. The protected area had also been shortlisted for introduction of Asiatic Lions from heavily populated Gir in Gujarat. In order to not give lions to Kuno, Gujarat's legal counsel had put forward the argument that Kuno was being used for the introduction of African cheetah which might take several years to fully settle down and repopulate the area and hence reintroduction of lions should only be done after that.

- **Perpetual problems with India's wildlife**
- As the import of the Cheetahs from Africa will be very limited, the problems being faced by the wildlife in the country might undo the efforts.
- It is advisable to resolve following issues first:
  - Human-wildlife conflict,
  - loss of habitat and loss of prey
  - illegal trafficking.
  - The advent of climate change and growing human populations have only made these problems worse.
- With less available land for wildlife, species that require vast home range like the cheetah are placed in competition with other animals and humans, all fighting over less space.

BARN OWL

- The barn owl (Tyto alba) is the most widely distributed species of owl in the world and one of the most widespread of all species of birds.
- It is also known as the common barn owl, to distinguish it from the other species in its family, Tytonidae, which forms one of the two main lineages of living owls, the other being the typical owls (Strigidae).
- The barn owl is found almost everywhere in the world except for the polar and desert regions, Asia north of the Himalayas, most of Indonesia, and some Pacific islands.
- The Lakshadweep Administration has embarked on the 'Pilot project on Biological Control of Rodents (Rats) by Using Barn Owls (Tyto alba) in Kavaratti Island'.

RED ALGAE

- Red algae are the **oldest group of eukaryotic algae** containing over 6000 species. They fall under the **kingdom Protista and phylum Rhodophyta.** They **contain chlorophyll** and can prepare their own food by the process of photosynthesis.
- Red algae are named so because of their red colour which they obtain from the pigment **Phycoerythrin**. The pigment reflects red light and absorbs blue light and hence give a reddish appearance to the algae.
- Red algae form an important part of the ecosystem and are consumed by various organisms such as crustaceans, fish, worms and even humans. Red algae are also used to **produce agar** that is used as a food additive. They are rich in calcium and also used in vitamin supplements.
- Red algae are **commonly found in coral reefs and tide pools**. They have the ability to survive at a greater depth than other algae because the pigment **Phycoerythrin** absorbs the blue light that can penetrate deeper than any other light wave. This allows red algae to carry out photosynthesis at a greater depth.
- Red algae are different from other groups except for diatoms. Listed below are general characteristics of Red Algae.

  - Lack of flagella and centrioles
  - Presence of photosynthetic pigments
  - Found both in marine and freshwater
  - They show biphasic or triphasic life cycle patterns.
  - They are a multicellular, filament, blade structure.
  - Stored food is in the form of starch and polymers of galactan sulphate
  - A pit connection (hole in the septum) is formed between two algal cells.
  - Have a diffuse growth pattern- Apical growth, Complex oogamy (triphasic)
  - These group of red algae is generally found in tropical marine locations
  - The mode of nutrition may either be saprophytic, parasitic or also epiphytic.
  - Their cell walls consist of cellulose and many different types of carbohydrates.
  - Grow on solid surfaces independently or sometimes found attached to other algae.
  - Presence of pit in the cell walls, through which cytoplasmic connections are maintained.
  - The male sex organs are known as spermatangium and the female sex organs are called carpogonia or procarp.
  - **Mode of Reproduction**: It takes place by all the three means: vegetative, asexual and sexual. Asexual mode of reproduction is by monospores and during the sexual mode of reproduction, they undergo alternation of generations.

- The different pigments present in red algae are: *Red Phycoerythrin, Blue Phycocyanin, Zeaxanthin, Carotenes, Lutein.*

WHITEFLIES

- Whiteflies are soft-bodied, winged insects closely related to **aphids and mealybugs**. Despite their name, whiteflies are not a type of fly, though they do have wings and are capable of flying.
- Whiteflies can be as small as **1/12 of an inch**, are somewhat **triangular in shape**, and are often **found in clusters on the undersides of leaves.** They are active during the day and will scatter when disturbed, so they can be easier to spot than some nocturnal insect pests.
- There are hundreds of species of whiteflies, but most affect only a small number of host plants. However, there are a few whitefly species that affect a wider range of plants, which make them the most problematic in horticulture.
- These whitefly species include the **greenhouse whitefly, bandedwinged whitefly, giant whitefly,** and **silverleaf whitefly**, among others.
- Whiteflies can be found on a wide variety of plants, from ornamental flowers to warm-weather vegetables, including tomatoes, eggplant, peppers, and okra. Some species may attack sweet potatoes, plants from the cabbage family, and citrus trees. Indoors, they will feed on most common houseplants, especially those with soft, smooth leaves.
- Like aphids, whiteflies use their piercing mouthparts to suck up plant juices and, in turn, produce a sticky substance known as **honeydew.**

- Honeydew left on its own can cause fungal diseases such as sooty mold to form on leaves.
- With heavy whitefly feeding, plants will quickly become extremely weak and may be unable to carry out photosynthesis. Leaves will wilt, turn pale or yellow, growth will be stunted, and eventually leaves may shrivel and drop off the plant.

Where to find whiteflies on plants

- Whiteflies tend to **prefer to feed on new growth**, so check around any newly unfurled leaves first.
- Check the **undersides of leaves**—**especially around the veins**—for white insects, even if they aren't immediately visible, and feel leaf surfaces for sticky honeydew. If the whiteflies are feeding, they'll suddenly all fly off the leaves in a swarm.
- Eggs are laid on the undersides of leaves. This is the beginning of a new generation! When the eggs hatch, the larvae will look like teeny white ovals without legs; they don't move but they immediately start sucking the plant juice. This is why gardeners often miss whiteflies until it's too late.

CLIMATE

CLIMATE CHANGE

- The Earth's average temperature is about **15C** but has been much higher and lower in the past.
- There are natural fluctuations in the climate but scientists say temperatures are now rising faster than at many other times.
- This is linked to the **greenhouse effect**, which describes how the Earth's atmosphere traps some of the Sun's energy.
- Solar energy radiating back to space from the Earth's surface is absorbed by greenhouse gases and re-emitted in all directions.
- This heats both the lower atmosphere and the surface of the planet. Without this effect, the Earth would be about 30C colder and hostile to life.
- Scientists believe we are adding to the natural greenhouse effect, with gases released from industry and agriculture trapping more energy and increasing the temperature.
- This is known as **climate change or global warming.**

What are greenhouse gases?

- The greenhouse gas with the greatest impact on warming is **water vapour**. But it remains in the atmosphere for only a few days.
- **Carbon dioxide (CO2), however, persists** for much longer. It would take hundreds of years for a return to pre-industrial levels and only so much can be soaked up by natural reservoirs such as the oceans.
- Most man-made emissions of CO2 come from burning fossil fuels. When carbon-absorbing forests are cut down and left to rot, or burned, that stored carbon is released, contributing to global warming.
- Since the Industrial Revolution began in about 1750, CO2 levels have risen more than 30%. The concentration of CO2 in the atmosphere is higher than at any time in at least 800,000 years.
- Other greenhouse gases such as **methane and nitrous oxide** are also released through human activities but they are less abundant than carbon dioxide.

What is the evidence for warming?

- The world is about **one degree Celsius warmer** than before widespread industrialisation, according to the World Meteorological Organization (WMO).
- It says the past five years, 2015–2019, were the warmest on record.
- Across the globe, the **average sea level increased by 3.6mm per year** between 2005 and 2015.

- Most of this change was because water increases in volume as it heats up.
- However, melting ice is now thought to be the main reason for rising sea levels. Most glaciers in temperate regions of the world are retreating.
- And satellite records show a dramatic **decline in Arctic sea-ice since 1979**. The Greenland Ice Sheet has experienced record melting in recent years.
- Satellite data also shows the **West Antarctic Ice Sheet is losing mass**. A recent study indicated East Antarctica may also have started to lose mass.
- The effects of a changing climate can also be seen in vegetation and land animals. These include earlier flowering and fruiting times for plants and changes in the territories of animals.

How much will temperatures rise in future?

- The change in the global surface temperature **between 1850 and the end of the 21st Century is likely to exceed 1.5C**, most simulations suggest.
- The WMO says that if the current warming trend continues, temperatures could rise 3-5C by the end of this century.
- Temperature rises of 2C had long been regarded as the gateway to dangerous warming. More recently, scientists and policymakers have argued that limiting temperature rises to 1.5C is safer.
- An Intergovernmental Panel on Climate Change (IPCC) report in 2018 suggested that keeping to the 1.5C target would require "rapid, far-reaching and unprecedented changes in all aspects of society".
- The UN is leading a political effort to stabilise greenhouse-gas emissions. China emits more CO2 than any other country. It is followed by the US and the European Union member states, although emissions per person are much greater there.
- But even if we now cut greenhouse-gas emissions dramatically, scientists say the effects will continue. Large bodies of water and ice can take hundreds of years to respond to changes in temperature. And it takes CO2 decades to be removed from the atmosphere.

How will climate change affect us?

- There is uncertainty about how great the impact of a changing climate will be.
- It could cause **fresh water shortages**, dramatically **alter our ability to produce food**, and **increase the number of deaths** from floods, storms and heatwaves. This is because climate change is expected to **increase the frequency of extreme weather events** - though linking any single event to global warming is complicated.
- As the world warms, more water evaporates, leading to more moisture in the air. This means many areas will experience **more intense rainfall** - and in some places snowfall. But the **risk of drought** in inland areas during hot summers will increase. **More flooding** is expected from storms and rising sea levels. But there are likely to be very strong regional variations in these patterns.
- Poorer countries, which are least equipped to deal with rapid change, could suffer the most.
- Plant and animal extinctions are predicted as habitats change faster than species can adapt. And the World Health Organization (WHO) has warned that the health of millions could be threatened by increases in malaria, water-borne disease and malnutrition.

IPCC

- The Intergovernmental Panel on Climate Change (IPCC) is the leading **international body for assessment of climate change.**
- It is a key source of scientific information and technical guidance to the United Nations Framework Convention on Climate Change (UNFCCC), the Kyoto Protocol and Paris Agreement. The IPCC provides governments at all levels with scientific information they can use to develop climate policies.
- The IPCC is an **organisation of governments that are members of the United Nations or the World Meteorological Organization (WMO). The IPCC currently has 195 members**.

- The **IPCC Plenary is the main body** of IPCC members. Representatives of IPCC member governments meet one or more times a year in Plenary Sessions of the Panel. They **elect a Bureau of scientists** for the duration of an assessment cycle. Governments and Observer Organisations nominate, and Bureau members select, experts to prepare IPCC reports.

IPCC's main activities are to prepare:

- comprehensive **Assessment Reports** on climate change, its causes, impacts and response options.
- **Methodology Reports** which provide practical guidance to Parties to help them prepare national greenhouse gas inventories.
- **Special Reports** on topics that inform the Assessment Reports.
- The IPCC **does not undertake new research but synthesises** published and peer-reviewed literature to develop a comprehensive assessment of scientific understanding, published in IPCC Assessment Reports.
- The IPCC's work is guided by a set of principles and procedures that govern all the main activities of the organisation. IPCC member governments and observer organisations nominate experts and the IPCC Bureau selects authors and editors, with expertise in a range of scientific, technical and socio-economic fields. IPCC reports are the product of multiple drafting and review processes to promote an objective, comprehensive and transparent assessment of current knowledge.
- The IPCC was created in **1988 by the World Meteorological Organization (WMO)** and the **United Nations Environment Programme (UNEP).**

Sixth Assessment Report

- The IPCC is preparing its Sixth Assessment Report. It will provide an update on the scientific, technical and socio-economic aspects of climate change, its causes, potential impacts and response strategies. It is divided into three main topics with each prepared by a separate Working Group:

  - Physical Sciences
  - Impacts, Adaption and Vulnerability
  - Mitigation of Climate Change

- **Special Reports**: The IPCC delivered three Special Reports between 2018 and 2019:

1. **Global warming of 1.5°C** assesses literature relevant to global warming of 1.5°C and for the comparison between global warming of 1.5°C and 2°C above pre-industrial levels. It was requested by the Parties to the Paris Agreement to inform key aspects of climate policy and strengthening the global response to climate change.
2. The **Ocean and the Cryosphere in a Changing Climate assesses** how the ocean and cryosphere have and are expected to change with ongoing global warming. It also assesses the risks and opportunities these changes bring to ecosystems and people, and options for reducing future risks.
3. **Climate Change and Land** provides information on the impacts of climate change on land systems and opportunities for action. The report covers climate change and its relevance to land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems.

GREEN HOUSE EFFECT AND GREEN HOUSE GASES

- Greenhouse gases (GHGs) are a group of gases that are able to absorb heat in the atmosphere keeping the earth's surface warm. This absorbed heat/thermal radiation by the greenhouse gases is re-radiated back to earth's surface in all directions. This ability of gases to trap heat in thermal form and spread evenly at earth's surface is known as Greenhouse effect.
- The spreading of these greenhouse gases is responsible for the heat required to sustain life on earth. But the presence of these GHGs in excess enhances the Greenhouse effect which is creating global warming and consequently climate change.

- Water vapour (H_2O), carbon dioxide (CO_2), nitrous oxide (N_2O) and methane (CH_4) are the primary greenhouse gases in the Earth's atmosphere.
- Along with the rapid industrialisation in the 19th and 20th centuries human activities such as burning of fossil fuels and deforestation have increased the level of the presence of these gases within the earth's atmosphere.
- UNFCCC's (United Nations Framework Convention on Climate Change) **Kyoto Protocol** has recognised six main greenhouse gases primarily responsible for global warming. They are:
- *Carbon dioxide (CO_2), Methane (CH_4), Nitrous oxide (N_2O), Hydro fluorocarbons (HFCs), Per fluorocarbons (PFCs), Sulphur hexafluoride (SF_6).*
- The most dominant greenhouse gas overall is water vapour, but it has a very short atmospheric lifetime (about 10 days) and is very nearly in a dynamic equilibrium in the atmosphere, so it is not a forcing gas in the context of global warming.
- CO_2 is identified as the dominant greenhouse gas followed by methane and nitrous oxide as the major forcing contributors to global warming.
- Maximum anthropogenic GHG emissions is from Power stations followed by Industries, Transportation fuels, Agriculture by-products, Land use and burning, etc.

Green House Gas	**Sources and Causes**
Carbon dioxide (CO2)	Burning of fossil fuels, deforestation
Methane (CH_4)	Growing paddy, excreta of cattle and other livestock, termites, burning of fossil fuel, wood, landfills, wetlands, fertilizer factories.
Nitrous oxides (N_2O)	Burning of fossil fuels, fertilizers; burning of wood and crop residue.
Hydro fluorocarbons (HFCs)	Used as refrigerants, aerosol propellants, solvents and fire retardants.
Per fluorocarbons (PFCs)	Produced as a by-product in aluminium production and manufacturing of semi-conductors.
Sulphur hexafluoride (SF6)	Used as tracer gas for leak detection, used in electrical transmission equipment

UNFCCC

United Nation Framework Convention on Climate Change (UNFCCC) is an international environment treaty opened for signature in 1992. It came into force from 1994. Secretariat is located in Bonn, Germany. The convention is legally non-binding, but makes provisions for meeting called protocols where negotiating countries can set legally binding limits.

- It **aims** to **stabilize greenhouse gas concentrations** in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. The framework set no binding limits on greenhouse gas emissions for individual countries and contains no enforcement mechanisms. Instead, the framework outlines how specific international treaties (called "protocols" or "Agreements") may be negotiated to set binding limits on greenhouse gases. Kyoto Protocol was negotiated under this framework.
- One of the first tasks set by the UNFCCC was for signatory nations to establish national greenhouse inventories of greenhouse gas (GHG) emissions and removals, which were used to create the 1990 benchmark levels for accession of Annex I countries to the Kyoto Protocol and for the commitment of those countries to GHG reductions. Updated inventories must be regularly submitted by Annex I countries. Annex I, Annex II countries and developing countries.

Parties to UNFCCC are classified as:

- **Annex I countries:** Industrialized countries and economies in transition.
- **Annex II countries:** Developed countries which pay for costs of developing countries. Annex II countries are a sub-group of the Annex I countries.
- **Non-Annex I countries:** Developing countries are not required to reduce emission levels unless developed countries supply enough funding and technology.

- **Setting no immediate restrictions under UNFCCC serves three purposes: i.** It avoids restrictions on their development, because emissions are strongly linked to industrial capacity; **ii.** They can sell emissions credits to nations whose operators have difficulty meeting their emissions targets; **iii.** they get money and technologies for low-carbon investments from Annex II countries; **iv.** Developing countries may volunteer to become Annex I countries when they are sufficiently developed; **v.** India is Non Annex party to UNFCCC.

REDD and REDD+

- It is a mechanism negotiated under UNFCC since 2005.
- Its objective is to mitigate climate change through reducing net emissions of greenhouse gases through enhanced forest management in developing countries.
- Inclusion of reducing emissions from land use change is considered essential to achieve the objectives of the UNFCCC.
- During the negotiations for the Kyoto Protocol the inclusion of tropical forest management was debated but eventually dropped due to anticipated methodological difficulties in establishing – in particular – additionality and leakage (detrimental effects outside of the project area attributable to project activities).
- India did not participate in UN-REDD.
- **REDD+ (Defined in Bali Action Plan, 2007, CoP13)**
- **What constitutes** "+": 1. sustainable management of forests, 2. conservation of forest carbon stocks and 3. enhancement of forest carbon stocks.

What is the difference between REDD and REDD+?

- REDD = "reducing emissions from deforestation in developing countries"
- REDD+ (or REDD-plus) = to "reducing emissions from deforestation and forest degradation in developing countries, and the role of conservation, sustainable management of forests, and enhancement of forest carbon stocks in developing countries"
- REDD+ is essentially **a vehicle to financially reward developing countries** for their verified efforts to reduce emissions and enhance removals of greenhouse gases through a variety of forest management option.
- India favours REDD+

OZONE LAYER

- The Earth's atmosphere is divided into several layers. The lowest region, the troposphere, extends from the Earth's surface up to about 10 kilometres (km) in altitude. Virtually all human activities occur in the troposphere. Mt. Everest, the tallest mountain on the planet, is only about 9 km high.
- The next layer, the stratosphere, continues from 10 km to about 50 km. Most atmospheric ozone is concentrated in a layer in the stratosphere, about 15-30 kilometers above the Earth's surface.
- This ozone layer in the Earth's stratosphere absorbs most of the Sun's ultraviolet (UV) radiation that may cause skin cancer. It contains high concentrations of ozone (O_3) in relation to other parts of the atmosphere. Stratospheric Ozone is not harmful, but its presence on land is harmful.

Difference between Stratospheric and Tropospheric Ozone

PRESCRIPTION	GROUND-LEVEL OZONE	STRATOSPHERIC OZONE
Description	• Bad Ozone • Part of Photochemical Smog • Found in Troposphere (0-15 Km)	• Good Ozone • Natural filter that absorbs the Sun's UV rays • Found in Stratosphere (15 - 35 km)

Sources	• Forms when Nitrous oxides (NOx) reacts with Volatile Organic Compounds (VOCs).	• Naturally forms when Oxygen is in the presence of UV radiation.
Effects	• Eye and respiratory irritation • Lung tissue damage, shortened lifespan and lung disease • Corrosion in buildings, damage to crops, increase in Vulnerability to diseases.	• Thinning of ozone shield that absorbs UV rays leads to crop damage, Aquatic life death, eye irritation and skin cancer.

POLLUTION AND SOLUTIONS

POLLUTION CATEGORIZATION OF INDUSTRIES

The Ministry of Environment, Forest and Climate Change (MoEFCC) has issued the guidelines to classify activities which cause pollution into red, green, orange and white category.

- The purpose of the categorization is to **ensure that the industry is established** in a manner which is **consistent with the environmental objectives**.
- The new criteria will **prompt industrial sectors** willing to **adopt cleaner technologies**, ultimately resulting in generation of fewer pollutants.
- Another feature of the new categorization system lies in **facilitating self-assessment by industries** as the subjectivity of earlier assessment has been eliminated.
- This 'Re-categorization' is a part of the efforts, policies and objective of the government to create a **clean & transparent working environment** in the country and **promote the Ease of Doing Business**.

Categories and criteria for categorisation

- MoEFCC has developed the criteria of categorization of industrial sectors based on the Pollution Index which is a function of the **emissions (air pollutants), effluents (water pollutants), hazardous wastes generated and consumption of resources**.
- **For this purpose, the references are taken from:**

a) the Water (Prevention and Control of Pollution) Cess (Amendment) Act, 2003;
b) Standards so far prescribed for various pollutants under Environment (Protection) Act, 1986; and
c) Doon Valley Notification, 1989 issued by the MoEFCC.

- **The Pollution Index PI of any industrial sector is a number from 0 to 100** and the increasing value of PI denotes the increasing degree of pollution load from the industrial sector. The following are the criteria on 'Range of Pollution Index' for the purpose of categorization of industrial sectors.
- Industrial Sectors having Pollution Index score of **60 and above - Red category**
- Industrial Sectors having Pollution Index score of **41 to 59** – **Orange category**
- Industrial Sectors having Pollution Index score of **21 to 40** – **Green category**
- Industrial Sectors having Pollution Index score incl.& **up to 20 - White category**

Implications of categorisation

- There shall be **no necessity of obtaining the Consent to Operate for White category of industries**. An intimation to concerned SPCB / PCC shall suffice.
- **No Red category of industries** shall normally be permitted **in the ecologically fragile area / protected area**.

HEAVY METAL CONTAMINATION

- The presence of metals in drinking water is to some extent unavoidable and certain metals, in trace amounts is required for good health. However, when present above safe limits, they are associated with a range of disorders.

1. Long term exposure of heavy metals may result in slowing progressing physical, muscular and neurological degenerative processes that mimic Alzheimer's disease, Parkinson's disease, muscular dystrophy and multiple sclerosis.
2. Majority of Indians still use water directly from rivers for their domestic use, with an increase in population, the pressure on these rivers will only increase.
3. Concentration of such toxic metals has increased rapidly over the past few decades. Consequently, concentrations of toxic metals in grains and vegetables grown in contaminated soils have increased at alarming rates.
4. Serious threat to humans and the environment because of its toxicity, non-bio- degradability and bioaccumulation.

Arsenic pollution:

- Leads to arsenical skin lesions.
- Arsenicosis is a chronic illness resulting from drinking water with high As level over a long period of time.
- High concentrations of arsenic in drinking water also result in an increase in stillbirths and spontaneous abortions.

Pollutants	Major sources	Effect on human health	Permissible levels (mg/L)
As	Pesticides, fungicides, metal smelters	Bronchitis, dermatitis, poisoning	0.02
Cd	Welding, electroplating, pesticides, fertilizer	Renal dysfunction, lung disease, lung cancer, bone defects, kidney damage, bone marrow	0.06
Pb	Paint, pesticides, smoking, automobile emission, mining, burning of coal	Mental retardation in children, development delay, fatal infant encephalopathy, chronic damage to nervous system, liver, kidney damage	0.1
Mn	Welding, fuel addition, ferromanganese production	Inhalation or contact damage to central nervous system	0.26
Hg	Pesticides, batteries, paper industry	Tremors, gingivitis, protoplasm poisoning, damage to nervous system, spontaneous abortion	0.01
Zn	Refineries, brass manufacture, metal plating	Damage to nervous system, dermatitis	15
Cr	Mine, mineral sources	Damage to nervous system, irritability	0.05
Cu	Mining, pesticide production, chemical industry	Anemia, liver and kidney damage, stomach irritation	0.1

Cadmium pollution:

- Itai-Itai disease (Severe pain in body and joints)
- One of the most widely known toxic effects manifested by Cd poisoning is nephro-toxicity. Adverse renal effects are more commonly seen with exposure to low levels of Cd.

Chromium Pollution:

- Hexavalent Chromium is a danger to human health, mainly for people who work in the steel and textile industry. People who smoke tobacco also have a higher chance of exposure to chromium. Chromium (VI) is known to cause various health effects. When it is a compound in leather products, it can cause allergic reactions, such as skin rash. After breathing in, chromium (VI) can cause nose irritations and nosebleeds.

Copper Pollution:

- It is seen that though copper is essential for life and health, its deficiency or excesses both cause adverse effects.
- Industrial exposure to copper fumes, dusts, or mists may result in metal fume fever with atrophic changes in nasal mucous membranes. Chronic copper poisoning results in Wilson's Disease, characterized by a hepaticcirrhosis, Brain damage, demyelination, renal disease, and copper deposition in the cornea.

Iron Pollution:

- Iron is an essential element in human nutrition.
- The presence of higher concentration of iron in drinking water makes its taste unpleasant; however, living organism can tolerate higher concentration of iron without any serious damage to their system.
- Causes aesthetic problems such as discoloured water, precipitation, scaling, staining and metallic water taste.

Recommendations:

1) Quality of water should be monitored at least four times a year.

2) All the toxic metallic elements like chromium and its other associated heavy metals coming from the tanneries, mining and other industries should be treated chemically and biologically before such wastes find their way to River.
3) Promotion of effective and efficient implementation of water pollution control laws and regulations.
4) There are various wastewater treatment technologies available for treating heavy metals contaminated water prior to ultimate discharge in natural water bodies, for example chemical precipitation, evaporative recovery, oxidation/ reduction, filtration, ion exchange, membrane technologies and electrochemical treatment technologies are commonly used for practical applications.

NET-ZERO EMISSIONS

- Net-zero, which is also referred to as carbon-neutrality, does not mean that a country would bring down its emissions to zero. Rather, net-zero is a state in which a **country's emissions are compensated by absorption and removal of greenhouse gases from the atmosphere.**
- Absorption of the emissions can be increased by creating more carbon sinks such as forests, while removal of gases from the atmosphere requires futuristic technologies such as carbon capture and storage.
- This way, it is even possible for a country to have negative emissions, if the absorption and removal exceed the actual emissions. A good example is **Bhutan which is often described as carbon-negative** because it absorbs more than it emits.
- A very active campaign has been going on for the last two years to get every country to sign on to a **net-zero goal for 2050**. It is being argued that global carbon neutrality by 2050 is the only way to achieve the Paris Agreement target of keeping the planet's temperature from rising beyond 2°C compared to pre-industrial times.

What Does It Mean to Reach Net-Zero Emissions?

- We will achieve net-zero emissions when any remaining human-caused GHG emissions are balanced out by removing GHGs from the atmosphere in a process known as **carbon removal**.
- **First and foremost**, human-caused emissions — like those from fossil-fueled vehicles and factories — should be reduced as close to zero as possible. Any remaining GHGs would be balanced with an equivalent amount of carbon removal, for example by restoring forests or through **direct air capture and storage (DACS)** technology.
- The concept of net-zero emissions is akin to **"climate neutrality."**

When Does the World Need to Reach Net-Zero Emissions?

- Under the Paris Agreement, countries agreed to limit warming well below 2 degrees C (3.6 degrees F) and ideally 1.5 degrees C (2.7 degrees F). Climate impacts that are already unfolding around the world, even with only 1.1 degrees C (2 degrees F) of warming — from melting ice to devastating heat waves and more intense storms — show the urgency of minimizing temperature increase to no more than 1.5 degrees C. The latest science suggests that to meet the Paris Agreement's temperature goals, the world will need to reach net-zero emissions on the following timelines as given in image below:
- In scenarios that limit warming to 1.5 degrees C, carbon dioxide (CO_2) reaches net-zero on average by 2050 (in scenarios with low or no overshoot) to 2052 (in scenarios that have high overshoot, in which temperature rise surpasses 1.5 degrees C for some time before being brought down). Total GHG emissions reach net-zero between 2063 and 2068.
- In 2 degrees C scenarios, CO_2 reaches net-zero on average by 2070 (in scenarios with a greater than 66% likelihood of limiting warming to 2 degrees C) to 2085 (50–66% likelihood). Total GHG emissions reach net-zero by the end of the century.
- The Special Report on Global Warming of 1.5˚C, from the Intergovernmental Panel on Climate Change (IPCC), finds that if the world reaches net-zero emissions one-decade sooner, by 2040, the chance of limiting warming to 1.5 degrees C is considerably higher. The sooner emissions peak, and the lower they are at that point, the more realistic it is that we achieve net-zero in time. We would also need to rely less on carbon removal in the second half of the century.

Do All Countries Need to Reach Net-Zero at the Same Time?

- The timelines above are global averages. Because countries' economies and stages of development vary widely, there is no one-size-fits-all timeline for individual countries.
- There are, however, hard physical limits to the total emissions the atmosphere can support while limiting global temperature increase to the agreed goals of the Paris Agreement.
- At the very least, major emitters (such as the United States, the European Union and China) should reach net-zero GHG emissions by 2050, or it will be hard for the math to work regardless of what other countries do. Ideally, major emitters will reach net-zero much earlier, given that the largest economies play an outsize role in determining the trajectory of global emissions.

How Do We Achieve Net-Zero Emissions?

- Policy, technology and behavior need to shift across the board. For example, in pathways to 1.5 degrees C, **renewables are projected to supply 70-85% of electricity** by 2050.
- **Energy efficiency** and **fuel-switching measures** are critical for transportation.
- Improving the **efficiency of food production**, **changing dietary choices**, **halting deforestation**, **restoring degraded lands**, and **reducing food loss** and **waste** also have significant potential to reduce emissions.
- It is critical that the structural and economic transition necessary to limit warming to 1.5 degrees C is approached in a just manner, especially for workers tied to high-carbon industries.
- The good news is that most of the technologies we need are available and they are increasingly cost-competitive with high-carbon alternatives. Solar and wind now provide the cheapest power for 67% of the world. Markets are waking up to these opportunities and to the risks of a high-carbon economy, and shifting accordingly.
- Additionally, **investments will need to be made in carbon removal**. The different pathways assessed by the IPCC to achieve 1.5 degrees C rely on different levels of carbon removal, but all rely on it to some extent. Removing CO2 from the atmosphere will be necessary to compensate for emissions from sectors in which reaching zero emissions is more difficult, such as aviation. Carbon removal can be achieved by several means, including land-based approaches (**such as restoring forests and boosting soil uptake of carbon**) and technological approaches (**such as direct air capture and storage, or mineralization**).

Does the Paris Agreement Commit Countries to Achieving Net-Zero Emissions?

- In short, yes.

  The Paris Agreement has a long-term goal of achieving "a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases in the second half of this century , on the basis of equity, and in the context of sustainable development and efforts to eradicate poverty." The concept of balancing emissions and removals is akin to reaching net-zero emissions.
- Coupled with the ultimate goal to limit warming well below 2 degrees C, and aiming for 1.5 degrees C, the Paris Agreement commits governments to sharply reduce emissions and ramp up efforts to reach net-zero emissions in time to avoid the worst consequences of climate change. The Paris Agreement framework also invites countries to submit long-term, low-emissions development strategies by 2020. These strategies can be a vehicle for setting net-zero targets and chart how countries aim to make such transitions.
- Commitments to create bold short- and long-term targets that align with a net-zero emissions future would send important signals to all levels of government, to the private sector, and to the public that leaders are betting on a safe and prosperous future, rather than one devastated by climate impacts.

GREEN ENERGY

- Green energy is any energy type that is **generated from natural resources**, such as sunlight, wind or water. It often comes from renewable energy sources although there are some differences between renewable and green energy, which we will explore, below.
- The key with these energy resources are that they don’t harm the environment through factors such as releasing greenhouse gases into the atmosphere.

- As a source of energy, green energy often comes from renewable energy technologies such as solar energy, wind power, geothermal energy, biomass and hydroelectric power. Each of these technologies works in different ways, whether that is by taking power from the sun, as with solar panels, or using wind turbines or the flow of water to generate energy.

What Does it Mean?

- In order to be deemed green energy, a **resource cannot produce pollution**, such as is found with fossil fuels. This means that not all sources used by the renewable energy industry are green. For example, power generation that burns organic material from sustainable forests may be renewable, but it is not necessarily green, due to the CO2 produced by the burning process itself.
- Green energy sources are **usually naturally replenished**, as opposed to fossil fuel sources like natural gas or coal, which can take millions of years to develop. Green sources also often avoid mining or drilling operations that can be damaging to eco-systems.

Types: The main sources are wind energy, solar power and hydroelectric power (including tidal energy, which uses ocean energy from the tides in the sea). Solar and wind power are able to be produced on a small scale at people's homes or alternatively, they can be generated on a larger, industrial scale. The six most common forms are as follows:

1. **Solar Power:** This common renewable, green energy source is usually produced using **photovoltaic cells** that capture sunlight and turn it into electricity. Solar power is also used to heat buildings and for hot water as well as for cooking and lighting. Solar power has now become affordable enough to be used for domestic purposes including garden lighting, although it is also used on a larger scale to power entire neighbourhoods.
2. **Wind Power:** Particularly suited to offshore and higher altitude sites, wind energy uses the power of the flow of air around the world to push turbines that then generate electricity.
3. **Hydropower:** Also known as hydroelectric power, this type of green energy uses the flow of water in rivers, streams, dams or elsewhere to produce energy. Hydropower can even work on a small scale using the flow of water through pipes in the home or can come from evaporation, rainfall or the tides in the oceans.
4. **Geothermal Energy:** This type of green power uses thermal energy that has been stored just under the earth's crust. While this resource requires drilling to access, thereby calling the environmental impact into question, it is a huge resource once tapped into. Geothermal energy has been used for bathing in hot springs for thousands of years and this same resource can be used for steam to turn turbines and generate electricity. The energy stored under the United States alone is enough to produce 10 times as much electricity as coal currently can. While some nations, such as Iceland, have easy-to-access geothermal resources, it is a resource that is reliant on location for ease of use, and to be fully 'green' the drilling procedures need to be closely monitored.
5. **Biomass:** This renewable resource also needs to be carefully managed in order to be truly labelled as a 'green energy' source. Biomass power plants use wood waste, sawdust and combustible organic agricultural waste to create energy. While the burning of these materials releases greenhouse gas these emissions are still far lower than those from petroleum-based fuels.
6. **Biofuels:** Rather than burning biomass as mentioned above, these organic materials can be transformed into fuel such as ethanol and biodiesel. Having supplied just 2.7% of the world's fuel for transport in 2010, the biofuels are estimated to have the capacity to meet over 25% of global transportation fuel demand by 2050.

Why is it Important?

- Green energy is important for the environment as it **replaces the negative effects of fossil fuels** with more environmentally-friendly alternatives.
- Derived from natural resources, **green energy is also often renewable and clean**, meaning that they emit no or few greenhouse gases and are often readily available.
- Even when the full life cycle of a green energy source is taken into consideration, they **release far less greenhouse gases** than fossil fuels, as well as few or low levels of air pollutants. This is not just good for the planet but is also better for the health of people and animals that have to breathe the air.

- Green energy can also **lead to stable energy prices as these sources are often produced locally and are not as affected by geopolitical crisis, price spikes or supply chain disruptions**. The economic benefits also include job creation in building the facilities that often serve the communities where the workers are employed. Renewable energy saw the creation of 11 million jobs worldwide in 2018, with this number set to grow as we strive to meet targets such as net zero.
- Due to the local nature of energy production through sources like solar and wind power, the energy infrastructure is **more flexible and less dependent on centralised sources** that can lead to disruption as well as being less resilient to weather related climate change.
- Green energy also represents a **low cost solution for the energy needs** of many parts of the world. This will only improve as costs continue to fall, further increasing the accessibility of green energy, especially in the developing world.

Which Type Is the Most Efficient?

- Renewable energy sources are currently ranked as follows in efficiency (although this may change as developments continue):

- Wind Power
- Geothermal
- Hydropower
- Nuclear
- Solar Power

Green Energy vs Clean Energy vs Renewable Energy – What is the Difference?

- Green energy is that which comes from natural sources, such as the sun. Clean energy are those types which do not release pollutants into the air, and renewable energy comes from sources that are constantly being replenished, such as hydropower, wind power or solar energy.
- Renewable energy is often seen as being the same, but there is still some debate around this. For example, can a hydroelectric dam which may divert waterways and impact the local environment really be called 'green?'
- However, a source such as wind power is renewable, green and clean – since it comes from an environmentally-friendly, self-replenishing and non-polluting source.

SAFAR

- The **System of Air Quality and Weather Forecasting And Research (SAFAR)** is a national initiative introduced by the Ministry of Earth Sciences (MoES) to measure the air quality of a metropolitan city, by measuring the overall pollution level and the location-specific air quality of the city.
- The system is indigenously developed by the **Indian Institute of Tropical Meteorology (IITM), Pune** and is operationalized by the India Meteorological Department (IMD).
- It has a giant true color LED display that gives out real-time air quality index on a 24x7 basis with color-coding (along with 72 hours advance forecast).
- The ultimate objective of the project is to increase awareness among the general public regarding the air quality in their city so that appropriate mitigation measures and systematic action can be taken up.
- It organizes awareness drive by educating the public (prompting self-mitigation).
- It also helps the policy-makers to develop mitigation strategies keeping in mind the nation's economic development.
- SAFAR is an integral part of India's first Air Quality Early Warning System operational in Delhi.
- It **monitors all weather parameters** like temperature, rainfall, humidity, wind speed, and wind direction, UV radiation, and solar radiation.
- **Pollutants monitored**: *PM2.5, PM10, Ozone, Carbon Monoxide (CO), Nitrogen Oxides (NOx), Sulfur Dioxide (SO2), Benzene, Toluene, Xylene, and Mercury*.

- The World Meteorological Organization has recognized SAFAR as a prototype activity on the basis of the high-quality control and standards maintained in its implementation.
- SAFAR system would benefit cost savings to several other sectors like agriculture, aviation, infrastructure, disaster management, tourism, etc. which directly or indirectly gets affected by air quality and weather.

AIR QUALITY INDEX (AQI)

- The AQI is an index for reporting daily air quality.
- It focuses on health effects one might experience within a few hours or days after breathing polluted air.
- AQI is calculated for eight major air pollutants:

1. Ground-level ozone,
2. PM10,
3. PM2.5,
4. Carbon monoxide,
5. Sulfur dioxide,
6. Nitrogen dioxide,
7. Ammonia,
8. Lead,

- Ground-level ozone and airborne particles are the two pollutants that pose the greatest threat to human health in India.

GOAL 7: AFFORDABLE AND CLEAN ENERGY

- Lack of access to energy supplies and transformation systems is a constraint to human and economic development. The environment provides a series of renewable and non-renewable energy sources i.e. solar, wind, hydropower, geothermal, biofuels, natural gas, coal, petroleum, uranium.
- Increased use of fossil fuels without actions to mitigate greenhouse gases will have global climate change implications. Energy efficiency and increase use of renewables contribute to climate change mitigation and disaster risk reduction. Maintaining and protecting ecosystems allow using and further developing hydropower sources of electricity and bioenergy.

Facts:

- 3 billion people rely on wood, coal, charcoal or animal waste for cooking and heating.
- Energy is the dominant contributor to climate change, accounting for around **60 per cent of total global greenhouse gas emissions**
- Since 1990, global emissions of CO2 have increased by more than 46 per cent.
- Hydropower is the largest single renewable electricity source today, providing 16% of world electricity at competitive prices. It dominates the electricity mix in several countries, developed, emerging or developing.
- Bioenergy is the single largest renewable energy source today, providing 10% of world primary energy supply.

Targets linked to the environment:

1. **Target 7.1**: By 2030, ensure universal access to affordable, reliable and modern energy services.
2. **Target 7.2:** By 2030, increase substantially the share of renewable energy in the global energy mix.
3. **Target 7.3**: By 2030, double the global rate of improvement in energy efficiency.
4. **Target 7.a:** By 2030, enhance international cooperation to facilitate access to clean energy research and technology, including renewable energy, energy efficiency and advanced and cleaner fossil-fuel technology, and promote investment in energy infrastructure and clean energy technology

5. **Target 7.b**: By 2030, expand infrastructure and upgrade technology for supplying modern and sustainable energy services for all in developing countries, in particular least developed countries, small island developing States, and land-locked developing countries, in accordance with their respective programmes of support.

OCEAN RENEWABLE ENERGY

Ocean renewable energy refers to all forms of renewable energy derived from the sea including wave energy, tidal energy, ocean current energy, salinity gradient energy and ocean thermal gradient energy.

- **Wave Energy**: It is generated from the power of waves near their surface. It can be captured through oscillating water columns, which trap waves in a column and change the air pressure in the upper portion which drives a turbine.
- **Tidal Energy**: The Tides in the oceans are caused by the combined effects of gravitational forces exerted by the Moon, the Sun, and the rotation of the Earth. Tidal Energy converts the natural rise and fall of the tides into Electricity.
- **Ocean Current Energy:** It refers to harnessing the energy of the ocean currents to generate electricity.
- **Salinity gradient energy**: Salinity gradient power is the energy created from the difference in salt concentration between fresh and salt water, e.g., when a river flows into the sea. Hence, Salinity gradient power plants are based on the natural mixing of fresh and salt water.
- **Ocean thermal gradient energy**: It is a technology for producing energy by harnessing the temperature differences (thermal gradients) between ocean surface waters and deep ocean waters.

- India has **wave energy potential of 40,000 MW**, **tidal energy potential of 9000 MW** and **Ocean thermal gradient** energy potential of around **180,000 MW.**
- **Tidal Energy**: To capture sufficient power from the tidal energy potential, the **height of high tide must be at least five meters more than the low tide**. The Gulf of Cambay and the Gulf of Kutch in Gujarat with higher tidal ranges are considered to be suitable places for harnessing tidal energy.

Benefits of harnessing ocean energy

- **Optimum utilisation of Potential**: India has a long coastline with estuaries and gulfs where waves and tides are strong enough to move turbines for electrical power generation.
- **Reliable and Predictable Power:** As tides follow monthly cycle, which are more predictable in nature, the dependence of tidal energy on rise and fall of tides makes tidal energy a more uniform, reliable and predictable energy source. Similarly, wave energy is reliable because of perpetual motion of ocean waves.
- **Easier Grid Integration**: The power generated from renewable sources such as wind and solar is dependent on random weather patterns. Hence, the power generated may face grid integration challenges due to their unpredictable nature. However, ocean energy, being uniform and reliable does not pose grid integration challenges.
- **Seashore protection**: The Offshore breakwaters are used along beaches for providing protection against coastal erosion by the waves. These structures can be combined with tidal and wave energy projects to reap the dual benefits of sea shore protection and harnessing tidal / wave energy.
- **Higher Energy Density**: Water has higher energy density than air i.e. it can store a larger amount of energy per unit volume as compared to other forms of renewable energy, such as the wind. Hence, for a given electricity output, tidal turbines can be much smaller than equivalent wind turbines. Further, it is possible to harness energy at low speeds from wave and tidal sources as compared to wind which require comparatively higher speeds.
- **Less Visual and Noise Impact:** Tidal and wave power systems have less prominent visual impact as compared to wind and solar systems. They require less space as compared to wind turbine or solar projects. Furthermore, they produce less amount of noise, unlike wind turbines, which produce aerodynamic noise, thereby avoiding disturbance to the marine surroundings.
- **Socio-economic Impact**: Ocean Energy projects provide a number of socio-economic benefits for the coastal population ranging from local electricity production and consumption, creation of job opportunities, creation of industrial clusters etc.

DISASTER MITIGATION

RAINWATER HARVESTING

Water is one of the basic necessities of every living being for their survival. Despite being renewable, water is also a finite resource and therefore, needs extreme precautionary and judicious use of it. Out of the total water available on the planet, only 3% is fresh and can be used for drinking purposes. However, the available fresh water is distributed very unevenly, rendering serious implications on the steady supply across the globe. Moreover, with increasing population, increasing urbanization, expanding agriculture, and rising standards of living, the water demand has now touched a new arena, where it is getting difficult to meet even the essentialities.

- In **Indian perspective**, water shortage is one of the most difficult problems being faced in present time. **Rainfall is quite erratic and non-uniform** across the length and breadth of the country
- About **80 – 90% of the total rainfall is received during the summer monsoons** (i.e. July to September) while rest of the period goes dry.
- **Urban centres in India are more prone to water shortage**. During the rainy seasons, it is often seen that roads get flooded while during the summers, acute water shortage is faced by the dwellers. Although the cities receive good amount of rainfall, still the problem of flooding during monsoon and droughts during summers has become a very common phenomenon. This is because of the fact that the rainfall usually occurs for short duration but with high intensity. Such conditions result in the heavy flow of water leaving very little amount for the recharge of groundwater. Thus, groundwater does not get chance to replenish.
- Considering this situation, the **rainwater harvesting (RWH) technique has emerged as a boon**.
- Rainwater harvesting (RWH) is a process of **collecting**, **conveying**, and **storing** the rainfall in an area for the beneficial purposes.
- Considering the problems of severe water scarcity, pollution in existing surface water bodies, and floods during rainy seasons in India; the adoption of rainwater harvesting practices is quite necessary and need of the hour.
- The methods involved in this practice are simple and can be maintained at a minimal cost. Besides this, rainwater harvesting is also very attractive because India is having a good potential for harvesting rains. Being a tropical – monsoonal country, India's rains are sufficient to cater the need of its people, if there is judicious use of it.
- Rainwater harvesting does not only improve the water usage practices, rather it is **also helpful in the groundwater recharge**. Considering the depletion of groundwater resources due to excessive pumping of water, and its pollution from the leachate of waste dumping sites and agricultural lands, replenishment of groundwater resources is also necessary.

Methods of rainwater harvesting: Basically, the water harvesting methods can be classified into two:

1. **Surface run-off harvesting**: During heavy downpour, the water flows away as surface runoff. This runoff water can be collected and used for recharging aquifers.
2. **Rooftop harvesting**: In this system, the roof itself becomes the catchment and rainwater can be collected from the roof of the house / building . The water can either be stored for utilization or it can be diverted to an artificial recharge system. In this method, water can be collected without much expense. This method is highly effective and it can also help in the recharge of ground water level.

Components of rainwater harvesting system: It includes the following components:

- **Catchments**
  - The area or surface which receives the rainfall is known as catchment area for rainwater harvesting. It may be rooftop, courtyard, open ground etc.
  - In the simplest method, rainwater is collected in vessels at the edge of the roof / open ground. Moreover, gutters may also be used at some places which drain into the collection vessel with the use of various pipes. Sometimes, the collected water is also passed through the settling tanks for the suspension of sinkable particles before the collection in storage tank for domestic use.

- In rooftop catchment, the amount and quality of rainwater collected depends on the area and type of roofing material. As per the Indian standard guidelines for rainwater harvesting, rooftop water may be collected from roofs constructed with galvanized iron sheet, aluminium sheet, deleterious glass fibre sheet, asbestos cement sheets, tiles, and slates etc. Bamboo gutters and thatched roof may also be used as rooftop material for the collection of water if these are covered by water proof sheeting like food grade low density polyethylene films.
- To obtain the fresh quality of water, the roofs having metallic paint or any other type of coating should be avoided. The catchment area should also be cleaned on regular basis to remove dust, leaves, and bird droppings so that water quality can be maintained.
- Only non-toxic paints should be used in case the water has to be collected from painted roof. Moreover, water collected from roofs painted with toxic materials should not be used for potable purposes.
- If the catchment area is a land surface or ground, then water can be collected in reservoirs using drain pipes. As compared to rooftop catchment, it is easier to collect rainwater from the ground surface or open area. However, in ground surface catchment, there is the possibility of water infiltration into the underground reservoir. Therefore, water collection after the rain should be immediate and sufficient measures should be taken to reduce the infiltration to the ground.

- **Gutters (drains) and downtake pipes** are essential for taking up the water from catchment area to the storage tanks. The materials to be used for gutters, as per the Indian standard guidelines for rainwater harvesting, are galvanized iron sheet, wood, bamboo, or reinforced cement concrete.
- **Filters and first flush devices**: These devices remove grit, leaves, and dirt which are often found in the first rains. It is necessary to remove these from the water as it may contaminate the whole water of the storage tank. Sometimes, these devices are also useful when rains occur after a long time. In such conditions, the rainwater carries with it, various dissolved pollutants. Materials such as gravel, sand, or coconut, palm, or betelnut fibre, etc. may be used as filter media. Filters and first flush divert the water from the first rain to avoid mixing of it with the water of storage tank.
- **Storage tanks:** These tanks might be either above ground or underground or partly underground. The tank should always be covered so that water should be clean. The storage tanks may be made up of reinforced cement concrete, masonry etc. The size of the tank depends upon factors like daily demand, duration of dry spell, catchment area, and rainfall.

  Underground storage tanks should be suitably lined with water proofing material and preferably have a hand pump installed for withdrawal of water.

Delivery systems

- There should be efficient piping system which can deliver the stored water for the end use. In the absence of any treatment, rainwater should be avoided for the consumption and cooking. However, it can be used for other purposes. To be used for consumption, conventional water treatment is necessary. Leaking and rusted pipes should be avoided completely. To avoid any leakage, timely check-up of the pipes is necessary.

Recharge structures

- Harvested rainwater can also be used for charging the ground water aquifers through the construction of various kinds of structures like **dugwells, borewells, recharge trenches, and recharge pits**.
- There may be different depths in recharge structures, such as depth can be such that water reaches to lower soil strata. Examples of such structures are recharge trenches, permeable pavements etc.
- In other case, the depth of the pipe down in the soil can be such that it reaches to the level of ground water and joins it. Examples of these kinds of structures are recharge wells.

REGENERATIVE AGRICULTURE

- "Regenerative Agriculture" describes farming and grazing practices that, among other benefits, reverse climate change by rebuilding soil organic matter and restoring degraded soil biodiversity – resulting in both carbon drawdown and improving the water cycle.

- The key to regenerative agriculture is that it not only "does no harm" to the land but actually improves it, using technologies that regenerate and revitalize the soil and the environment.
- Regenerative agriculture leads to healthy soil, capable of producing high quality, nutrient dense food while simultaneously improving, rather than degrading land, and ultimately leading to productive farms and healthy communities and economies.
- It is dynamic and holistic, incorporating permaculture (sustainable and self-sufficient agricultural ecosystems) and organic farming practices, including conservation tillage, cover crops, crop rotation, composting, mobile animal shelters and pasture cropping, to increase food production, farmers' income and especially, topsoil.
- It has been promoted to counter loss of the world's fertile soil and biodiversity, along with the loss of indigenous seeds and knowledge.

BIOLOGICAL DISASTER

NDMA action points on biological disaster are given below:

- **Capacity development** – Facilities and amenities must be developed to cover all issues of environmental management like water supply, personal hygiene, and vector control, burial/disposal of the dead and the risk of occurrence of zoonotic disorders.
- **Pharmaceutical and non-pharmaceutical interventions and biosafety/biosecurity measures** – Tools must be developed to monitor the status of available pharmaceutical interventions including antibiotics, chemotherapeutics and anti-virals, and listing of essential drugs that may be required to manage biological emergencies.
- **Establishment of command, control and coordination functions** – A well-orchestrated medical response to biological disasters will only be possible by having a command and control function at the district level with the district collector as commander.
- **Capacity development of human resource, training and education, community, standardised documentation procedures and R&D** – The roles of various health and non-health professionals at various levels in the management of a biological crisis must be defined. Control rooms to support the field responders should be set up. These professionals must be trained through refresher courses to fill the prevailing gaps.
- **Development of critical infrastructure for management of biological emergencies** – The development of a laboratory network including national/state level referral laboratories, and district level diagnostic laboratories with medical colleges to confirm diagnosis under a single integrated framework. On a similar basis, a chain of public health laboratories must also be developed and networked. The critical infrastructure must also be supported by biomonitoring techniques based on advanced molecular and biochemical techniques.
- A **properly functioning epidemiological mechanism** must be used to prepare an action plan for the management of avian flu, and similar incidences to effectively combat the inherent risks. Various international best practices must be tested and incorporated in the DM plans by the nodal and line ministries to prevent the spread of biological disasters across international boundaries.
- **Preparedness for biological containment of microbial agents** – SOPs for biosafety and biosecurity must be developed by the respective laboratories in accordance with the National Code of Practice for Biosecurity and Biosafety.

URBAN FLOODS

Recently, Hyderabad suffered from urban flooding.

- **What is an Urban Flood?** Urban pluvial (surface water) flooding – flooding in urban areas caused by intense and/or prolonged rainfall which overwhelms the capacity of the drainage system – is one of the principal hazards in modern towns and cities. This type of flooding often leads to major economic losses and devastating social and environmental impacts.
- **Reasons for Urban Flooding:** Urban flooding is caused by three main factors – meteorological, hydrological and human factors.
  - **Meteorological factors include heavy rainfall**, cyclonic storms and thunderstorms.

- **Hydrological factors** include presence or absence of overbank flow channel networks and occurrence of high tides impeding the drainage in coastal cities.
- **Human factors include** land use changes, surface sealing due to urbanization (which increases run-off), occupation of flood plains and obstruction of flood flows, urban heat island effect (which has increased the rainfall in and around urban areas), poor solid waste management etc.

Urbanisation:

- Rapid urbanization combined with a lack of efficient waste disposal systems have left several water bodies in the cities in poor condition.
- Blocked waterways and reduced width and depth of canals, while the speed and scale of construction reduces the permeability of the ground.

Improper Drainage:

- In Indian cities and towns, large habitations are coming up in low-lying areas, often encroaching over drainage channels.
- Encroachment in the immediate upper catchments of hilly urban area has also caused serious flooding in the flood plains of cities surrounded by hills.
- Hyderabad's century-old drainage system (developed in the 1920s) covered only a small part of the core city. In the last 20 years, the city has grown at least four times its original built-up area.

- **Population Growth:**

- Most of our cities have now reached a saturation point in terms of population growth and accommodation, and the developmental activities have now shifted to low-lying areas and areas next to the riverbanks. So, whenever a city experiences a large amount of rainfall within a short time, there are chances it gets flooded

Major threats that Urban Floods poses:

- **Economic:** Urban areas are also centers of economic activities with vital infrastructure which needs to be protected. In most of the cities, damage to vital infrastructure has a bearing not only for the state and the country but it could even have global implications. Therefore, management of urban flooding has to be accorded top priority.
- **Urban Planning:** Increasing trend of urban flooding is a universal phenomenon and poses a great challenge to urban planners the world over. Problems associated with urban floods range from relatively localized incidents to major incidents, resulting in cities being inundated from hours to several days.

SOUTH ASIAN FLASH FLOOD GUIDANCE SYSTEM

The India Meteorological Department (IMD) has launched the South Asian Flash Flood Guidance System (FFGS), which is aimed at helping disaster management teams and governments make timely evacuation plans ahead of the actual event of flooding.

- In the South Asia region, flash floods account for a significant portion of the lives lost and property damages that result from flooding. Given that flash floods can occur at any time or place with disastrous results, there is an urgent need to prioritize efforts that aim to improve early warnings capabilities. Improvements help society to cope with flash flood threats by enabling the mandated national authorities to undertake appropriate measures, thereby contributing to protecting the population at risk from the disastrous effects of flash floods.
- The South Asia Flash Flood Guidance (SAsiaFFG) System Initial Planning Meeting was held in Kathmandu in 2012. Representatives of six South Asian countries, namely Bangladesh, Bhutan, India, Pakistan, Sri Lanka, and Nepal were represented in the workshop. Participants expressed their interests to participate in SAsiaFFG project, indicating that flash floods cause considerable human losses and property damages.
- SAsiaFFG System was developed by the Hydrologic Research Center (HRC) and ran one and half years at its premises in San Diego, USA. The servers were shut down after one and half year of operation because of lack of regional collaboration and cooperation to make progress in the regional implementation of the system.

CSCAF

*Recently, Ministry of Housing and Urban Affairs (MoHUA) launched the **Climate Smart Cities Assessment Framework (CSCAF) 2.0**, along with the 'Streets for People Challenge' in a virtual event organized by the Smart Cities Mission.*

- The objective of CSCAF is to provide a clear roadmap for cities towards combating Climate Change while planning and implementing their actions, including investments.
- In the last decade, an increase in frequency of cyclones, floods, heat waves, water scarcity and drought-like conditions have had adverse impacts on many of our cities. Such extreme events and risks cause loss of life as well as impact on the economic growth. In this context, CSCAF initiative intends to inculcate a climate-sensitive approach to urban planning and development in India.

INDIA'S EFFORTS FOR COMBATING CLIMATE CHANGE

As a Party to the UNFCCC, India submitted its Second Biennial Update Report (BUR) to the UNFCCC towards fulfilment of the reporting obligation under the Convention. As per the BUR, the emission intensity of India's GDP has reduced by 21 per cent over the period of 2005-2014 which is the result of India's proactive and sustained actions on climate change. The actions are:

- **National Action Plan on Climate Change (NAPCC):** Launched in 2008, India's National Action Plan on Climate Change (NAPCC) identifies a number of measures that simultaneously advance the country's development and climate change related objectives of adaptation and mitigation through focused National Missions.
- **National Mission for Enhanced Energy Efficiency (NMEEE)**: Under it, The Perform, Achieve and Trade (PAT) scheme was designed on the concept of reduction in Specific Energy Consumption.
- **National Solar Mission:** It aims to increase the share of solar energy in the total energy mix. Under the total target of 100 GW, 32.5 GW of solar electric generation capacity has been installed.
- **National Water Mission:** It focuses on monitoring of ground water, aquifer mapping, capacity building, water quality monitoring and other baseline studies. It seeks to increase water use efficiency by 20%.
- **National Mission for a Green India**: It seeks to increase tree and forest cover by 5 million hectares. It also seeks to increase the quality of existing forests by additional 5 million hectares.
- **National Mission on Sustainable Habitat:** It is being implemented through three programmes: Atal Mission on Rejuvenation and Urban Transformation, Swachh Bharat Mission, and Smart Cities Mission. Energy Conservation Building Rules 2018 for commercial buildings has been made mandatory.
- **National Mission for Sustainable Agriculture**: It aims at enhancing food security and protection of resources. Key targets include covering 3.5 lakh hectare of area under organic farming, 3.70 under precision irrigation, 4.0 lakh hectare under System of Rice Intensification, 3.41 lakh hectare under diversification to less water consuming crop, 3.09 lakh hectare additional area under plantation in arable land and 7 bypass protein feed making. The mission has resulted in the formation of National Innovations on Climate Resilient Agriculture, a network project.
- **National Mission for Sustaining the Himalayan Ecosystem**: It aims to evolve suitable management and policy measures for sustaining and safeguarding the Himalayan Ecosystem.
- **National Mission on Strategic Knowledge for Climate Change:** It seeks to build a knowledge system that would inform and support national action for ecologically sustainable development. Key achievements include setting up of 11 Centres of Excellence and 10 State Climate Change Centres.

ESSO-INCOIS

Indian National Center for Ocean Information Services (INCOIS) is an autonomous organization of the Government of India, under the Ministry of Earth Sciences, located Hyderabad. ESSO-INCOIS was established as an autonomous body in 2007 under the Ministry of Earth Sciences (MoES) and is a unit of the Earth System Science Organization (ESSO).

- It **provides** ocean data, information and advisory services to society, industry, the government and the scientific community through sustained ocean observations and constant improvements through systematic and focused research in information management and ocean modelling.

- Provides **round-the-clock monitoring and warning services** for the coastal population on tsunamis, storm surges, high waves, etc. through the in-house Indian Tsunami Early Warning Centre (ITEWC). The Intergovernmental Oceanographic Commission (IOC) of UNESCO designated ITEWC as a Regional Tsunami Service Provider (RTSP) to provide tsunami warnings to countries on the Indian Ocean Rim.
- Provides **daily advisories** to fisher folk to help them easily locate areas of abundant fish in the ocean while saving on both fuel and time used to search for the same. These advisories called **Potential Fishing Zone Advisories** are issued in Hindi, English and 8 vernacular languages. Currently more than one lakh fisher folk successfully use these advisories obtained through SMS, Village Information Centres, local radio, local TV, Electronic Display Boards at fish landing centres, NGO websites, the ESSO-INCOIS website etc.
- **Short term (3-7 days) Ocean State Forecasts** (waves, currents, sea surface temperature, etc.) are issued daily to fisher folk, the shipping industry, the oil and natural gas industry, the Navy, the Coast Guard, etc. These forecasts inform users about the expected sea conditions during the next few days and help them to plan their activities at sea.
- **Deploys and maintains a suite of Ocean Observing Systems** in the Indian Ocean to collect data on various oceanic parameters to understand the processes in the ocean and to predict their changes.
- **Conducts systematic quality checks and archives** all observational, satellite and other oceanic data at the ESSO-INCOIS Data Centre and then makes such data available to students, researchers and any other users. ESSO-INCOIS has been designated as the 'National Oceanographic Data Centre' by IOC/IODE of UNESCO and is also identified as the 'Regional Argo Data Centre for the Indian Ocean'.
- **Generates Global Ocean Analysis data** using mathematical models and observations on a daily basis to provide the initial conditions to ocean-atmosphere coupled models used for the prediction of the monsoon and to understand oceanic processes.
- Carries out **Research and Modeling** to optimize the performance of mathematical models used for ocean state forecasts, prediction of tsunami waves, storm surges, etc. along the coast.
- ESSO-INCOIS has a prominent international presence, being a permanent member of the Indian delegation to IOC of UNESCO and a founding member of the **Indian Ocean Global Ocean Observing System (IOGOOS**) and the **Partnership for Observing the Oceans (POGO)** which is actively engaged in capacity building and international exchange of students and researchers.
- ESSO-INCOIS houses the IOGOOS secretariat and the Sustained Indian Ocean Biogeochemistry and Ecosystem Research (SIBER) International Programme Office. Through the **Regional Integrated Multi-Hazard Early Warning System for Africa and Asia (RIMES)**, ESSO-INCOIS provides ocean information and forecasts to member countries. ESSO-INCOIS is also a member of the Global Ocean Data Assimilation Experiment (GODAE) Ocean View Science Team (GOVST) and Patron's Group.

PROJECTS AND SCHEMES

JAL JEEVAN MISSION

- Government of India has restructured and subsumed the ongoing **National Rural Drinking Water Programme(NRDWP) into Jal Jeevan Mission (JJM)** to provide Functional Household Tap Connection (FHTC) to every rural household i.e., **Har Ghar Nal Se Jal (HGNSJ) by 2024**.

Mission- Jal Jeevan Mission is to assist, empower and facilitate:

- States/ UTs in planning of participatory rural water supply strategy for ensuring potable drinking water security on long-term basis to every rural household and public institution, viz. GP building, School, Anganwadi centre, Health centre, wellness centres, etc.
- States/ UTs for creation of water supply infrastructure so that every rural household has Functional Tap Connection (FHTC) by 2024 and water in adequate quantity of prescribed quality is made available on regular basis.
- States/ UTs to plan for their drinking water security

- GPs/ rural communities to plan, implement, manage, own, operate and maintain their own in-village water supply systems
- States/ UTs to develop robust institutions having focus on service delivery and financial sustainability of the sector by promoting utility approach
- Capacity building of the stakeholders and create awareness in community on significance of water for improvement in quality of life
- In making provision and mobilization of financial assistance to States/ UTs for implementation of the mission.

Objectives: The broad objectives of the Mission are:

- To provide FHTC to every rural household.
- To prioritize provision of FHTCs in quality affected areas, villages in drought prone and desert areas, Sansad Adarsh Gram Yojana (SAGY) villages, etc.
- To provide functional tap connection to Schools, Anganwadi centres, GP buildings, Health centres, wellness centres and community buildings
- To monitor functionality of tap connections.
- To promote and ensure voluntary ownership among local community by way of contribution in cash, kind and/ or labour and voluntary labour (shramdaan)
- To assist in ensuring sustainability of water supply system, i.e. water source, water supply infrastructure, and funds for regular maintenance.
- To empower and develop human resource in the sector such that the demands of construction, plumbing, electrical, water quality management, water treatment, catchment protection, O&M, etc. are taken care of in short and long term
- To bring awareness on various aspects and significance of safe drinking water and involvement of stakeholders in manner that make water everyone's business.

Components Under JJM: The following components are supported under JJM:

- Development of in-village piped water supply infrastructure to provide tap water connection to every rural household
- Development of reliable drinking water sources and/ or augmentation of existing sources to provide long-term sustainability of water supply system
- Wherever necessary, bulk water transfer, treatment plants and distribution network to cater to every rural household
- Technological interventions for removal of contaminants where water quality is an issue
- Retrofitting of completed and ongoing schemes to provide FHTCs at minimum service level of 55 lpcd;
- Greywater management
- Support activities, i.e. IEC, HRD, training, development of utilities, water quality laboratories, water quality testing & surveillance, R&D, knowledge centre, capacity building of communities, etc.
- Any other unforeseen challenges/ issues emerging due to natural disasters/ calamities which affect the goal of FHTC to every household by 2024, as per guidelines of Ministry of Finance on Flexi Funds
- Efforts should be made to source funds from different sources/ programmes and convergence is the key.

CHAR DHAM PROJECT

- The Char-Dham Road Project is a prestigious two-lane expressway scheme being executed in the Himalayan state, Uttarakhand. The project proposes widening of roads up to 10 meters to improve the accessibility to **Char-Dham (shrines); Yamunotri, Gangotri, Badrinath and Kedarnath**.
- A significant portion of the project area falls under the **dry deciduous biome** along the dry slopes of the rivers. Ruthless harvesting or uprooting of vegetation in the widening of roads can prove to be perilous for the biodiversity and regional ecology.

- The existence of river slopes depends on the vegetal cover. These slopes become fragile for flash floods and landslides in the absence of vegetal cover. River-slope vegetation contributes to slope stability by increasing the resisting force in the form of root-cohesion; reduces the pore water pressure; reduces the weight of the soil mass by absorbing the moisture; reduces surface run-off; and intercepts rainfall.
- Besides, river slopes act as conduits for species migration from low areas to mountains.

Biodiversity within project corridor

- Prominent vegetation along river slopes of the project includes *Chir Pine (Pinus roxburghii); Malu (Bauhinia vahlii); Semal (Bombax ceiba); Khair (Acacia catechu); Bel (Aegle marmelos); Dhaula (Woodfordia fruticosa); Bansa (Adhatoda vasica) along with high-value medicinal herbs like Kalihari (Gloriosa superba) and Makoy (Solanum nigrum).*
- Grasses such as *Apluda mutica, Heteropogon contortus, Thysolaena sp., and Eriophorum comosum* can also be found.
- *Leopard (Panthera pardus), Sambhar (Rusa unicolor), Kakad (Muntiacus muntjak), Goral (Naemorhedus goral), Siyar (Canis aureus), Sehi (Hystrix indica), Khargosh (Lepus nigricollis), Udbilav (Lutra lutra & Aonyx cinerea) and many species of bats are common mammals* of this biome.
- Birds like *Kalij Pheasant (Lophura leucomelanos, Schedule-I), Tragopans (Tragopan melanocephalus & Tragopan satyra, Schedule-I), and various species of Vultures (Schedule-I) along with endangered fish Golden Mahseer (Tor putitora)* are among the wonderful species found there.

Adverse impacts

- Forest loss is among the major impacts of project — about 508.66 hectares of forest area would be diverted into the non-forestry purpose and 33,000-43,000 trees would be cut down to build roads.
- Uttarakhand has 24,295 square kilometres (2,429,500 hectares) forest area with a trivial increase of 23 hectares (@ 11.5 ha / year) between 2015 and 2017. If we maintain the current rate of forest cover increase, it would take 40-45 years to recover this loss.
- The loss of forest will reduce the probability of maintaining effective reproductive units of plant and animal populations in the project zone.
- Removal of roadside trees will lead to patch isolation, reduced canopy cover and decreased number of successful dispersers that can be devastating in community establishment and ecosystem functioning.
- The road edge effect is a common ecological phenomenon that wraps wide areas and creates ecological pressures on nearby plant and animal communities.
- Possibilities of landslides

INDUS WATER TREATY

- Indus Waters Treaty was signed on September 19, 1960, between India and Pakistan and brokered by the World Bank. The treaty fixed and delimited the rights and obligations of both countries concerning the use of the waters of the Indus River system**.**
- The Indus River rises in the **southwestern Tibet Autonomous Region** of China and flows through the Kashmir region and then into Pakistan to drain into the Arabian Sea. It is joined by numerous tributaries, notably those of the eastern Punjab Plain—the Jhelum, Chenab, Ravi, Beas, and Sutlej rivers. The Indus River system has been used for irrigation since time immemorial.
- Modern irrigation engineering work began about 1850. During the period of British rule in India, large canal systems were constructed, and old canal systems and inundation channels were revived and modernized. However, in 1947 British India was partitioned, resulting in the creation of an independent India and West Pakistan (later called Pakistan). The water system was thus bifurcated, with the headworks in India and the canals running through Pakistan.

- The Inter-Dominion Accord of May 4, 1948, required India to provide water to the Pakistani parts of the basin in return for annual payments. This too was intended as a stopgap measure, with further talks to take place in hopes of reaching a permanent solution.
- Negotiations soon came to a standstill, however, with neither side willing to compromise. In 1951 David Lilienthal, former head of both the Tennessee Valley Authority and the U.S. Atomic Energy Commission, visited the region for the purpose of researching articles that he was to write for Collier's magazine. He suggested that India and Pakistan should work toward an agreement to jointly develop and administer the Indus River system, possibly with advice and financing from the World Bank.
- Eugene Black, who was then the president of the World Bank, agreed. At his suggestion, engineers from each country formed a working group, with engineers from the World Bank offering advice. Political considerations, however, prevented even these technical discussions from arriving at an agreement. In 1954 the World Bank submitted a proposal for a solution to the impasse. After six years of talks, Indian Prime Minister Jawaharlal Nehru and Pakistani President Mohammad Ayub Khan signed the **Indus Waters Treaty in September 1960.**
- The treaty gave the waters of the **western rivers—the Indus, Jhelum, and Chenab—to Pakistan** and those of the **eastern rivers—the Ravi, Beas, and Sutlej—to India**. It also provided for the funding and building of dams, link canals, barrages, and tube wells—notably the Tarbela Dam on the Indus River and the Mangla Dam on the Jhelum River. These helped provide water to Pakistan in the amounts that it had previously received from the rivers now assigned to India's exclusive use. Much of the financing was contributed by member countries of the World Bank. The treaty required the creation of a **Permanent Indus Commission**, with a commissioner from each country, in order to maintain a channel for communication and to try to resolve questions about implementation of the treaty. In addition, a mechanism for resolving disputes was provided.
- Numerous disputes were peacefully settled over the years through the Permanent Indus Commission. In a significant challenge to the treaty, in 2017 India completed the building of the Kishanganga dam in Kashmir and continued work on the Ratle hydroelectric power station on the Chenab River despite Pakistan's objections and amid ongoing negotiations with the World Bank over whether the designs of those projects violated the terms of the treaty.

KEN BETWA LINK PROJECT

- The Ken-Betwa Link Project is the **first project under the National Perspective Plan for interlinking of rivers.** Under this project, water from the **Ken river will be transferred to the Betwa river**. Both these rivers are **tributaries of river Yamuna.**
- The Ken-Betwa Link Project has two phases. Under **Phase-I,** one of the components — **Daudhan dam** complex and its appurtenances like Low Level Tunnel, High Level Tunnel, Ken-Betwa link canal and Power houses — will be completed. While in the **Phase-II**, three components — Lower Orr dam, Bina complex project and Kotha barrage — will be constructed.
- According to the Union Jal Shakti Ministry, the project is expected to provide annual irrigation of 10.62 lakh hectares, drinking water supply to about 62 lakh people and also generate 103 MW of hydropower.
- According to the **Comprehensive Detailed Project Report**, the cost of Ken-Betwa Link Project is estimated at Rs 35,111.24 crore at 2017-18 prices.

Which region will get the benefits of the KBLP?

- The Ken-Betwa Link Project lies in **Bundelkhand,** a drought-prone region, which spreads across 13 districts of Uttar Pradesh and Madhya Pradesh.
- According to the Jal Shakti Ministry, the project will be of immense benefit to the water-starved region of Bundelkhand, especially in the districts of Panna, Tikamgarh, Chhatarpur, Sagar, Damoh, Datia, Vidisha, Shivpuri and Raisen of Madhya Pradesh and Banda, Mahoba, Jhansi and Lalitpur of Uttar Pradesh.
- It will pave the way for more interlinking of river projects to ensure that scarcity of water does not become an inhibitor for development in the country.

Will the project affect the Panna tiger reserve?

- According to a written reply given by Minister of State for Jal Shakti Rattan Lal Kataria, out of the 6,017 ha of forest area coming under submergence of Daudhan dam of Ken Betwa Link Project, 4,206 ha of area lies within the core tiger habitat of Panna Tiger Reserve.

Are there previous examples of river-linking in India?

- In the past, several river linking projects have been taken up. For instance, under the Periyar Project, transfer of water from Periyar basin to Vaigai basin was envisaged.
- It was commissioned in 1895. Similarly, other projects such as Parambikulam Aliyar, Kurnool Cudappah Canal, Telugu Ganga Project, and Ravi-Beas-Sutlej were undertaken.

Recent developments on interlinking of rivers in India

- In the **1970s,** the idea of transferring surplus water from a river to water-deficit area was mooted by the then Union Irrigation Minister (earlier the Jal Shakti Ministry was known as Ministry of Irrigation) Dr K L Rao.
- Dr. Rao, who himself was an engineer, suggested construction of a National Water Grid for transferring water from water-rich areas to water-deficit areas. Similarly, Captain Dinshaw J Dastur proposed the Garland Canal to redistribute water from one area to another.
- However, the government did not pursue these two ideas further. It was in August, **1980 that the Ministry of Irrigation prepared a National Perspective Plan (NNP)** for water resources development envisaging inter basin water transfer in the country.
- The NPP comprised two components: **(i) Himalayan Rivers Development**; and **(ii) Peninsular Rivers Development**. Based on the NPP, the National Water Development Agency (NWDA) identified 30 river links—16 under Peninsular component and 14 under Himalayan Component. Later, the river linking idea was revived under the then Atal Bihari Vajpayee Government. **Ken Betwa Link Project is one of the 16 river linking projects under the Peninsular component.**

Which are the clearances required for a river-linking project?

- Generally, **4-5 types of clearances** are required for the interlinking of river projects. These are: Techno-economic (given by the Central Water Commission); Forest Clearance and Environmental clearance (Ministry of Environment & Forests); Resettlement and Rehabilitation (R&R) Plan of Tribal Population (Ministry of Tribal Affairs) and Wildlife clearance (Central Empowered Committee).

KALESHWARAM LIFT IRRIGATION PROJECT

- The Kaleshwaram Lift Irrigation System is considered to be one of the world's largest multi-purpose projects.
- It is designed to provide water for irrigation and drinking purposes to about 45 lakh acres in 20 of the 31 districts in Telangana, apart from Hyderabad and Secunderabad.
- The cost of the project is Rs 80,000 crore, but is expected to rise to Rs 1 lakh crore by the time it is completely constructed by the end of 2020.

Features

- This project is unique because Telangana will harness water at the confluence of two rivers, **Godavari** and **Pranhita**, by constructing a barrage at Medigadda in Jayashankar Bhupalpally district and reverse pump the water into the main Godavari River and divert it through lifts and pumps into a huge and complex system of reservoirs, water tunnels, pipelines and canals.
- The project has set many records with the world's longest water tunnels, aqueducts, underground surge pools, and biggest pumps. By the time the water reaches Kondapochamma Sagar, the last reservoir in the system, about 227 kms away in Gajwel district, the Godavari water would have been lifted to a height of 618 metres from its source at Medigadda.

- The total length of the entire Kaleshwaram project is approximately 1,832 km of which 1,531 km is gravity canals and 203 km comprise water tunnels. There are 20 water lifts and 19 pump houses in the project.
- The massive project is divided into seven links and 28 packages and involved digging of 20 reservoirs in 13 districts with a total capacity to store 145 TMC. The reservoirs are interconnected through a network of tunnels running about 330 km, the longest being 21 km long connecting **Yellampalli reservoir** with **Medaram reservoir** in Peddapalli district.
- While the intricate canal network covers approximately 1,832 km, the farthest point is Narketpally in Nalgonda district which is 500 km away from the source. Except for a few stretches involving pipelines and canals, much of the project is complete.

Importance

- Kaleshwaram will transform Telangana into an agricultural powerhouse. The project will enable farmers in Telangana to reap multiple crops with a year-round supply of water wherein earlier they were dependent on rains resulting in frequent crop failures. This year, Telangana farmers have already delivered bumper rabi crops of paddy and maize due to better irrigation facilities and an extended monsoon.
- KLIS covers several districts which used to face rainfall deficit and the groundwater is fluoride-contaminated. Apart from providing water for irrigation to 45 lakh acres, a main component of the project is supply of drinking water to several towns and villages and also to twin cities of Hyderabad and Secunderabad.
- Mission Bhagiratha, the Rs 43,000-crore project to supply drinking water to every household in villages, draws a large quantity of water from the KLIS and some quantity from projects on River Krishna. There is a burgeoning fresh water fishing industry in the state as the numerous water bodies created under the project are also being used to grow fish and locals are given rights to fish and sell.

BHADHUT PROJECT

Bhadbhut project in Bharuch is meant to solve freshwater problems in this region of Gujarat.

- It is planned to be a 1.7-km causeway-cum-weir barrage, across the River Narmada, 5 km from Bhadbhut village, and 25 km from the mouth of the river, where it flows into the Gulf of Khambhat.
- The barrage will stop most of the excess water flowing out of the Sardar Sarovar Dam from reaching the sea and thus create a “sweet water lake” of 600 mcm (million cubic metres) on the river.
- The barrage will also have a six-lane road that will connect the left and right banks of the river and provide shorten the land distance between two large industrial estates in Surat and Bharuch.
- The project also aims to prevent flooding in years when rainfall is higher than normal. Embankments 22 km long will be made and will extend upstream towards Bharuch, from either side of the river.

Need for this project

- The main purpose of the project is to prevent salinity ingress.
- For example
  - At the beginning of the 21st century, an estimated 16.30 million acre feet (MAF) of water used to be released from the dam.
  - By 2017, when the height of the dam rose, flow into the river reduced to 4.7 MAF. Due to the reduced flow of fresh water, saline seawater gushes into the Narmada estuary during high tide, thus increasing salinity along the banks.
- The sweet water from the reservoir will aim to meet the residential and industrial water requirements of Bharuch, Ankleshwar and Dahej.
- The project is part of the larger **Kalpasar Project**, which entails construction of a 30-km dam across the Gulf of Khambhat between Bharuch and Bhavnagar districts. The reservoir is meant to tap the waters of the Narmada, Mahisagar and Sabarmati.

- Part of **Aliya Bet**, an island in the delta of the Narmada and known for shrimp farming, is likely to get submerged. A portion of the forest in Aliya Bet too will get affected by the project. Most of the Aliya Bet is downstream from the barrage.

ASAFOETIDA PROJECT

The scientists at CSIR-Institute of Himalayan Bioresource, Palampur (IHBT) are growing heeng in the Indian Himalayas. The first sapling has been planted in Himachal Pradesh's ***Kwaring village in Lahaul valley****.*

- Heeng is one of the top condiments and is a high-value spice crop in India.
- Ferula asafoetida is a herbaceous plant of the umbelliferae family.
  - It is a perennial plant whose oleo gum resin is extracted from its thick roots and rhizome. The plant stores most of its nutrients inside its deep fleshy roots.

Ideal Conditions for plant:

- The plant prefers cold and dry conditions for its growth and takes approximately five years for the production of oleo-gum resin in its roots.
- The plant can withstand a maximum temperature between 35 and 40 degree, whereas during winters, it can survive in temperatures up to minus 4 degree. During extreme weather, the plant can get dormant.
- Regions with *sandy soil, very little moisture and annual rainfall of not more than 200mm* are considered conducive for heeng cultivation in India
- Therefore cold desert areas of Indian Himalayan region are suitable for the cultivation of asafoetida.

Benefits:

- It has a range of medicinal properties of heeng, including relief for digestive, spasmodic and stomach disorders, asthma and bronchitis.
- The herb is commonly used to help with painful or excessive bleeding during menstruation and premature labour.
- Being anti-flatulent, the herb is fed to new mothers.

- Asafoetida is endemic to Iran and Afghanistan, the main global suppliers. India imports about 1200 tonnes of raw asafoetida annually from Afghanistan, Iran and Uzbekistan and spends approximately 100 million USD per year.
- Lack of planting material of Ferula asafoetida plants in India was a major bottleneck in the cultivation of this crop.