VISIONIAS
INSPIRING INNOVATION

MAINS 365

Environment

Classroom Study Material 2020
(September 2019 to September 2020)

ENVIRONMENT

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1. CLIMATE CHANGE

- Climate change refers to **significant changes in global temperature, precipitation, wind patterns and other measures of climate** that occur over several decades or longer. While "climate change" and "global warming" are often used interchangeably, global warming—the recent rise in the global average temperature near the earth's surface—is just one aspect of climate change.
- **Various factors are responsible** for it including-
  - **Natural Factors:** such as continental drift, volcanoes, ocean currents, the earth's tilt, and comets and meteorites. The natural factors affect the climate change in long term and persist for thousand to millions of years.
  - **Anthropogenic (Human Caused) Factors:** includes greenhouse gases, aerosols and pattern of land use changes etc.
- In 2013 the **IPCC in its Fifth Assessment Report** has identified that climate change is real and human activities are the main cause. It highlighted that from 1880 to 2012, the average global temperature increased by 0.85°C.
- In 2018, the **IPCC issued a special report on the impacts of global warming of 1.5°C,** finding that limiting global warming to 1.5°C would require rapid, far-reaching and unprecedented changes in all aspects of society.
- According to the IPCC, the **extent of climate change effects on individual regions will vary** over time and with the ability of different societal and environmental systems to mitigate or adapt to change.
- It predicts that increases in global mean temperature of less than 1.8 to 5.4 degrees Fahrenheit (1 to 3 degrees Celsius) above 1990 levels will produce beneficial impacts in some regions and harmful ones in others. Net annual costs will increase over time as global temperatures increase.

1.1. IMPACTS OF CLIMATE CHANGE

1.1.1. ON INDIAN REGION

As per Global Climate Risk Index (released by Germanwatch), India's rank has worsened from 14th spot in 2017 to 5th most vulnerable country to climate change in 2018.

- India's high rank is due to severe rainfalls, followed by heavy flooding and landslides.
- India has also recorded the **highest number of fatalities** due to climate change and the **second highest monetary losses** from its impact in 2018.

Ministry of Earth Sciences' (MoES) recently released a report titled '**Assessment of Climate Change over the Indian Region'**. The report **highlights the observed and projected changes** in various climatic dimensions over the Indian region, their impacts and various policy actions to deal with the regional climate change.

Following are the observed and projected changes in various climatic dimensions over the Indian region:

Dimension	Observations and Projections
Rise in Temperature	- Average temperature has **risen by around 0.7°C during 1901–2018**. **Causes:** The surface air temperature changes over India are attributed **mostly by greenhouse gases** and partially offset by other anthropogenic forcing **including aerosols and land use land cover change.** **As compared to 1976-2005 period**, by the end of 21st century, it is projected that: **temperature may rise by approximately 4.4°C.** **frequency of summer heat waves over India may be 3 to 4 times higher**
Change in Rainfall pattern	**Summer monsoon rainfall** has **declined by 6%,** over India between 1951-2015 especially in the densely populated Indo-Gangetic plains and the Western Ghats. - The **frequency of localized heavy rain occurrences as well as dry spells has significantly increased**. **Causes:** Global-scale anthropogenic forcing such as GHGs as well as regional-scale forcing such as aerosols and land-use/ land-cover changes i.e. increasing urbanisation. **Projections:** Frequency of extreme precipitation events may increase; Lengthening of the monsoon season.

Droughts	• The **area affected by drought has also increased by 1.3% per decade** during 1951–2016. Areas over **central India, southwest coast, southern peninsula and north-eastern India have experienced more than 2 droughts per decade**, on average, during this period • **Causes:** Overall **decrease of seasonal summer monsoon rainfall** during the last 6–7 decades. • **Projections:** Increase in the frequency (>2 events per decade), intensity and area under drought conditions.
Floods	• Flooding events have **increased since 1950, in part due to enhanced occurrence of localized, short-duration intense rainfall events.** • **Projections: Higher rates of glacier and snowmelt** in a warming world would enhance stream flow and **compound flood risk over the Himalayan river basins.**
Sea-level rise in the North Indian Ocean	• It occurred at a rate of **1.06–1.75 mm per year during 1874–2004** and has **accelerated to 3.3 mm per year between 1993 and 2017**, which is comparable to the current rate of global mean sea-level rise. o **Also,** Sea surface temperature **(SST) of the tropical Indian Ocean has risen by 1°C on average** during 1951–2015, markedly higher than the global average SST warming of 0.7°C. • **Causes:** Continental ice melt and thermal expansion of ocean water in response to global warming • **Projection: Sea level in the NIO may rise by 300 mm** relative to the average over 1986–2005
Tropical Cyclonic Storms	• The **frequency of very severe cyclonic storms (VSCSs) during the post-monsoon season has increased** significantly (+1 event per decade) during the last two decades • **Causes:** The intensity of tropical cyclones (TC) is closely linked to ocean SST and heat content, with regional differences in their relationships. • Climate models **project a rise in the intensity of tropical cyclones** in the NIO basin during 21st century.
Himalayan Cryosphere	• The Hindukush Himalayas (HKH) (largest area of permanent ice cover outside the North and South Poles, also known as the 'Third Pole') experienced **a declining trend in snowfall and also retreat of glaciers in recent decades**. However, parts of the **high-elevation Karakoram Himalayas have, in contrast, experienced increased wintertime precipitation** in association with enhanced amplitude variations of synoptic western disturbances o Climate of the **HKH is characterised by tropical/subtropical climatic conditions from the foothill region of the mountains to permanent ice and snow-covered peaks at higher altitudes** • **Projection:** Significant decrease of snowfall in several regions of the HKH, high-elevation locations (> 4000 m) in the Karakoram Himalayas are projected to experience an increase in annual precipitation during the 21st century.

Implications of increasing regional climate change

- **Food Security:** Rising temperatures, heat extremes, floods, droughts and rainfall variability **can disrupt rainfed agricultural food production and adversely impact crop yield.**
  - For instance, as per a NITI Aayog document, of the total pulses, oilseeds and cotton produced in the country, **80% pulses, 73% oilseeds and 68% cotton come from rain-fed agriculture.**
- **Water Security:**
  - Droughts and floods **are detrimental to surface and groundwater recharge.**
  - Rising sea level leads to **intrusion of saltwater in the coastal aquifers** contaminating the groundwater. E.g. in Gujarat, Tamil Nadu, and Lakshadweep etc.
  - Declining trend in snowfall and retreat of glaciers in HKH region may **impact the water supply in the major rivers and streams** including the Indus, Ganges, and Brahmaputra.
- **Energy demand:** Rising temperatures are likely to **increase energy demand for space cooling**, further adding to the global warming by increasing GHG emissions.
- **Human Health:**
  - Higher temperatures, extreme weather events, and higher climate variability could **elevate risk of heat strokes, cardiovascular and neurological diseases, stress-related disorders and spread of vector-borne diseases** such as malaria and dengue fever.
  - Decrease in the availability or affordability of food and potable water may lead to **reduced nutritional intake, particularly among economically weaker sections.**
- **Biodiversity:** Species specially adapted to narrow environmental conditions are likely to be affected the most.

- o For example, the Indian Ocean is home to 30% of the world's coral reefs and 13% of global wild-catch fisheries. This marine ecosystem, including corals and phytoplankton, and fisheries are being impacted by a rise in heat waves in the ocean, known as **marine heat waves.**
- **Economy:**
  - o According to the International Labour Organization**,** the **loss in productivity** by 2030 **because of heat stress** could be the equivalent of India losing 34 million full-time jobs.
  - o According to Ministry of Environment Forest and Climate Change, **Desertification, land degradation and drought cost India about 2.5% of gross domestic product** in 2014-15.
  - o **Health-care costs and productivity losses from pollution are as much as 8.5% of GDP**, according to the World Bank.
  - o **Sea-level rise increases the vulnerability of some large cities** located at coastline.
- **Social issues**
  - o **Large scale migration** induced due to climatic disasters such as droughts, cyclones and floods.
  - o Repeated crop failures add to the burden of already distressed farmers who then resort to suicides.

Recommended policy suggestions by the report

- **Make vulnerability assessment central to long-term planning** for developing adaptation and mitigation strategies. Inclusion of detailed, regional-scale climate change risk assessments would help develop region and sector-specific mitigation and adaptation measures to reduce vulnerability to climate change.
- **Greater emphasis on widening observational networks**, sustained monitoring, expanding research on regional changes in climate and their impacts. For instance, networks of tide gauges with GPS along the Indian coastline would help monitor local changes in sea level.
- **Afforestation efforts:** It helps to mitigate climate change through carbon sequestration. It also enhance resilience to flash floods and landslides by improving soil retention, improve resilience to droughts by increasing percolation of surface water into the soil, improve resilience of coastal infrastructure and habitation by reducing coastline erosion due to storm surges and sea-level rise, reduce vulnerability to extreme heat by reducing ambient temperatures, and support native wildlife and biodiversity.
- **Equity and social justice** for building climate resilience since the most vulnerable people such as the poor, the disabled, outdoor labourers and farmers will bear the brunt of climate change impacts.

1.1.2. ON OCEANS

1.1.2.1. SEA LEVEL RISE

- Sea levels have risen by between **180 to 200 mm since 1900.**
- As per IPCC special report on the Ocean and Cryosphere in a Changing Climate (SROCC), if global temperatures are limited to well-below 2 degree Celsius in 2100, then the rate of SLR will still increase from around 4mm per year today to 4-9mm/year by 2100.
- The value of global assets exposed to this change is projected to be between **$6-$9 trillion or 12-20% of the global GDP.**

Causes of the sea-level rise

- **Thermal expansion:** When water heats up, it expands. About half of the sea-level rise over the past 25 years is attributable to warmer oceans simply occupying more space.
- **Melting glaciers:** Persistently higher temperatures caused by global warming have led to greater-than-average summer melting of mountain glaciers as well as diminished snowfall due to later winters and earlier springs.
  - o That creates an imbalance between runoff and ocean evaporation, causing sea levels to rise.
- **Loss of Greenland and Antarctica's ice sheets**: Melt water from above and seawater from below is seeping beneath Greenland's ice sheets, effectively lubricating ice streams and causing them to move more quickly into the sea.
  - o The vast ice sheets in **Greenland and Antarctica currently hold about 66 metres of potential global sea level rise.**
- **Changes in the net storage of terrestrial freshwater:** E.g., groundwater/river extraction, reservoirs, changes in rainfall and evaporation from climate variability.

- **Local factors:** Over relatively short time spans (hours to years), the influence of tides, storms, earthquakes and landslides and climatic variability—such as El Niño—dominates sea level variations at local level.

Impacts of Sea Level Rise

- **Coastal Flooding: 0.5-0.7% of the world's land area is at a risk of episodic coastal flooding by 2100**, impacting up to 4% of the population.
  o By 2100, the global population potentially exposed to episodic coastal flooding will increase **from 128-171 million to 176-287 million.**
- **Loss of habitat:** Almost 3 billion people are living with in 200 km of the coasts and islands all over the world. A sea level rise will lead to loss of habitation and hence leads to de-urbanization.
  o Indonesia is planning to shift its capital from **Jakarta, the "world's fastest-sinking city"** owing to sinking of land by 25 cm per year.
  o It may also significantly affect tourism and recreation through impacts on landscapes (e.g., beaches), cultural features etc.
- **Agriculture:** SLR will affect agriculture mainly through land submergence, soil and fresh groundwater resources salinisation, and land loss due to permanent coastal erosion, with consequences on production, **livelihood diversification and food security.**
- **Coastal fisheries and aquaculture:** The negative effects of SLR on fisheries and aquaculture are indirect, through adverse impacts on habitats (e.g., coral reef degradation, reduced water quality in deltas and estuarine environments, soil salinisation, etc.).
- **Impact on Small Island Nations:** Because of small islands' high coastline to land area ratio, most of their human settlements, agricultural lands, and critical infrastructure are at or near the coasts.
- **Storm Surges:** Higher sea levels are coinciding with more dangerous hurricanes and cyclones that move more slowly and drop more rain, contributing to more powerful storm surges.
- **Digital exclusion:** The prospect of higher coastal water levels threatens basic services such as Internet access, since much of the underlying communications infrastructure lies in the path of rising seas.
- **Maritime disputes:** With sea-level rise, the baselines from which most maritime zones (defined under **United Nation Convention on Law of Seas (UNCLOS)**) are measured will change. As a consequence, the outer boundary of the zone may also change, retreating landward, which may lead to maritime disputes.

Way forward

- **Integrated coastal management:** It will help in resource management following an integrative, holistic approach and an interactive planning process in addressing the complex management issues in the coastal area.
  o **Coastal Regulation Zone** notifications issued under **Environmental Protection Act, 1986** will help in this integrated management.
- **Community ownership:** Policy makers should engage stakeholders in the early stages of decision-making and throughout the entire decision-making process to enhance overall resilience in coastal areas, while supporting community ownership.
- **Barriers to urban areas:** Rotterdam has offered a model to other cities seeking to combat flooding and land loss. **Rotterdam has built barriers**, drainage, and innovative architectural features such as a "water square" with temporary ponds.
- **Enclosure dams:** To protect 25 million people, and important economic regions of 15 Northern European countries from rising seas as a result of climate change a **mammoth Northern European Enclosure Dam (NEED), enclosing all of the North Sea is being planned.**
- **Adaptation to Sea Level Rise:**
  o **Relocating utility infrastructure**, such as treatment plants and pump stations, to higher elevations would reduce risks from coastal flooding.
  o **Understanding and modeling groundwater conditions** will inform aquifer management and projected water quantity and quality changes.
  o **Coastal restoration plans** may protect water utility infrastructure from damaging storm surge by increasing protective habitat of coastal ecosystems such as **mangroves and wetlands.**
  o **The injection of fresh water into aquifers** can help to act as a barrier, while intrusion recharges groundwater resources.

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1.1.2.2. OCEAN AND MARINE LIFE

IPCC report has identified following observations and projections across all the oceans:

- **Marine heatwaves:** around the world have **doubled in frequency since 1982,** becoming longer-lasting, more intense and more extensive.
- **Changes in salinity, oxygen content and acidification** are already impacting the ocean life and, by extension, the millions of people who rely on them for food and income.
- **Surface warming** combined with a **surge in freshwater runoff** entering the top layer of the oceans is making the **oceans more stratified –** meaning the **top is less dense** than the deeper parts, and there is **less mixing** between the different levels.
  - o In general, **future increases in stratification will trap nutrients** in the ocean interior and reduce upper ocean nutrient levels.
- **Ocean Deoxygenation:** The areas known as **oxygen minimum zones,** where only specially adapted organisms can survive, are **projected to grow larger** in the future as the overall levels of oxygen in seawater drops.
  - o These chemical changes are posing a particular threat to some **Eastern Boundary Upwelling Systems,** highly productive areas of the ocean where nutrient rich waters are brought up from the depths. E.g. California Current and Humboldt Current.
- **Projections of "net primary productivity"** (the rate at which plants and algae produce organic materials by photosynthesis) declining by 4-11% under a high-emissions scenario. This may cause decline of around 15% in the total mass of marine animals by 2100 and up to a 25.5% drop in "maximum catch potential" of fisheries.
- **Coral reefs are particularly threatened:** Almost all coral reefs will degrade from their current state, even if global warming remains below 2 degree Celsius, and the remaining shallow coral reef communities will differ in species composition and diversity from present reefs.
  - o These declines in coral reef health will greatly diminish the services they provide to society, such as food provision, coastal protection and tourism.
- **Extreme events:** The proportion of the **most damaging Category 4 and 5 tropical cyclones "will increase" globally** and the rainfall associated with each storm will also rise, by at least 7% per degree of warming at the sea surface.
  - o The **strongest El Niño and La Niña events** since the pre-industrial have occurred during the last fifty years. Extreme El Niño events are projected to occur about twice as often in the 21st century compared to the 20th century.
  - o Arabian Sea has witnessed increased cyclonic activity as evident by the occurrence of **simultaneous cyclones (Cyclone Kyarr and Maha)** recently.

Socioeconomic implications of a changing ocean

- **Revenue from fisheries:** Gross revenues from the world's marine fisheries were around $150bn in 2010 USD, providing jobs for around 260 million people. As stocks are depleted and critical species are forced to migrate, there will be a need to adapt to a less reliable future.
- **Food Security: Seafood is an essential contributor to humanity's health,** as over 4.5bn people in the world obtain more than 15% of their protein intake from seafood. Many of the populations at risk from climate-related marine food insecurity, such as in the Pacific Islands and West Africa, reside in areas where land-based food production is also at risk.
- **Potential for conflicts** resulting from climate change, particularly as certain species move into waters controlled by different territories.
- **Risk to livelihood: Around 121 million people each year participate in ocean-based tourism,** spending $47bn in 2003 USD and **supporting one million jobs.** Extreme events and coral bleaching etc. are placing tourism at risk, particularly for nations in Caribbean islands that rely on it as main source of foreign revenue.
- **Health:** Warming waters are also expected to **expand the range of certain bacteria and harmful algal blooms,** with potentially severe consequences for human health. Cholera is highlighted as one disease likely to become more of a threat that have already been observed spreading to the poles.

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Way forward

- **Networks of protected areas** help maintain ecosystem services, including carbon uptake and storage, and enable future ecosystem-based adaptation options.
- **Terrestrial and marine habitat restoration, and ecosystem management tools** such as assisted species relocation and coral gardening, can be locally effective in enhancing ecosystem-based adaptation. Such actions are most successful when they are community-supported, are science-based whilst also using local knowledge and Indigenous knowledge.
- **Strengthening precautionary approaches**, such as rebuilding overexploited or depleted fisheries, and responsiveness of existing fisheries management strategies reduces negative climate change impacts on fisheries, with benefits for regional economies and livelihoods.
- **Restoration of vegetated coastal ecosystems**, such as mangroves, tidal marshes and seagrass meadows (coastal 'blue carbon' ecosystems), could provide climate change mitigation through increased carbon uptake.
- **Integrated water management approaches** across multiple scales can be effective at addressing impacts and leveraging opportunities from cryosphere changes in high mountain areas. These approaches also support water resource management through the development and optimization of multi-purpose storage and release of water from reservoirs, with consideration of potentially negative impacts to ecosystems and communities.
- **Prioritising measures to address social vulnerability and equity** underpins efforts to promote fair and just climate resilience and sustainable development, and can be helped by creating safe community settings for meaningful public participation, deliberation and conflict resolution.
- **Sustained long-term monitoring, sharing of data, information and knowledge and improved context-specific forecasts**, including early warning systems to predict more extreme El Niño/La Niña events, tropical cyclones, and marine heatwaves, help to manage negative impacts from ocean changes such as losses in fisheries, and adverse impacts on human health, food security, agriculture, coral reefs, aquaculture, wildfire, tourism, conservation, drought and flood.

1.1.3. ON CRYOSPHERE

The cryosphere refers to frozen components of the Earth system that are at or below the land and ocean surface. These include "snow, glaciers, ice sheets, ice shelves, icebergs, sea ice, lake ice, river ice, permafrost and seasonally frozen ground.

1.1.3.1. PERMAFROST

- **Permafrost is defined as** "ground (soil or rock containing ice and frozen organic material) that remains **at or below Zero degrees Celsius for at least two consecutive years".** The northern hemisphere has an area of permafrost thrice larger than Antarctica's.
- It occurs on land in polar and high-mountain areas, and also as submarine permafrost in shallow parts of the Arctic and Southern oceans. The thickness of permafrost ranges from less than one metre to more than a kilometre. Typically, it sits beneath an "active layer" that thaws and refreezes every year.
- There is **approximately twice as much carbon in permafrost than is currently in the Earth's atmosphere.** A **warming climate increases the emission of CO_2 and methane** as permafrost thaws, "thus accelerating the pace of climate change".
- By 2100, **near surface permafrost area will decrease** by 2-66% and 30-99% under various projections releasing up to as much as 240 GtC (gigatons) of permafrost carbon as CO_2 and methane to the atmosphere with the potential to accelerate climate change.
- The **stimulated plant growth in permafrost areas -** from warmer conditions and CO_2 fertilisation could help sequestering new carbon into plant biomass and increasing carbon inputs into the surface soil.

1.1.3.2. HIGH-MOUNTAIN REGIONS

- High-mountain regions are **home to around a tenth of the world's population**. Their glaciers, permafrost and snow are also the site of critical cryosphere changes.
- By the end of the century, glaciers are projected to lose around 33% of their mass compared to 2015 levels under a high-emissions scenario with the accompanying sea level rise resulting from these glacier to be 200mm.

- **Non-polar regions with relatively little ice cover**, such as Central Europe and North Asia, are projected to **lose on average more than 80**% of their current glacier mass by 2100.
- Due to a "pronounced imbalance" between current glacier mass and climate, **glaciers will continue to melt even with no further climate change**, thus asserting the IPCC AR5 findings.
- **Alpine Glacier Loss:** Since 1850, more than 500 Swiss glaciers have completely disappeared. In a recent study published, the researchers indicated that the **Alps' largest glacier,** the **mighty Aletsch,** could completely disappear over the next eight decades.

Impacts

- **River runoff:** Following a period of increased runoff due to more ice melting, a turning point known as **"peak water"** would occur after which runoff declines.
- **Mountain Slopes:** Retreating glaciers and thawing permafrost have already **destabilised** mountain slopes and there has been an increase in **"wet snow" avalanches** (water saturated snow).
- **Water Quality:** Glaciers hold a significant **store of toxic human-derived chemicals** including DDT, heavy metals and black carbon, all of which **could diminish drinking water quality** in surrounding areas as they are released from the ice.
- **Energy:** Hydropower, which contributes almost 100% of electricity generation in some mountainous nations, such as Albania and Peru, is also at risk **due to changes in runoff** from glaciers and snow cover.
- **Habitability:** Overall biodiversity has increased at higher elevations due to more habitable areas being opened up by snow and ice retreating. However, this comes at the expense of more specialist mountain-dwelling species, some of which are expected to decline in numbers.

1.1.3.3. POLAR REGIONS

Arctic Region

- **Arctic sea ice has seen a decline in extent, volume and age since 1979. Arctic sea ice melt season has extended** by 3 days per decade since 1979 due to earlier melt onset, and 7 days per decade due to later freeze-up.
- **Arctic sea ice is also generally younger.** Ice "at least five years old" declined from 30% to 2% between 1979 and 2018.
- **Arctic surface air temperatures** over the past two decades have **increased at more than double the global average.** This rapid phenomenon is known as **"Arctic amplification".** In part, it stems from the rapid loss of sea ice cover in the region resulting into **decreasing albedo.**
- **Greenland ice sheet** is currently losing mass **at around twice the rate** of its Antarctic counterpart. **Melting in Greenland** has increased up to five times greater than the level seen in preindustrial times becoming the **largest terrestrial contributor to global sea level rise** between 2005 and 2016.
- Recently, a **rare ozone hole** was also observed in the region.
  - While ozone holes developing over the Antarctic every year are common during Southern Hemisphere spring, the conditions needed for such strong ozone depletion are not normally found in the Northern Hemisphere. Arctic ozone hole is thus unusual in that we only have events like this **about once per decade.**
  - The Arctic stratosphere is usually **less isolated than its Antarctic counterpart** because the presence of nearby land masses and mountain ranges disturbs the weather patterns more than in the Southern Hemisphere.
  - This explains why the **polar vortex in the Northern Hemisphere is usually weaker** and **more perturbed** than in the Southern Hemisphere, and temperatures do not fall so low.
  - But, **polar vortex during winter was "incredibly strong and persistent"** this year.
  - This led to **frigid Arctic air** staying mostly locked in the Arctic and allowed lofty clouds to form in the stratosphere. These are called **Polar Stratospheric clouds (PSCs).**
  - These clouds create an ideal environment for the human-made chemical chlorofluorocarbons (CFCs) to react with sunlight, which then makes chlorine, the chemical that ultimately destroys ozone.
  - Moreover, this robust polar vortex **prevented ozone-rich air from other regions from washing into the Arctic,** which kept ozone levels depleted.

> The polar vortex is a **large area of low pressure and cold air** surrounding both of the Earth's poles. It always exists near the poles but **weakens in summer** and **strengthens in winter**.
> - The term "vortex" refers to the counter-clockwise flow of air that helps keep the colder air near the Poles.

Antarctica Region

- In contrast to the Arctic, the **Antarctic continent** has seen **less uniform air temperature changes** over the past 30-50 years, with warming over parts of West Antarctica and no significant overall change over East Antarctica. Multiple factors contribute to this **regional variability in Antarctic sea ice extent including the** "meridional winds", which flow north-to-south or vice versa.

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- **Human-caused warming at the surface in Antarctica is delayed by the Southern Ocean circulation,** which transports heat downwards into the deep ocean. This, and other factors, may explain the weak response of Antarctic sea ice cover to increased atmospheric greenhouse gas concentrations compared.
- Climate change has led to some **rare and unusual events** in and around the region the recent times:
- **Sudden Stratospheric Warming**
  - This rare warming phenomenon occurs when rapid warming begins high up in the stratosphere.
  - While the sudden stratospheric warming is **common and occurs every second year on average in the northern hemisphere** associated with cold weather, it is a **rarity in the southern hemisphere.**
  - It has **raised temperatures in the South Pole by more than 40 degrees** Celsius impacting climate in the nearby regions such as Australia.
  - Every winter, **westerly winds** – often up to 200 km/hr– develop in the stratosphere high above the South Pole and circle the polar region. These winds **develop as a result of the difference in temperature** over the pole (where there is no sunlight) and the Southern Ocean (where the sun still shines).
  - Later during the spring, waves of air from the lower atmosphere and associated **warming causes the stratospheric polar vortex and associated westerly winds to gradually weaken** over the period of a few months.
  - Very rarely, **if the waves are strong enough** they can rapidly break down the polar vortex, actually reversing the **direction of the winds** so they **become easterly.** This is **called "sudden stratospheric warming."**
  - Apart from warming the Antarctic region, the **most notable effect will be a shift of the Southern Ocean westerly winds towards the Equator** and thus impacting other regions as well.
- **First known Heat Wave**
  - East Antarctica has witnessed an ozone hole in spring since the late 1970s.
  - Ozone depletion and related lack of heating cool the stratosphere. This cooling increases the **north–south temperature gradient** between the southern mid-latitudes and the Antarctic, which strengthened the stratospheric westerly winds in the Southern Hemisphere.
    - ✓ It promotes a generally more **"positive" state of the Southern Annular Mode** in summer. This means the Southern Ocean's westerly wind belt has tended to stay close to Antarctica creating a **seasonal "shield",** reducing the transfer of warm air from the temperate regions to Antarctica.

> The **Southern Annular Mode** (SAM), also known as the Antarctic Oscillation (AAO), refers to the (non-seasonal) north-south movement of the strong westerly winds that blow almost continuously in the mid- to high-latitudes of the southern hemisphere.

  - But during the spring of 2019 a strong warming of the stratosphere over Antarctica significantly reduced the size of the ozone hole. This helped to support a more **"negative" state of the Southern Annular Mode** and weakened the shield.
  - **Other factors in late 2019 may have also helped** to warm Antarctica.
    - ✓ The **Indian Ocean Dipole** was in a strong "positive" state due to a late retreat of the Indian monsoon. This meant that water in the western Indian Ocean was warmer than normal.
    - ✓ Air rising from this and **other warm ocean patches in the Pacific Ocean** provided energy sources that altered the path of weather systems and helped to disturb and warm the stratosphere.

Impacts

- **Alteration in regional weather:** In recent times, **high temperatures** have been recorded **in the Siberian region,** causing a prolonged heatwave, which have been attributed to absence of sea ice among other factors.
- **Loss of habitat** for seals and polar bears increasing human animal encounters.
- **Rapid coastal erosion** when wind-driven waves combined with thawing permafrost
- **Impact on global climate:** In the Arctic, ocean circulation is driven by the sinking of dense, salty water. Fresh meltwater coming primarily from the Greenland Ice Sheet could interfere with ocean circulation at high latitudes, slowing it down. Any changes in ocean circulations can have unpredictable global impacts even in lower latitudes such as extreme weather events, droughts etc.
- **Positive feedback cycle (the ice-albedo feedback):** Sea ice has higher albedo than ocean water. Once sea ice begins to melt, a self-reinforcing cycle often begins whereby as more ice melts and exposes more dark water, the water absorbs more sunlight and the sun-warmed water then melts more ice.
- **Shipping activity will continue to rise** across the Arctic as **northern routes** become increasingly accessible. This will have **"significant socio-economic and political implications",** related to **safety** (marine accidents, local accidents, ice as a hazard), **security** (trafficking, terrorism), and **environmental and cultural sustainability** (invasive species, release of biocides, chemicals and other waste, marine mammal strikes, fuel spills, air and underwater noise pollution, impacts to subsistence hunting).

1.1.4. ON GENDER & SECURITY

Recently, a new report titled **Gender, Climate & Security: Sustaining Inclusive Peace on the Frontlines of Climate Change** was published by the UN Environment Programme (UNEP), UN Women, the UN Development Programme (UNDP), and the UN Department of Political and Peacebuilding Affairs (UNDPPA).

Key Highlights

Link between climate change and security

- **Outcomes of climate change threatening security and disrupting peace**: Rising temperatures, extended droughts, heavier rains and harsher storms are resulting in exacerbated loss of livelihoods, food insecurity, competition over scarce resources, migration and displacement and political and economic instability.
  - ○ **Example**- In some parts of the **Sahel region**, rapid reduction in the availability of fertile land and reliable water sources, have spurred **localized violent conflict** between different livelihood groups.
- **Violence affecting communities' capability to deal with climate change**: Violent conflict and political instability leave communities poorer, less resilient, and ill-equipped to cope with the effects of climate change.
  - ○ **For example**, due to the ongoing humanitarian crisis in the Lake Chad Basin, communities are less able to adapt to changing conditions in terms of the availability and distribution of key natural resources and increased frequency of natural hazards.

UN Department of Political and Peacebuilding Affairs (DPPA)

- The DPPA was **established in 2019** following the reform of the United Nations peace and security infrastructure, which brought together the former Department of Political Affairs (DPA) and the United Nations Peacebuilding Support Office.
- It plays a central role in United Nations efforts to prevent deadly conflict and build sustainable peace around the world.

Link between Gender and climate-related security risks

- **Climate-related security risks impact men and women differently:**
  - ○ Pre-existing inequalities, gender-related roles and expectations, and unequal access to resources **can deepen inequality** and leave some groups disproportionately vulnerable.
  - ○ May lead to **physical insecurities for men** who migrate away may to areas with higher levels of violence, or entering into unsafe working conditions.
- **Traditional and expanding responsibilities due to climate change can expose women to new security risks**: including sexual and gender-based violence, additional barriers to education and heightened burden of household responsibilities, such as collecting water or fuelwood in degraded environments.
  - ○ **For example**- In urban Pakistan, women have experienced domestic violence for failing to manage households with depleting water supplies due to climate change.
- **New opportunities for involving women in peacebuilding, conflict prevention and climate change adaptation**: Incorporating women's unique knowledge of natural resources – as providers of food, water, and energy – into climate change adaptation can strengthen the design and implementation of adaptation plans.

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o **For example**-In Sudan, women in some communities have become actively involved in facilitating dialogue over natural resource disputes.

Recommendations for Integrated Action

- **Integrate complementary policy agendas:** Policies to address climate-related security risks should systematically include gender dimensions.
  - **Some UN policy frameworks and global agendas** which present opportunities for integrated action are-
    - ✓ United Nations Framework Convention on Climate Change (UNFCCC)- Kyoto Protocol (1997), Paris agreement (2015), Lima Work Programme on Gender (2014)
    - ✓ 2030 Agenda For Sustainable Development
- **Scale up integrated programming** through cross-sectoral partnerships.
- **Increase targeted financing:** Dedicated investments in women's empowerment can be increased in sectors related to natural resources, including agriculture and rural development, energy access, and water and sanitation.
- **Expand the evidence base:** Deeper analysis of the gender dimensions of climate-related security risks is needed.

1.1.5. ON PEOPLE'S LIVES AND LIVING CONDITION (ENVIRONMENTAL MIGRATION)

- Recently, various studies have pointed out that disasters due to climate change have been displacing more people than conflicts. This phenomenon is being **referred to as Environmental Migration.**
- According to Global Report on Internal Displacement (GRID, 2019), in 2018, of the total **new 28 million internally displaced people** in 148 countries, **61% were due to disasters (such as** floods, windstorms, earthquakes or droughts) as compare to 39% due to conflict and violence. In **India,** climate change led to the displacement of 2.7 million Indians in 2019 (highest in the world).
- The United Nations High Commissioner for Refugees (**UNHCR**) predicts that in the next 50 years between **250 million and 1 billion** humans will leave their homes because of climate change.

How climate change affect the movement of people and their living conditions?

- **Higher risk of humanitarian emergencies** due to greater frequency and intensity of weather-related natural disasters – both sudden- and slow-onset result in increased population movements.
- **Rising sea levels** may make coastal areas and low-lying islands uninhabitable.
- **Competition over shrinking natural resources** may exacerbate tensions and potentially lead to conflict and, in turn, to displacement.

Environmental Migrants and Environmental Refugees
- According to **International Organization for Migration (IOM), Environmental migrants** are persons or groups of persons who, predominantly for reasons of **sudden or progressive change in the environment that adversely affects their lives or living conditions**, are obliged to leave their habitual homes, or choose to do so, either temporarily or permanently, and who move either within their country or abroad.
- **Environmental Refugee** is a specific term which covers only cross-border migrants **forced to do so** due to environmental factors. It has **not been defined till date. These people** not recognised as refugees under the **1951 Refugee Convention or its 1967 protocol**, and thus do not qualify for protection under national or international legal frameworks for refugee protection.
  - **UN Refugee Convention (1951)** grants certain rights to people fleeing persecution because of race, religion, nationality, affiliation to a particular social group, or political opinion.

Both the above terms are used interchangeably, however they are not the same. There are following **challenges associated** with defining a climate migrant or according climate refugee status:
- **Climate migration is mainly internal where** people moving are under the responsibility of their own state, they do not cross borders and are not seeking protection from a third country or at the international level.
- **Migration is not necessarily forced,** so countries need to think first migration management and agreements rather than refugee protection.
- **Isolating environment/climatic reasons is difficult**, from humanitarian, political, social, conflict or economic ones.
- **Creating a special refugee status** for climate change related reasons might **lead to the exclusion of categories of people who are in need of protection,** especially the poorest migrants.
- **Opening the 1951 Refugee Convention might weaken the refugee status** and **creating a new convention** to recognise the climate migrants and refugees might be **a lengthy political process.**

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- **Exacerbate pre-existing vulnerabilities**: When household income in rural areas decreases, livelihood stress linked to climate change could, in some places, result in lower levels of outmigration. As migration requires resources, those people wanting to move but could not due to lack of resources become **trapped populations**.

Way Forward

- **Climate migration discussions should not lose their focus on preventive measures:** The key objective is to invest in climate and environmental solutions so that people will not have to leave their homes in a forced way in the future. The **Paris Agreement offers anchorage for climate action** that considers human mobility to avert, minimize and address displacement in the context of climate change.
- **Full use of all already existing bodies of laws and instruments**, both hard and soft law in humanitarian, human rights and refugee law, and others. Many responses can come from migration management and policy as highlighted already in the 2011 International Dialogue on Migration and the recently adopted Global Compact for Safe, Orderly and Regular Migration.
- **Human rights-based approaches are key for addressing climate migration:** States of origin bear the primary responsibility for their citizens' protection even if indeed their countries have not been the main contributors to global warming; they should therefore apply human rights-based approaches for their citizens moving because of environmental or climatic drivers.
- **Regular migration pathways** can provide relevant protection for climate migrants and facilitate migration strategies in response to environmental factors. Many **migration management solutions** can provide a status for people who move in the context of climate change impacts, such as humanitarian visas, temporary protection, authorization to stay, regional and bilateral free movements' agreements, among several others.

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

1.2. CLIMATE CHANGE EFFORTS

1.2.1. GLOBAL EFFORTS

1.2.1.1. PARIS AGREEMENT & COP 25

The Paris Agreement was adopted under United Nations Framework Convention on Climate Change (UNFCCC) in 2015.

- The central aim of the agreement is **to strengthen the global response to the threat of climate change** by keeping the global temperature rise, in this century, well below 2 degrees Celsius above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius.
- **China who is the largest emitter, has recently stated in UN that its CO2 emissions will peak before 2030** and will achieve carbon neutrality before 2060.

- The **US has become the first nation in the world to formally withdraw from the Paris climate agreement.** This weakens the global fight against climate change as US is the second largest emitter (~15%).

COP 25@Madrid

Leaders dubbed the event as "blue COP", laying out its intention to focus on oceans. It was conceded that it is no longer a climate crisis but a climate emergency.

Delegates committed to limiting the global temperature rise to 1.5°C, to achieve carbon neutrality by 2050, and to reduce greenhouse gas emissions by 45% of 2010 levels by 2030.

The focus of COP was to resolve the outstanding issues in the Climate Package, including:

- Carbon markets dealt with in Article 6 of the Paris Agreement
- Loss and Damage under Paris Agreement and setting up of a fund to help poor countries reeling from climate crisis
- Enhancing Nationally Determined Contributions (NDCs) by all countries to curb emissions.

The COP adopted the **"Chile Madrid Time for Action"** document.

- **On Emission Reductions:** Rather than strong language setting out a clear timeline for nations to enhance their NDCs in 2020, it merely reiterated the invitation to parties to communicate.
- **On Loss and Damage:** The final decision that emerged was not as strong as developing nations had pushed for. Some stronger language was lost, such as a specific call for "developed countries" to increase their support.
- **On Climate Finance:** The Paris Agreement **reaffirmed the obligations of developed countries**, while for the first time also **encouraging voluntary contributions** by other Parties.
  - o Parties agreed that the GCF and GEF as well as the SCCF and the LDCF shall serve the Paris Agreement.
  - o Developed countries agreed to continue mobilizing $100 billion a year until 2025, and governments agreed to **set a new collective mobilization goal beyond 2025,** which would represent a **progression beyond the existing goal**.
- **On Carbon Market:** The conference closed without resolving one of the most significant objectives it set out to achieve – setting rules for carbon markets under Article 6 of the Paris Agreement. The decision was deferred till COP26 next year.
- **On Gender Action Plan:** Decision was made on a new **five-year gender action plan (GAP),** intended to "support the implementation of gender-related decisions and mandates in the UNFCCC process".

COP22@Marrakech: The main thrust of COP 22 was to develop rules for operationalizing the Paris agreement and advance work on Pre-2020 actions.

COP23@Bonn:

- **Talanoa Dialogue:** a facilitative dialogue in 2018, to take stock of the collective efforts of Parties in relation to progress towards the long-term goal referred to Paris Agreement and to inform the preparation of nationally determine contributions (NDCs) was launched.
- **Gender Action Plan:** The first ever Gender Action Plan to the UNFCCC was adopted at COP23.

About Loss and Damage (L&D):

- Under L&D, rich countries who have historical responsibility for climate change are asked to be liable to the developing countries who are already facing climate change impacts.
- The **Warsaw International Mechanism (WIM)** on Loss and Damage came into being **in 2013 (COP 19)**. It acknowledges that "loss and damage associated with the adverse effects of climate change includes, and in some cases involves more than that which can be reduced by adaptation".
- **In Paris Agreement 2015**, developed countries agreed to include loss and damage in the agreement, but only with an added clause that the specific article which relates to loss and damage "does not involve or provide a basis for any liability or compensation"

Issues and debates related to L&D:

- Negotiations on L&D under the UNFCCC are stuck between demands for climate justice, understood as compensation, for increases in extreme and slow-onset event risk, and the reluctance of developed countries to consider L&D different from adaptation.
- Whether insurance instruments, especially micro-insurance and regional pools, can serve as a risk-reducing and equitable compensatory response to L&D from climate extremes occurring in developing countries.
- The WIM has made little progress identifying new or additional finance to address L&D. Vulnerable nations will likely require the use of innovative financial tools beyond insurance.

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1.2.1.2. CARBON MARKETS

- Carbon markets are one of the tools to tackle the climate change problem. The argument behind carbon trading is that the best way to take climate action is to reduce emissions where it is least costly to do so.
- **Article 6 under Paris Agreement** contains **three separate mechanisms** for **"voluntary cooperation"** towards climate goals: **two based on markets** and a **third based on "non-market approaches".**

Carbon markets under the Paris Agreement (Article 6)

- **Market Mechanism 1 (Article 6.2)** – It sets up a carbon market which allows countries on voluntary direct bilateral cooperation basis to sell any extra emission reductions {called as Internationally Transferred Mitigation Outcomes (ITMO)} they have achieved compared to their Nationally Determined Contributions (NDCs) target.
- **Market Mechanism 2 (Article 6.4)** - A new international carbon market would be created for the trading of emissions reductions created anywhere in the world by the public or private sector. This new market referred to as the **"Sustainable Development Mechanism" (SDM)** seeks to replace the **CDM**.
- **The non-Market Approach**: to boost "mitigation, adaptation, finance, technology transfer and capacity-building", in situations where no trade is involved. This could involve similar activities without the added element of trading. E.g., a country could support a renewable energy scheme overseas via concessional loan finance, but there would be no trading of any emissions cuts generated.

Why is Article 6 important?

- The principle of **OMGE within SDM** has the potential to go beyond the "zero-sum game" established by the Kyoto markets and achieve 'global' mitigation.
  - o Currently, international carbon market mechanisms operate under the rules set by the Kyoto Protocol where no net reduction of global emissions occurs as a result of transfers between Parties.
- Trading could help reduce emissions by making it **easier** and **cheaper** for countries to meet their climate targets, in the process encouraging them to set increasingly ambitious goals.
  - ✓ According to a World Bank Report, some 96 country climate pledges - about half of all NDCs - refer to the use of carbon pricing initiatives.
  - ✓ According to IETA, trading could save $250bn every year by 2030. This could be invested into further emissions cuts to raise ambition.
- It also has a clause that a **"share of the proceeds" generated under SDM** shall be utilised to assist developing country parties that are particularly vulnerable to the adverse effects of climate change to meet the costs of adaptation. This could become **another route to channel climate finance** from richer nations to developing countries, **supplementing existing measures, such as the Green Climate Fund.**
- Article 6 could also provide a **means of incorporating climate commitments by businesses** into the wider UN process. Article 6 is the only part of the text that directly refers to private sector participation in the Paris process.

Conclusion

The carbon market system must evolve towards something better than offsetting. It should aim to accelerate the transition, rather than offering a cheap way out and replacing somebody's efforts with those of someone else. The world should move away from offsetting mechanisms and towards financing climate projects that truly drive the zero-carbon transition.

1.2.1.3. CARBON PRICING

Why in news?

A Report of the High-Level Commission on Carbon Pricing and Competitiveness by Carbon Pricing Leadership Coalition makes a strong case for carbon pricing.

What is Carbon Pricing?

Carbon pricing is an instrument that **captures the external costs of greenhouse gas (GHG) emissions -**

About Carbon Pricing Leadership Coalition (CPLC)
- It is a **voluntary initiative** of 34 national and sub-national governments, over 163 businesses from a range of sectors and regions, and over 82 strategic partners representing civil society organizations, NGOs, and academic institutions etc.
- From India, Delhi Metro Rail Corporation and Indian Railways are the government level partners.

the costs of emissions that the public pays for, such as damage to crops, health care costs from heat waves

and droughts, and loss of property from flooding and sea level rise - and ties them to their sources through a price, usually in the form of a price on the carbon dioxide (CO2) emitted.

Types of Carbon Pricing: There are 2 major types of carbon pricing

- **Emissions Trading Systems (ETS):** ETS - also referred to as a cap-and-trade system - caps the total level of GHG emissions and allows those industries with low emissions to sell their extra allowances to larger emitters.
- A **carbon tax** directly sets a price on carbon by defining a tax rate on GHG emissions or - more commonly - on the carbon content of fossil fuels. It is **different from an ETS** in that the emission reduction outcome of a carbon tax is not pre-defined but the carbon price is.

Other mechanisms to price the carbon emission

- **An offset mechanism** designates the GHG emission reductions from project- or program-based activities, which can be sold either domestically or in other countries. Offset programs issue carbon credits according to an accounting protocol and have their own registry. These credits can be used to meet compliance under an international agreement, domestic policies or corporate citizenship objectives related to GHG mitigation.
- **Results-Based Climate Finance (RBCF)** is a funding approach where payments are made after pre-defined outputs or outcomes related to managing climate change, such as emission reductions.
  o Many RBCF programs also simultaneously aim to reduce poverty, improve access to clean energy and offer health and community benefits.
- **Internal carbon pricing** is a tool an organization uses internally to guide its decision-making process in relation to climate change impacts, risks and opportunities.

Significance of Carbon Pricing

- A price on carbon helps **shift the burden** for the damage from GHG emissions back to those who are responsible for it and who can avoid it.
- Instead of dictating who should reduce emissions where and how, a carbon price **provides an economic signal to emitters,** and allows them to decide to either transform their activities and lower their emissions, or continue emitting and paying for their emissions. In this way, the overall environmental goal is achieved in the **most flexible** and **least-cost way** to society.
- Placing an adequate price on GHG emissions is of fundamental relevance to **internalize the external cost of climate change** in the broadest possible range of economic decision making and in setting economic **incentives for clean development.**
- It can help to **mobilize the financial investments** required to stimulate clean technology and market innovation, fueling new, low-carbon drivers of economic growth.
- **For governments,** carbon pricing is one of the instruments of the climate policy package and a **source of revenue** needed to reduce emissions.
- **Businesses** use internal carbon pricing to evaluate the impact of mandatory carbon prices on their operations and as a **tool to identify** potential climate risks and revenue opportunities.
- **Long-term investors** use carbon pricing to analyze the potential impact of climate change policies on their investment portfolios, allowing

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Current status of carbon Pricing
- As of October 2019, there are 64 carbon pricing initiatives implemented or scheduled for implementation, covering 49 national jurisdiction.
- In total, these carbon pricing initiatives cover about **22% of global GHG emissions**, compared to 15% in 2017.
- **India's Case:** The **clean energy cess (now Clean Environment Cess)** is levied on coal, lignite and peat as well as on imported coal.
  o Gujarat launched **India's first emissions trading scheme** in Surat.
- **Paris Agreement e**stablishes the potential of trading emission reduction credits across borders, between nations or jurisdictions.

FASTER Principles for Successful Carbon Pricing: jointly developed by the World Bank and the OECD, distils **six key characteristics** of successful carbon pricing.
- **Fairness:** ensuring **"polluter pays" principle** and fare sharing of costs and benefits.
- **Alignment of policies and objectives:** to make it most effective.
- **Stability and predictability**: to send a clear, consistent, and (over time) increasingly strong signal to investors.
- **Transparency:** in carbon pricing
- **Efficiency and cost-effectiveness:** to lower the cost and increases the economic efficiency of process.
- **Reliability and environmental integrity:** Effective carbon pricing measurably reduces practices that harm the environment.

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them to reassess investment strategies and reallocate capital toward low-carbon or climate-resilient activities.

Concerns related to Carbon Pricing

- **Carbon leakage:** the phenomenon by which carbon-intensive industries or firms shift operations to lower-cost jurisdictions.
- **Policy overlap or inconsistency:** Policy makers must work carefully and deliberately to avoid potential overlap of and interaction between policy instruments, which could undermine the effectiveness of carbon pricing mechanisms.
- **Ineffective use of revenues**: effectiveness of many carbon pricing initiatives depends on how these revenues are spent.

Conclusion

Carbon pricing has the potential to radically decarbonize global economic activity by changing the behaviour of consumers, businesses, and investors while unleashing technological innovation and generating revenues that can be put to productive use. In short, **well-designed carbon prices offer triple benefits:** they protect the environment, drive investments in clean technologies, and raise revenue. For businesses, carbon pricing enables them to manage risks, plan their low-carbon investments, and drive innovation.

1.2.1.4. CLIMATE FINANCE

Introduction

- Climate finance refers to **local, national or transnational financing** - drawn from public, private and alternative sources of financing -that seeks to **support mitigation and adaptation actions** that will address climate change.
- The Convention (UNFCCC), the Kyoto Protocol and the Paris Agreement call for financial assistance. In accordance with the **principle of "common but differentiated responsibility and respective capabilities"** set out in the Convention, **developed country Parties are to provide financial resources to assist developing country Parties** in implementing the objectives of the UNFCCC.

Figure 1 UNFCCC Bodies and funds

UN FRAMEWORK CONVENTION ON CLIMATE CHANGE

KYOTO PROTOCOL — PARIS AGREEMENT

ADAPTATION FUND

FINANCIAL MECHANISM

GREEN CLIMATE FUND — GLOBAL ENVIRONMENTAL FACILITY

SPECIAL CLIMATE CHANGE FUND — LEAST DEVELOPED COUNTRIES FUND

Note: The dotted arrows indicate that the LDCF and SCCF are administered by the GEF.
Source: WRI.2018. & UNFCCC 2018. https://unfccc.int/

- To facilitate this, the Convention has **established Financial Mechanisms** to provide funds to developing country Parties.
  - The **Global Environment Facility (GEF)** has served as **an operating entity of the financial mechanism** since the Convention's entry into force in 1994.
  - At **Copenhagen COP 15**, in 2009, under **Copenhagen Accord,** developed countries committed to provide developing countries with "scaled up, new and additional, predictable and adequate funding" with a **target of mobilizing $100 billion per year by 2020** from a "wide variety of sources, public and private, bilateral and multilateral, including alternative sources of finance".
  - At **COP 16 (2010),** Parties established the **Green Climate Fund (GCF)** and in **2011 (COP 17)** also designated it as an operating entity of the financial mechanism.
  - Additionally, Parties have established special funds: **Special Climate Change Fund** (SCCF), the **Least Developed Countries Fund** (LDCF), both managed by the GEF; and the **Adaptation Fund** (AF) under the Kyoto Protocol in 2001.
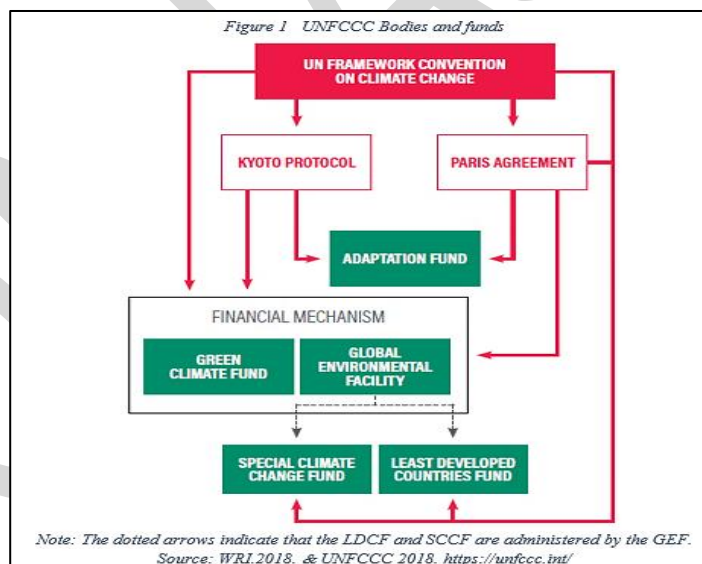
Key Issues involved in Climate Finance

Discussions around the financing of climate action revolve around **three key areas:**

- **The amounts of financing:** Financial commitments towards climate action are on an **upward trend as shown is in the Box**. However, **issues** remain there.

- o **Amounts are not at all sufficient** - for instance, global annual fossil fuel subsidies together with their externalities cost about $5.3 trillion.
  - o Further, **not all the trends are encouraging**; for instance,
    - ✓ Currently US has stopped further funding for the GCF.
    - ✓ An Adaptation Watch report found that of over 5000 adaptation projects worth $10.1 billion supported by OECD countries, **three-quarters lacked a clear connection to addressing vulnerability to climate change.**
  - o Although countries agreed **at Katowice COP 24 to initiate formal discussions** on the new post-2025 mobilization goal in 2020, countries such as **India believe that a decision to initiate deliberations is weaker than a decision to start the process of setting this goal.**
- **The definitions and reporting of climate finance:** Important issues revolve around-
  - o Even 10 years after COP 15, there is **no commonly agreed universal definition** of what type of finance can be counted as climate finance in support of the Copenhagen pledge under GCF.
  - o There is a **disagreement on a whole set of qualitative and normative criteria** that should provide the **framework** for how public climate finance is mobilized, governed and disbursed.
    - ✓ These include questions such as the **additionality** (on top of or as part of official development assistance) or **predictability** of climate finance.
  - o **Reporting guidelines approved at COP 24 for climate finance** provided by developed countries over the previous two years allow them to include an **almost limitless set of financial flows**, and even **non-financial efforts** such as capacity building or technology transfers, under climate finance.
  - o However, **some important provisions in reporting remain optional** and will require continued scrutiny.
    - ✓ As asserted by India, reporting processes should incorporate proper **verification mechanisms** and should be developed in **consultation with developing countries**.
    - ✓ A **two-year lag in reporting** also limits the ability to properly verify the flows of climate finance.
    - ✓ Concerns exist about the **accounting of financial instruments** such as market-rate loans and export credits towards developed country commitments, and
    - ✓ **Reporting requirements** around the **projected financing** provisions remain weak.
- **The market mechanism:** The Paris Agreement states that a share of proceeds from the new market mechanism under Article 6 will go to support adaptation in developing countries. This revenue stream will likely be directed to the Adaptation Fund. Key topics of discussion relate to the size of this share, and whether it should be applied to all mechanisms created under Article 6, or only some.

Conclusion

There still doesn't exist an operational definition of what counts as "climate finance" or "new and additional". Clarifying these definitional and accounting issues in a consultative way, with an eye on post-2025 actions, would go a long way towards increasing trust and scaling up collective action.

1.2.2. INDIA'S EFFORTS

India has continuously demonstrated its responsibility towards acknowledging the emerging threats from climate change and implementing the climate actions on the basis of the principles of Equity and Common but Differentiated Responsibilities for improving efficiency of the economy and its engines of growth. The major policies and plans include:

- **INDC under Paris Deal:** India has pledged to reduce the emissions intensity of its GDP by 33 to 35 per cent below 2005 levels, to increase the share of non-fossil fuels-based electricity to 40 per cent and to enhance its forest cover which will absorb 2.5 to 3 billion tonnes of carbon dioxide by 2030.
- **National Action Plan on Climate Change** (NAPCC), launched in 2008, formulated in the backdrop of India's voluntary commitment to reduce emission intensity of its GDP by 20 to 25 per cent by 2020 over 2005 levels. It was also meant to focus on key adaptation requirements and creation of scientific knowledge and preparedness for dealing with climate change.
- **State Action Plans on Climate Change** (SAPCC) in line with the NAPCC taking into account State's specific issues relating to climate change. So far, 33 States/ UTs have prepared their SAPCCs.
- **Climate Change Action Programme** (CCAP) has been launched in 2014 with the objective to build and support capacity at central and state levels, strengthening scientific and analytical capacity for climate

change assessment, establishing appropriate institutional framework and implementing climate related actions in the context of sustainable development.

- **National Adaptation Fund on Climate Change** was established in 2015 to meet the cost of adaptation to climate change for the State and Union Territories that are particularly vulnerable to the adverse effects of climate change

- **India's Second Biennial Update Report (BUR)** submitted to UNFCCC in December 2018. The report shows that
  - Emission intensity of India's GDP came down by 21% between 2005 & 2014 and its achievement of climate goal for pre-2020 period is on track.
  - A total of 2.607 billion tons of CO2 equivalent of GHGs were emitted from all activities (excluding Land use, Land-Use Change, and Forestry (LULUCF)) in India. Energy sector accounted for 73%, Industrial Processes and Product Use (IPPU) 8%, agriculture 16% and waste sector 3%.
  - About 12% of emissions were offset by the carbon sink action of forestland, cropland and settlements.

Note – India's efforts will be covered in detail in Updated Material.

1.3. MISCELLANEOUS

1.3.1. CITIES AND CLIMATE CHANGE

Why in News?

The C40 World Mayors' Summit was held recently in Copenhagen, Denmark facilitating discussion on cities role in Climate Change

How cities are linked to climate change?

- **Greenhouse gas emissions:** As per UN Habitat, cities consume 78% of energy production worldwide and account for more than **60% of global greenhouse gas emissions.**
- **Climate change and Urbanisation:** Increasing urbanisation has significant implications on air quality, water availability and quality, land use, and waste management.
- **Vulnerability of cities:** Cities, while being the main cause of climate change, are also the most affected. Most cities are situated near water putting them at risk from rising sea levels and storms.

How cities can Combat Climate Change?

About C40 Summit
- C40 is a network of the **world's megacities, started in 2005,** representing 700+ million citizens and one quarter of the global economy.
- C40 supports cities **to collaborate effectively, share knowledge and drive meaningful, measurable and sustainable action on climate change.**
- Six Indian cities are currently members of C40: **Bengaluru; Chennai; Delhi NCT; Jaipur; Kolkata and Mumbai.**

Major initiatives launched during C40 summit 2019
- **C40 Good Food Cities Declaration**: It aims to work with their citizens to achieve a **'Planetary Health Diet' by 2030, with balanced and nutritious food** "reflective of the culture, geography, and demography of their citizens."
- **C40 Clean Air Cities Declaration:** It aims to set ambitious pollution reduction targets within two years that meet or exceed national commitments; implement clean air policies by 2025 that address causes of pollution in the cities etc.
- **C40 Cities Knowledge Hub:** It is an online platform providing cities with information to drive climate action at greater speed and scale, which brings together practical experiences and successful approaches taken by cities for knowledge sharing and collaboration.
- **City-Business Climate Alliance:** The Alliance will enable mayors and CEOs to collaborate to translate global climate commitments into practical actions that work in cities.

- **Making transportation sustainable:**
  The transportation sector is responsible for around 15% of global emissions. C40 researchers said cities should implement walking, cycling and mass transit policies, introduce stringent emission standards, promote zero-emissions vehicles and establish zero emission areas.
- **Green buildings:** Cities should adopt strict regulations for new buildings and retrofit older buildings to improving heating, ventilation, air conditioning, water heating and lighting systems.
  - China is the leader in building efficiency, with a national mandate to make 50% of all buildings green certified by 2030.
- **Reclaiming green spaces:** As cities expand, natural green space gives way to concrete materials. Building community gardens, parks etc would help to combat climate change.

- **Making carbon dioxide expensive:** Reducing greenhouse gas emissions is essential to any meaningful climate action plan. Many cities around the world are taking the lead on this front.
  - o Oslo, Norway, for example, aims to reduce carbon emissions by 95% by 2030. The city was the first in the world to introduce a climate budget, which works by taxing carbon dioxide emissions and setting emissions limits on industrial and individual activities.
- **Banning plastic:** The vast majority of plastic isn't recycled. It ends up in landfills, oceans, green spaces, and elsewhere, where it pollutes ecosystems, harms animals, and contaminates drinking water. Plastic production is also responsible for significant greenhouse gas emissions.
  - o Plastic production could account for 17% of the global carbon budget by 2050, according to a recent study by the Centre of International Environmental Law. At present 18 cities have banned or restricted single-use, non-recyclable plastics.

> **Climate Smart Cities Assessment Framework (CSCAF 2.0)**
> - CSCAF is a **first-of-its-kind assessment framework** on climate relevant parameters launched in 2019 by Ministry of State for Housing and Urban Affairs (MoHUA).
> - Its objective is to **provide a clear roadmap for Indian cities towards combating climate change** while planning their actions within city including investments.
>   - o It intends to **inculcate a climate-sensitive approach** to urban planning and development.
> - Framework has 28 indicators across **five categories**: Energy and Green Buildings, Urban Planning, Green Cover & Biodiversity, Mobility and Air Quality, Water Management and Waste Management.
> - **Climate Centre for Cities** under National Institute of Urban Affairs is supporting MoHUA in implementation of CSCAF.

1.3.2. COVID-19 AND ITS IMPACT ON ENVIRONMENT AND CLIMATE CHANGE EFFORTS

Why in news?

The COVID-19 crisis could mark a turning point in progress on climate change.

Impact of COVID-19 Lockdown on Environment:

It has a **mixed impact** on environment-

- **Reduced Pollution:** There were a marked decline in air pollution (decreased concentrations of NO2 and PM 2.5), clean beaches due to lack of tourists and reduced noise pollution.
  - o For instance, the average Air Quality Index (AQI) for the major Indian cities was between 300-500; after the lockdown, it plunged to 50 to 100.
- **Decline in Carbon Emissions:** Huge decreases in transportation and industrial activity due to COVID-19 lockdown resulted in a drop in daily global carbon emissions of 17% in April.
  - o However, CO2 levels in the atmosphere reached their highest monthly average ever recorded in May - 417.1 parts per million. This is because the carbon dioxide already emitted can remain in the atmosphere for longer times.
- **Increased waste and More plastic:** COVID-19 has vastly increased our use of plastic: gloves and masks and PPE kits, and disposable shopping bags etc. E-commerce has also resulted in more packaging materials, increasing the carbon footprint of e-commerce.
  - o There has also been **reduction in waste recycling** as authorities have been concerned about the risk of COVID-19 spreading in recycling centers.

Effects of COVID-19 on Climate Change efforts

Public support for action on climate change increased to a peak prior to the pandemic; government and corporate action was also gathering momentum. COVID-19 has clearly slowed this momentum.

> **Four priorities for COP 26 of UNFCCC:**
> - The National climate plans – the **Nationally determined contributions (NDCs)** – should show that countries are working to implement the Paris Agreement, and that each new NDC should show more ambition than the previous one.
> - All nations should adopt strategies to reach net zero emissions by 2050.
> - The development of a robust package of projects and initiatives to help communities and nations adapt to climate disruption and build resilience against future impacts.
> - The provision of finance, with developed countries at COP26 delivering on their commitment to mobilize 100 billion dollars a year by 2020.

- **International negotiations delayed:** 2020 was supposed to be a "a pivotal year" for efforts to address climate change. COP26 of UNFCCC, World Conservation Congress, Convention on Biological Diversity and 2020 UN Ocean Conference etc. all are postponed.
  o Ahead of the COP26 summit, **196 countries were to announce plans to ratchet up climate actions**, since the plans they submitted in 2015 could still allow global temperatures to rise by a potentially catastrophic 3°C.
  o While the need to mobilize governments to act on climate has never been more urgent, the inability to gather world leaders to address the issue could make it all the more difficult to do so.
- **Less money for climate resilience and renewable energy:** The need for **more emergency services** coupled with a **reduction in tax revenue** has taken an economic toll on governments' efforts. As a result, some have had to delay and divert funding away from climate resilience projects and renewable energy.
- **Scientific research disrupted:** Due to lockdowns and travel bans, scientists have been unable to travel to do their fieldwork, and there's a limit to how much some can accomplish with data and computers alone.
- **Deforestation and illegal poaching:** As Brazil, hard hit by COVID-19, is focused on controlling the virus, **illegal loggers and miners** are taking advantage of the situation to cut down large swaths of the Amazon.

Learnings of COVID-19 for Environment and Climate Change

As the world is struggling with the rapid-onset COVID-19 crisis, here are some lessons on how to ensure that the recovery from the COVID-19 crisis will put the 2030 Agenda and the Paris Agreement at the center of sustainable development efforts.

- **Put science and scientists first:** In case of COVID-19, collaborative networks of scientist beyond political lines and national borders, has increased the efficiency and speed in research to find a cure.
  o **Learning:** Along with the multilateral political negotiation, well informed climate negotiations mean unimpeded transparency and scientific cooperation, such as the one provided by the Intergovernmental Panel on Climate Change (IPCC).
- **Mobilising Financial resources:** Governments have quickly mobilized financial support to back businesses and expand welfare benefits in response to the COVID-19 pandemic.
  o **Learning:** To avoid a climate catastrophe, climate finance must overcome difficult negotiations and political conflicts. The climate investments also make great economic sense. For example, it is estimated that for every dollar invested in climate resilient infrastructure six dollars are saved.
- **Protect and improve common goods:** Over-exploitation of common goods, without consideration for the long-term needs of our next generations, has resulted in the **"tragedy of the commons",** with big environmental impacts, including the zoonotic origins of the COVID-19 pandemic.
  o **Learning:** Cases of response to the current pandemic show that previous investments by countries in public health and welfare systems have produced better results. Equally important are investments to restore clean air and water, healthy ecosystems, and other environment and climate goods, which contribute to planetary health.
- **Focus on those already left behind:** The COVID-19 pandemic struck fast and affected those most vulnerable, those who had little means and access to health-care services, and those in nursing homes and homes for persons with disabilities.
  o **Learning:** In the case of climate change, the ones that have been left behind include poor farmers, people who lack access to basic services, people living in slums as well as climate migrants. Climate mitigation and adaptation activities should put these and other vulnerable groups at the center of attention and response.
- **Make the global value chains climate resilient:** The COVID-19 driven disruption in sectors like transport, medicine and tourism was immediate and hard.
  o **Learning:**
    ✓ The **climate crisis with its low on-set characteristics** will drive at least similar if not larger implications in the value chains of main sectors. There is an opportunity to develop systems able to increase the resilience of value chains in climate sensitive sectors; and ensure that critical commodities and services are available to all at times of climate-induced disasters.
    ✓ This will also impact the **supply of funds and finances**, which need to be directed to deal with critical situations, rather than bailing out polluting industries in decline, creating quick stimulus for sustainable and low-carbon commodities and common goods services.

- **Fix and make sustainable the food systems:** The FAO has started documenting the negative impacts of COVID-19 on food security. The impacts of climate change on agriculture have also been extensively documented by the IPCC and **food supply chain** has emerged as the **most crucial global value chain** to be secured against the climate emergency.
  - o **Learning:** Many policy options have been proposed and already implemented including ecological rotation of crops, robust estimation of the true cost of food, reducing food waste, fair trade, drastically reducing pesticides, decarbonizing food production and distribution systems.
- **Ensure credible information and not fake news leads the public discussion:** Since the causes and risks of climate change are already well examined, documented and vetted, scientific facts and solutions need to be brought widely to the attention of the public to avoid speculations and misconstrued theories, which only cause anxiety and panic, as is happening around this novel disease.
- **Institutionalise behaviour change:** The lockdown has enabled new behaviours and habits, especially among the corporate workforce, with remote work becoming normalised. Consumption patterns are also changing, with more focus on buying what is locally and easily available. Institutionalising these changes after the lockdown is eased or lifted can go a long way in lowering vehicular emissions, reducing air travel, and reducing the carbon footprints of people and products.

Conclusion

The pandemic has made it clear that failing to act on issues such as climate change and public health cuts into any development gains made in other sectors. Given the growing number of COVID-19 cases, and how communities have been affected along with their ability to cope with climate shocks, the government must factor in climate change in every decision related to the pandemic including devising the green economic recovery plans.

2. AIR POLLUTION

2.1. OVERVIEW

Air pollution in India is a serious health issue. As per World Air Quality Report compiled by IQAir (Swiss Air technology company), of the most polluted cities in the world, **21 out of 30 were in India in 2019.**

Rank	City	2019 AVG
1	Ghaziabad, India	110.2
2	Hotan, China	110.1
3	Gujranwala, Pakistan	105.3
4	Faisalabad, Pakistan	104.6
5	Delhi, India	98.6
6	Nodia, India	97.7
7	Gurugram, India	93.1
8	Raiwind, Pakistan	92.2
9	Greater Noida, India	91.3
10	Bandhwari, India	90.5

Source: 2019 World Air Quality Report, IQAir

- Cities in India, on average, **exceed the World Health Organisation (WHO) target for annual PM 2.5** exposure by 500 per cent.
- However, the report also mentions that Indian cities have shown improvement from last year. **National air pollution decreased by 20 per cent from 2018 to 2019** with 98 per cent of the cities experiencing improvement.

Causes of Air pollution in India

- **Emissions from burning of fossil fuels** which include vehicular emissons, industrial emissions, emissions from petroleum refineries and power plants.
- **Emissions from stubble burning**- in agriculture, increases air pollution in Delhi and NCR area.
- **Release of dust and chemicals**- from mining operations.
- **Other Causes**- Dust Storm, Forest Fires, Deforestation, Landfills, Electronic Waste etc.

Impacts of Air Pollution

- **On Health-** A recent study by the Centre for Science and Environment (CSE) revealed that life expectancy in India has gone down by 2.6 years due to deadly diseases caused by air pollution.
- **On Economy-** Estimates peg the economic cost of air pollution to the Indian economy at more than US$150 billion a year due to pollution-related death, sickness and welfare
- **Climate Change-** which include global warming, acid rain, depletion of ozone layer etc.
- **Impact on Wildlife:** Toxic chemicals present in the air can force wildlife species to move to new place and change their habitat.

Some Steps taken by the Government

- **Clean Air- India Initiative:** to curb air pollution in Indian cities by promoting partnerships between Indian start-ups and Dutch companies and build a network of entrepreneurs working on business solutions for cleaner air.
  - Under it, an **'INDUS impact' project** aims to halt the hazardous burning of paddy stubble by promoting business partnerships that "up cycle" it. This entails using paddy straw as feedstock to make materials that would find use in construction and packaging.
- **Notification of National Ambient Air Quality Standards** and sector-specific emission and effluent standards for industries to reduce emission of PM 10, SO2 and oxide of nitrogen.
- Launching of **National Air Quality Index (AQI).**
- **Promotion of fuel standards-** Leapfrogging from BS-IV to BS-VI fuel and **ban on pet coke and furnace oil.**
- **Subsidy to cooking fuel** under Pradhan Mantri Ujjwala Yojana (PMUY) to curb indoor pollution.
- **Encouraging Alternatives:** Promotion of public transport and network of metro, e-rickshaws, promotion of car-pooling etc.

Note – Delhi-NCR Air Pollution issue will be covered in detail in Updated Material

2.2. FLY ASH MANAGEMENT

Why in news?

The National Green Tribunal has recently directed **thermal power plants to take prompt steps toward the scientific disposal of fly ash.**

Fly ash and concerns relating to it

- It is a fine powder, which is the by-product of burning coal in thermal power plants. It includes substantial amounts of oxides of silica, aluminum and calcium. Elements like Arsenic, Boron, Chromium, lead etc. are also found in trace concentrations.
- Owing to large-scale dependence on thermal power generation and high ash content in Indian coal, large quantity of ash is generated in the country (nearly 200 million tons). It not only **requires large area of precious land for its disposal** but is also one of the sources of air and water pollution.

Advantages with fly ash utilisation

- **In agriculture:** It **improves water holding capacity, works as soil conditioner and contains micronutrients** like phosphorus, potassium and calcium thus increasing the crop yield.
- **In Construction works**- Fly ash is a **proven resource material** for many applications of construction industries and currently is being utilized in manufacturing of portland cement, bricks/blocks/tiles manufacturing, road embankment construction and low-lying area development, etc.
    - **Concrete made with fly ash is stronger and more durable** than traditional concrete made with Portland cement.
    - Fly ash is a **lightweight material and therefore it undergoes lesser settlement** and hence can be used for embankment construction over weak substrate such as alluvial clay or silt where excessive weight could cause failure.
- **In manufacturing of Absorbents** that are suitable for purification of waste gases, drinking water purification, waste water treatment etc.
- **In preventing contamination of Water Resources**- by preventing contamination of surface water through erosion, runoff, airborne particles landing on the water surface etc.

Government Measures to promote Fly Ash Utilization

- **Central Electricity Authority (CEA)** has been monitoring the fly ash generation and its utilization in the country at coal/ lignite based thermal power stations since 1996-97.
- The Ministry of Environment, Forests and Climate Change (MoEFCC) issued **notifications on Fly Ash Utilization in 2016** that had following features-
    - **Mandatory uploading of details of fly ash** available on Thermal Power Station's (TPS) website
    - **Increase in mandatory jurisdiction of area of application** from 100 km to 300 km;
    - **Cost of transportation of fly ash** to be borne entirely by TPS up to 100 km.
    - **Mandatory use of fly ash based products** in all Government schemes or programmes e.g. Pradhan Mantri Gramin Sadak Yojana, Mahatma Gandhi National Rural Employment Guarantee Act, 2005, Swachh Bharat Abhiyan, etc.
- As per, **2019 government notification** the existing red clay brick kilns located within 300 km shall be converted into fly ash-based bricks or blocks or tiles manufacturing unit within one year.
- The **GST rate** on fly ash and fly ash aggregate with 90% or more of fly ash content was **reduced from 18% to 5%.**
- A **mobile app for ash management**- ASH TRACK was created to help establish a link between fly ash users and power plant executives.
- NTPC in collaboration with Institutes like IIT-Delhi and IIT-Kanpur has initiated manufacturing of pre-stressed railway concrete sleepers.

> **State level initiatives**
> - Maharashtra- became the 1st state to adopt the fly ash utilization policy.
> - Odisha has ordered the plants to subsidize the transport costs.

With the above measures in place, at present, **63% of the fly ash is being utilised in India.**

Way Forward

- **Renovation and modernization of coal/lignite based Thermal Power Stations** need to include -

- o **technological advancement** required to ensure development of dry fly ash collection, storage and disposal facilities so that fly ash in dry form could be made available to its users.
  - o **marketing strategy** for the development of fly ash based industries and making available fly ash and fly ash based building products in the nearby markets.
- **Policy support:** To promote the usage of fly ash, state and local governments should issue preferential policies that encourage its recycling, such as the preferential purchase of recycled fly ash products and reduction of the overall effective tax.
- **Identifying prospective users:** Areas having large prospective of fly ash utilization needs to be discovered for increasing the overall utilization of fly ash in India. New emerging areas includes Light Weight Aggregates and Geo-polymers, Coal Beneficiation Blending and Washing, etc.
- Specifications for **Fly Ash based building materials should be standardized** and their use must be promoted.
- **Encouraging Industry-Academia Partnership and interactions** regarding scientific disposal of fly ash for entrepreneur development, creating awareness and organizing training programmes.
  - o In view of large quantity of fly ash generation, Induction of 'Fly Ash' as a subject in academic curriculum of Engineering and Architecture may be introduced.

> **Two methods of scientific fly ash disposal**
> - **Dry Fly Ash Disposal system**: Electrostatic precipitation (ESP) enables collection of dry Fly Ash which is then transported by trucks or conveyors at a site and disposed of by constructing a dry embankment.
> - **Wet Fly Ash Disposal System**: Fly Ash is mixed with water and transported as slurry through pipe and disposed of in ash ponds or dumping areas near the plants.

2.3. DECARBONISING TRANSPORT

Why in news?

NITI Aayog in collaboration with International Transport Forum (ITF) have jointly launched the Decarbonising Transport in India project.

Concept of Decarbonising transport

- Transport emits around 23% of the energy-related CO_2 that feeds global warming. Without immediate action, its share could reach 40% by 2030 and 60% by 2050.
- Decarbonisation means **reducing greenhouse gas (GHG) emissions produced as a result of transport**. It includes
  - o Emissions released directly during transport
  - o Emissions due to related activities - for example emissions from the production of electricity used to power a given mode.
  - o **Emissions resulting from the manufacture** and/or disposal/recycling of products and vehicles.

Measures to achieve decarbonisation in transport sector

- **Pull policies** that attract citizens into more efficient modes of transport such as metros, bus rapid transit, and bicycles; emerging trends such as work from home, e-commerce etc. incentivising people to travel less.

About the project
- The project is carried out in the wider context of the International Transport Forums's(ITF) Decarbonising Transport Initiative(DTI) and is a **part of Decarbonising Transport in Emerging Economies(DTEE)** family of projects, which supports transport decarbonisation across different world regions.
- **Purpose is to**
  - o develop a pathway towards a **low-carbon transport system** for India.
  - o design a tailor-made **transport emissions assessment framework for India**
  - o facilitate the government with a **comprehensive understanding of present as well as future transport activities** along with the related CO2 emissions.

About DTI and DTEE
- Launched **in 2016, DTI promotes carbon-neutral mobility to help stop climate change.** It provides decision makers with tools to select CO2 mitigation measures that deliver on their climate commitment.
- Under it, the **DTEE project** helps national governments and other stakeholders to identify transport measures and establish pathways to reduce transport CO2 emissions and meet their climate goals and NDCs.
- India, Argentina, Azerbaijan, and Morocco are current participants.

About ITF
- The ITF is an **inter-governmental organisation within the OECD** system and is the **only global body with a mandate for all modes of transport.**
- It acts as a **think tank for transport policy issues**.
- **India has been a member** of ITF since 2008.

- **Push measures** that make the use of CO2 and energy intensive modes less attractive, e.g. reduced and more expensive parking space; high taxes on fuel and polluting vehicles, promoting electric vehicles etc.
- **Land-use policies** such as **Transit oriented development (TOD)** increasing the accessibility on short-to-medium distances that enable the use of public transit, walking and cycling.
- **Improving Infrastructure:** There is great potential for energy savings in infrastructure, both for new and older assets. This includes escalators, lifts, building insulation, heating, cooling, cogeneration, lighting, etc. Another example is the **increasingly popular production of renewable electricity** from photovoltaic panels installed on roofs of maintenance and parking/stabling facilities when tax or investment incentives are available.
- **Other policies** such as increasing commercial speed and reliability for public modes of transport, such as priority at traffic lights and reserved corridors/lanes such as Dedicated Freight Corridors.

Decarbonising transport	Public transport network & Less polluting electricity generation — SDG ③⑦⑬
	Public transport & Mass rapid transport systems — SDG ①⑤⑩
	Resilient transport through dedicated freight corridors — SDG ①②⑧
	Increased accessibility & participation through TOD — SDG ④⑧⑤
	Affordable and Sustainable transport — SDG ⑪
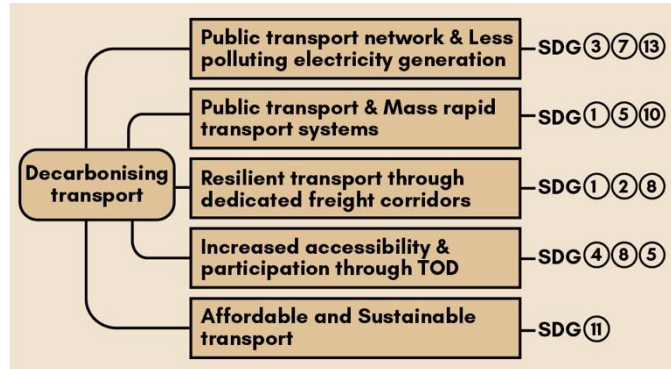
Government Initiatives

- **Government of India has initiated several policies and initiatives** for the transportation sector with the objective of enhancing passenger mobility, improving logistics of freight transport, increasing rail use by improving efficiency, raising the average speed, promoting low-carbon transport, and at the same time improving energy security and local benefits of air quality and congestion:

Roads	• **National Electric Mobility Mission Plan (NEMMP) and Faster Adoption and Manufacturing of (Hybrid &) Electric vehicles in India (FAME India)**
	• BS VI norms.
	• **National Policy on Biofuels, 2018**
	• Remodelling of roads such as widening, expressways, flyovers, signal free movement etc. under Bharatmala Project.
	• Promoting public transports such as metro rail
	• High tax rates on polluting vehicles.
	• Hydrogen fuel based public transport
Railways	• Railway Electrification,
	• Improving energy efficiency of locomotives & trains and fixed installations, green certification for installations/stations,
	• Dedicated freight corridors.
	• Exploiting renewable sources of energy
	• It is all set to transform itself as 'Net Zero' Carbon Emission Mass Transportation Network by 2030.
Airways	AAI has recently outlined a series of major initiatives it has taken to check depletion of ozone layer and emissions through improved air navigation service (ANS) procedures and training. These include : • route optimisation, • upgrading of surveillance infrastructure, • upper airspace harmonisation, • continuous descent operations, • collaborative environmental initiatives and ground efficiency improvement programmes • blended bio-jet fuel experiment
Waterways	• Development of National Waterways. • LNG propelled vessels.

Way forward

- Opportunities exist to mitigate GHG emissions from India's transport sector and facilitate sustainable mobility by **integrating transportation policies with environment, development, and climate change policies.**
- **The sustainability focus is evident in policies of the Government of India.** For instance, India's National Action Plan on Climate Change (NAPCC) highlights a mix of measures, including higher share of public transport, penetration of biofuels, and significant improvements in vehicle efficiency.

- **Several cities are proactively initiating infrastructure investments** in mass transit, urban planning for better land use transport integration, and upgrading existing public transport. This should be replicated in other cities also to realize the desired mitigation potential.

2.3.1. CHARGING INFRASTRUCTURE FOR ELECTRIC VEHICLES

Why in news?

Recently, Ministry Power and New & Renewable Energy released **revised guidelines and specifications for Electric Vehicle (ERV) Charging Infrastructure.**

National Electric Mobility Mission Plan (NEMMP) 2020
- It is a **National Mission document by Ministry of Heavy Industries & Public Enterprises** providing the vision and the roadmap **for the faster adoption of electric vehicles** and their manufacturing in the country.
- As part of the NEMMP 2020, Scheme named Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles in India **(FAME) was launched in the year 2015** to promote manufacturing of electric and hybrid vehicle technology and to ensure sustainable growth of the same.
- The Phase-I of this Scheme (FAME I) was initially launched for a period of 2 years and was **implemented through four focus areas:**
  (i) Demand Creation,
  (ii) Technology Platform,
  (iii) Pilot Project and
  (iv) Charging Infrastructure.
- **FAME II**
  o It was **launched in March 2019** for a period of 3 years.
  o The main objective of the scheme is **to encourage faster adoption of electric and hybrid vehicle by way of offering upfront incentive** on purchase of electric vehicles and also by establishing the necessary charging infrastructure for electric vehicles.

Other taken by the Government to promote electric mobility in the country are:
- Under new GST regime, the rates of **GST on Electric Vehicles has been kept in the lower bracket of 12**% (with no Cess) as against the 28% GST rate with Cess up to 22% for conventional vehicles.
- Ministry of Power has allowed **sale of electricity as 'service' for charging of electric vehicles.** This would provide a huge incentive to attract investments into charging infrastructure.
- Ministry of Road Transport Highways issued notification regarding **exemption of permit** in case of battery operated vehicles.
- Issue of **Expression of Interest (EoI)** for deployment of 5000 electric buses by State Transport Departments/Undertakings etc.
- Policy has been proposed providing **incentives for companies setting up recycling facilities** for lithium ion batteries and make it incumbent on producers to collect used batteries.

Background

- The earlier guidelines and standards were issued by the Ministry of Power in December 2018 and will be superseded by the new guidelines.
- Lack of charging infrastructure is one of the main reasons behind poor adoption of electric mobility in India.
- According to a survey by the Economic Times in May 2019, **with appropriate infrastructure is in place, 90% car owners in India are willing to switch to EVs.**
- Under the NEMMP 2020, there is an ambitious target to achieve **6-7 million sales of hybrid and electric vehicles by the year 2020.**
- At present, **EV market penetration is only 1% of total vehicle sales in India,** and of that, 95% of sales are electric two-wheelers.

Challenges in setting Effective Charging Infrastructure in India
- **Lack of Crucial Resources:** India has very little known reserves of lithium; other crucial components such as nickel, cobalt and battery- grade graphite are also imported.
- **Lack of Skill:** We still lack sufficient technical know-how in lithium battery manufacturing.
- **Time consuming:** It still takes longer to charge an electric vehicle than it does to refuel a conventional car at the pump.
- **Sector Suitability:** Heavy-duty truck transportation and aviation, will remain difficult to electrify without drastic advances in battery technology.
- **Disposal of Lithium ion batteries** the policy mandate to have 30% of all vehicles as EVs by 2030, the demand for batteries will continue to rise. This translates to an exponentially growing stock pile of discarded batteries. Safe and environment friendly recycling of these batteries remains a challenge.
- **Power supply** India will need reliable excess power supply to feed the charging stations. This is a big challenge considering the frequent power outages experienced in many parts of the country, especially during summer.

Mains 365 – Environment

Brief of the Guidelines

- **Location of public charging stations (PCS):**
  o at least one charging station should be available in a grid of 3 Km X 3 Km in the cities.
- **Phase wise installation** in next 5 years on the basis of city size starting with the large cities.
- **Catering to the heavy duty vehicles with fast charging stations** at every 100 Kms on the highways.
- **Promoting private participation through** Private charging at residences/offices fascillitated by DISCOMs.
- **Ease of setting**: Setting up of PCS shall be a de-licensed activity and any individual/entity is free to set up public charging stations
- **Tariff:**
  o In the case of PCS, tariff for the supply of electricity to PCS shall be determined by the appropriate commission in accordance with the tariff policy issued under section 3 of Electricity Act 2003
  o Domestic charging shall be akin to domestic consumption of electricity and shall be charged as such.
- **Service charges:** The State Nodal Agency shall fix the ceiling of the Service Charges to be charged by the Public Charging Stations.
- **Nodal Agency:** Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power has been nominated as the Central Nodal Agency. Further a provision for State Nodal Agency for the respective states has been provided for in the Guidelines.

Conclusion

Overall success in EV adoption will critically hinge upon the coordination between manufacturers, government policies and, most importantly — consumer ability to participate in this new age green revolution.

2.4. ENERGY EFFICIENCY MEASURES

Realising the importance of energy efficiency in promoting low carbon transformation, India had launched the **Energy Conservation Act in 2001.** It had further directed its policies to focus specifically on energy efficiency by setting up the **Bureau of Energy Efficiency (BEE)** and then initiating the **National Mission for Enhanced Energy Efficiency (NMEEE).**

The role of energy efficiency remains crucial in complying by **India's emission intensity reduction targets**.

Recently, Bureau of Energy Efficiency released the Report titled "Impact of energy efficiency measures for the year 2018-19".

Impact of various Energy Efficiency Interventions in India

- Adoption of energy efficiency schemes/ programmes have led to **overall electricity savings to the tune of 9.39%** of the net electricity consumption.
- **Energy savings (electrical + thermal),** achieved in the energy consuming sectors (i.e. Demand Side sectors) is to the tune of **2.84%** of the net total energy consumption (581.60 Mtoe) in 2018-19.
- The **total energy savings** achieved is **2.69% of the total primary energy supply** (879.23 Mtoe) during 2018-19. This includes both Supply Side and Demand Side sectors of the economy.
- PAT scheme contributed to 57.72% of the total energy savings, while S&L and UJALA accounted for 36.26% of the total energy saving from all major interventions carried out during the FY18-19.
- Overall, various energy efficiency measures have translated into **savings worth INR 89,122 crores (approximately)** and contributed in **reducing 151.74 Million Tonnes of CO_2 emission.**

Energy Consumption Scenario in India
- With a total energy consumption of 553.9 Million Tonnes of Oil Equivalent (Mtoe)1 in 2017-18, India stood the **third largest energy consumer** in the world after United States of America and China.
- **India also ranks highest in terms of growth rate of energy consumption** in the world.
- India's energy consumption is expected to grow fastest among global economies and account for 11% of global energy demand by 2040.
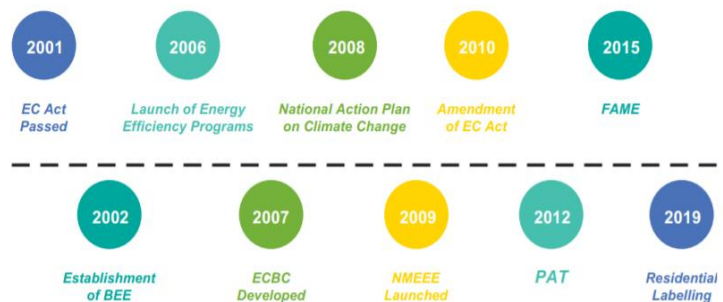
Figure 9: Chronograph of EE policies and programs in India

Way forward

- Current schemes/programs are largely successful in achieving significant energy savings across various sectors viz. Industry, building (domestic and commercial), municipal, agriculture, and transport. However, the **future landscape would be driven by disruptive technologies and economic mega-trends** such as smart cities, e-mobility etc. which are changing the dynamics of energy sector.

Sector Wise Energy Savings

Industries have the highest share (49.18%) in the total energy savings, while domestic sector has the maximum share (67%) in electrical energy savings.

Energy Saving (Mtoe, % Share)

- 7.91, 33.33%
- 11.67, 49.18%
- 2.34, 9.86%
- 1.08, 4.55%
- 0.61, 2.57%
- 0.12, 0.51%

Industry / Domestic / Agriculture / Municipal / Transport / Commercial

- The BEE has developed a National Strategy Plan - **Unlocking National Energy Efficiency Potential (UNNATEE).** As per the Plan, India's energy saving potential is estimated to be 86.9 Mtoe in case of a "moderate" implementation of EE programs and 129 Mtoe in case of an "ambitious" implementation of EE programs by year 2031 which stands at 15% reduction in energy demand as compared to business as usual approach to energy savings.

Impact of various EE measures on the Energy Consumption of the country

Total Energy Savings vis-à-vis Total Energy Consumption

Energy Savings (Mtoe): 1.68, 2.46, 3.02, 12.04, 12.10, 12.90, 16.87, 23.73

Business as Usual (Mtoe): 282.6, 335.4, 427.5, 496.0, 531.4, 553.8, 570.8, 605.3

Actual Consumption (Mtoe): 280.9, 332.9, 424.5, 484.0, 519.3, 540.9, 553.9, 581.6

Years: 2011-12, 2012-13, 2013-14, 2014-15, 2015-16, 2016-17, 2017-18, 2018-19

- **Activities to operationalize the National Strategic Plan on Energy Efficiency** would not only focus on available technology to make such improvements but would also include relatively **new technologies** such as E-mobility, fuel cell vehicles (FCVs), integration of renewables & storage, net zero buildings, district cooling, smart meters, internet of things, active appliance feedback, blockchain technologies etc. for decarbonizing various sectors of the economy.
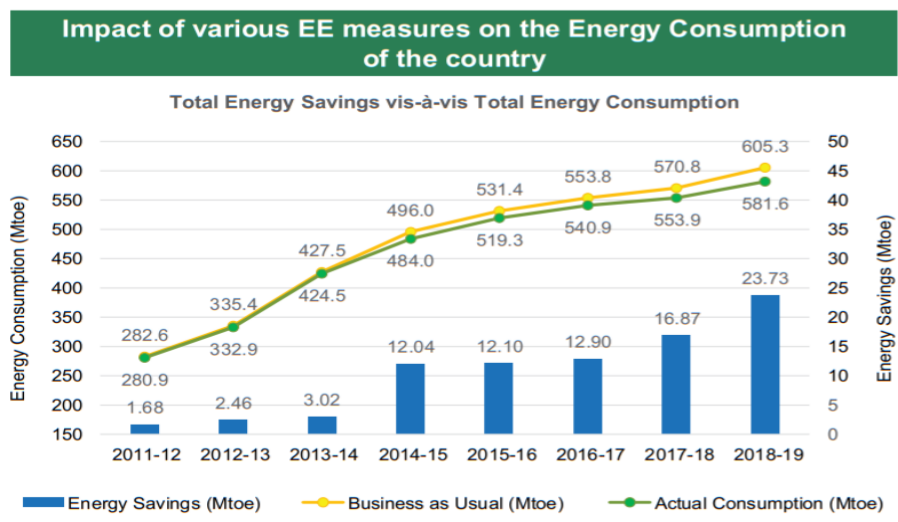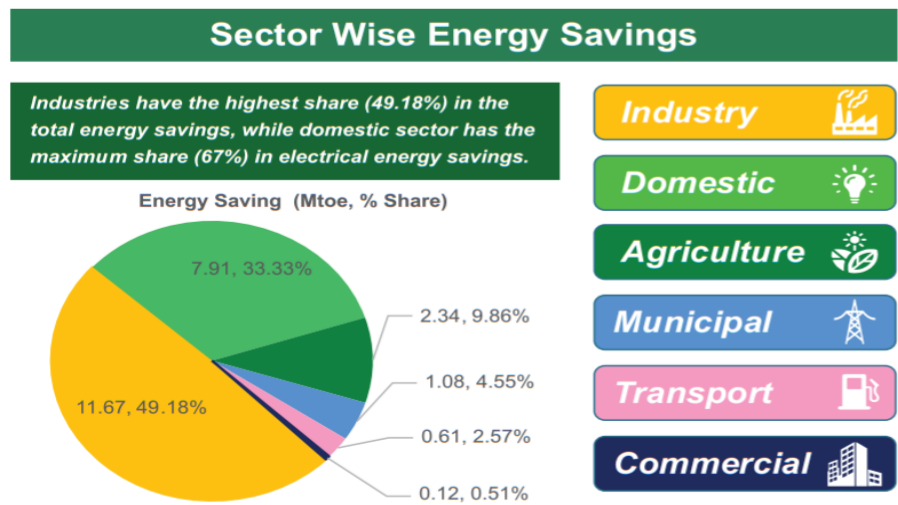
2.5. MANAGING AGRICULTURAL EMISSIONS

Why in news?

Recently Union Government **launched Green-Ag Project** to reduce emissions from agriculture.

Agricultural emissions in India

- **Contribution:** In India, agriculture and livestock accounts **for 18% of gross national GHG emissions**, the third-highest sector after energy and industry. Most of this takes place from states like **Punjab, Haryana, UP, Bihar, West Bengal etc.**
- **Sources:**
  o **Enteric fermentation:** is a natural part of the digestive process in ruminant animals such as

About Green-Ag Project

- It **aims to bring at least 104,070 ha of farms under sustainable land and water management** and ensure 49 million carbon dioxides equivalent sequestered or reduced through sustainable land use and agricultural practices.
- Project will be implemented in **Mizoram, Rajasthan, Madhya Pradesh, Odisha and Uttarakhand.**
- It is **funded by the Global Environment Facility (GEF),** while the Department of Agriculture, Cooperation, and Farmers' Welfare is the national executing agency.

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cattle, sheep, goats, and buffalo. Microbes in the digestive tract, or rumen, decompose and ferment food, producing methane as a by-product.

- o **Rice cultivation:** GHG emissions from rice cultivation consist of methane gas from the anaerobic decomposition of organic matter in paddy fields due to standing water in the rice fields.
- o **Manure management:** GHG emissions from manure management consist of methane and nitrous oxide gases from aerobic and anaerobic manure decomposition processes.
- o **Synthetic fertilisers:** GHG emissions from synthetic fertilisers such as urea consist of nitrous oxide gas from synthetic nitrogen additions to managed soils due to volatilisation.
- o **Crop residues:** GHG emissions from crop residues consist of nitrous oxide gas deriving from the decomposition of nitrogen in crop residues and burning of crop residues. Eg. Stubble burning in outskirts of Delhi causing rise of particulate matter.
- o **Energy use:** Irrigation uses highly inefficient water pumps and accounts for around 70% of the energy consumption of agriculture causing emissions of carbon dioxide, methane and nitrous oxide gases associated with fuel burning and the generation of electricity used in agriculture.

38.9% Livestock product
36.9% Rice
12.5% Ruminant meat
3.2% Cereals
1.1% Fruit
4.8% Other
0.4% Potato
2.1% Pulses
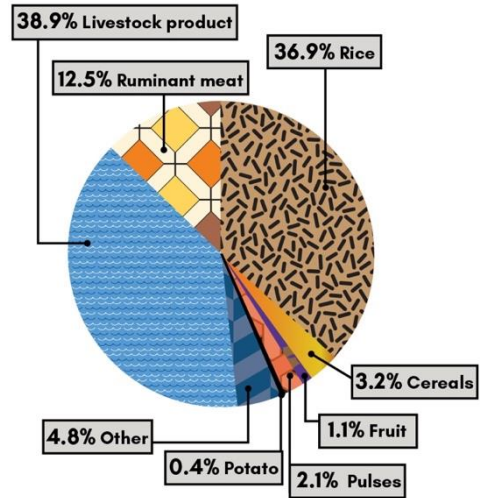
- **Impacts:**
  - o **Pollution**
    - ✓ Short-lived climate pollutants (SLCPs) such as black carbon materials and particulate matter PM10 and PM2.5 are generated due to burning of stubbles.
    - ✓ Fertilisers rich in nitrogen can pollute water and threaten aquatic ecosystems.
  - o **Greenhouse gases:** Use of excess nitrogenous fertilizers, paddy cultivation and enteric fermentation components which causes global warming.

Challenges to reduce agricultural emissions

- **High population & demand:** Due to food grain needs of India's population, production has substantially increased to feed their demand which creates challenge for sustainable agriculture.
- **Unfair government policies: Highly subsidised nitrogen-based fertilisers in India** lead to farmers overreliance on nitrogen-based fertilisers which are major source of nitrogenous emissions.
- **Poor agro-tech advancement:** Farmers' **adoption of the alternative and clean technologies largely depends on the socio-economic and political environment,** hence farmers with poor socio-economic condition cannot adopt it.
- **Poor knowledge:** To implement available technologies **adequate dissipation of knowledge among the farming community is lacking.**

> **Steps taken by Government**
> - India's **National Mission for Sustainable Agriculture (NMSA),** among eight NAPCC missions, aims to tackle agricultural emissions and enhance food security.
> - **Mandatory neem coating of urea** since 2015 to reduce nitrous oxide emissions.
> - Creating sustainable and climate-resilient agricultural systems is part of India's plan to meet pledge to the UNFCCC to **reduce the emissions intensity of its GDP by up to 35% by 2030, compared to 2005 levels.**
> - **Soil health cards** to use fertilizers efficiently and according to need of soil.
> - India has **installed 200,000 solar water pumps** and another 2.5 million are planned to reduce emissions from energy use in agriculture.

Way forward

- **Technological measures**
  - o **Adoption of zero tillage** (no-till farming) to minimise disturbing the soil by tillage and reduce emissions from fuel that would have been consumed for tillage operations.
  - o **Deep placement of manure and fertilizers** into the soil using fertilizer guns to increase nitrogen use efficiency and reduce N2O emissions.

o **Managing rice water by letting the field dry after irrigating** rather than keeping rice fields continuously flooded will reduce methane emissions without compromising yield. This also requires less energy for water pumping.
- **Institutional measures**
  o **Strengthening of private and public research and development** for sustainable development of agriculture.
  o Timely, simultaneous, and adequate availability of **credit, input, and extension support.**
- **Policy measures**
  o **Counter-productive policies should be avoided,** for example of heavy subsidies provided by the government to nitrogen fertilisers.
  o **Emphasis on biogas production and maximizing aerobic fermentation of manure**. Also, promotion of vermicomposting and keeping decomposed manure in an airtight container or with a proper cover.
- **Other Measures**
  o **Less dependence on ruminant animals, feeding of good-quality feed** to reduce methanogenesis and addition of yeast culture in feeds, supplementing green fodder to reduce enteric emissions.
  o **Mass awareness** about climate change, global warming, and the role of the livestock sector in climate change and the impact of climate change on the livestock sector.

2.6. METHANE MITIGATION

Methane Emissions **increased 9**% compared to the last decade as per the recent Methane Budget released by Global Carbon Project. Global **increase is mainly from anthropogenic sources** between Agriculture and Waste and Fossil Fuel.

Impact of Methane in atmosphere

- **Climate Impact:** Methane is a very **effective greenhouse gas.** While its **atmospheric concentration is much less than that of carbon dioxide**, methane is 28 times more effective (averaged over 100 years) at trapping infrared radiation.
- **Health Impact:** Methane is a key precursor gas of the **harmful air pollutant**, tropospheric ozone.
  o When inhaled tropospheric ozone can permanently damage lung tissue. It worsens diseases like bronchitis, emphysema, and triggers asthma.
- **Crop productivity:** Tropospheric ozone reduces the health of plants by reducing their ability to photosynthesize and absorb carbon. This impacts crop productivity.

Methane mitigation offers rapid climate benefits and economic, health and agricultural co-benefits that are highly complementary to CO2 mitigation. Therefore, efforts to be taken to develop technologies and practices that reduce methane emissions. Some of the measures include:

AGRICULTURE	▪ Improve manure management and animal feed quality
	▪ Apply intermittent aeration of continuously flooded rice paddies
	▪ Improve animal health and husbandry by combining herd and health management, nutrition and feeding management strategies
	▪ Introduce selective breeding to reduce emission intensity and increase production
	▪ Promote farm-scale anaerobic digestion to control methane emissions from livestock
FOSSIL FUELS	▪ Carry out pre-mining degasification and recovery and oxidation of methane from ventilation air from coal mines
	▪ Reduce leakage from long-distance gas transmission and distribution pipelines
	▪ Extend recovery and utilization from gas and oil production
	▪ Recover and use gas and fugitive emissions during oil and natural gas production
WASTE MANAGEMENT	▪ Separate and treat biodegradable municipal waste, and turn it into compost or bioenergy
	▪ Upgrade wastewater treatment with gas recovery and overflow control
	▪ Improve anaerobic digestion of solid and liquid waste by food industry
	▪ Upgrade primary waste water treatment
	▪ Divert organic waste
	▪ Collect, capture and use landfill gas

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2.7. CLEAN COAL TECHNOLOGIES

Clean coal technology seeks to reduce harsh environmental effects by using multiple technologies to purify the coal before it burns and contain its emissions.

Some of the common clean coal technologies include:

- **Coal washing**, removes unwanted minerals by mixing crushed coal with a liquid and allowing the impurities to separate and settle.
- **Wet scrubbers,** or flue gas desulfurisation systems, minimises sulfur dioxide emissions from burning of coal which is a major cause of acid rain.
- Low-NOx (nitrogen oxide) burners reduce the creation of nitrogen oxides, a cause of ground-level ozone.
- Electrostatic precipitators remove particulates that aggravate asthma and cause respiratory ailments.
- Carbon capture and storage capturing carbon dioxide usually from large point sources, such as a cement factory or **biomass power plant, transporting it to a storage site, and depositing it where it will not enter the atmosphere, normally an underground geological formation.**
- Recently, National Centre for Clean Coal Research and Development has been inaugurated at Indian Institute of Science (IISc) in Bengaluru **by Ministry of Science and Technology.**
  - The Centre would address several critical R&D challenges towards the development of clean coal technologies in tandem with developing supercritical power plant technologies.
- **Steps taken to promote clean coal technologies are:**

2.7.1. INDIA'S FIRST COAL GASIFICATION BASED FERTILISER PLANT TO BE SET UP IN TALCHER, ODISHA.

About Coal Gasification

- It is one of the clean coal technologies and involves the process of converting coal into synthesis gas (also called syngas).
- Syngas is a mixture of hydrogen (H_2), carbon monoxide (CO) and carbon dioxide (CO_2).
- **The by-products of coal gasification include coke, coal tar, sulfur, ammonia and fly ash, all having their own potential uses.**
- CO_2 and ammonia are further reacted to produce urea.
- Syngas can also be used in a variety of other applications such as in the production of electricity, fuel for IC engines, making plastics, cement etc.

2.7.2. EMISSION NORMS FOR THERMAL POWER PLANTS

In 2015, Ministry of Environment, Forests and Climate Change (MoEFCC) notified specific standards for the thermal power plants(TPPs) to control the emissions under **"Environment (Protection) Amendment Rules, 2015'. The deadline for the same has been extended to 2022 for over 300 such units.**

- **The emission norms provide different mechanisms** to reduce the emissions and usage of water such as:
  - **Flue Gas Desulphurization (FGD)** process for controlling SOx emissions.
  - **Selective Non-Catalytic Reduction (SNCR) and Selective Catalytic Reduction (SCR) system** for controlling NOx emissions.
  - **Electro-Static Precipitators (ESPs)** are to be deployed for control of particulate matter (PM) in thermal power stations.

- **Present status TPPs emissions**
  - In 2017, 165.9 gigawatts (GW) out of the total of 187.1 GW — or **89% of the country's existing coal based power capacity — were not in compliance** with the sulphur dioxide (SO_2) emission limits notified in 2015.
    - ✓ **Only 1% of the total coal-fired power plant capacity** have installed the mandatory FGD systems.
  - According to Centre for Science and Environment **less than half of the coal-fired capacity is in compliance with particulate matter (PM) standards.**
  - Of the total coal-fired capacity in the country, plants **with only 27% capacity have awarded bids for FGD implementation**. Around 72% capacity have not even awarded the bids at present.

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o **Installation of cooling towers** in order to change over to closed cooling water system for controlling water consumption.

2.7.3. CARBON CAPTURE, UTILISATION & STORAGE (CCUS)

The Department of Science & Technology (DST) has invited proposals from Indian researchers in the area of CCUS under **Accelerating CCUS Technologies (ACT)** in collaboration with other ACT member countries.

* ACT is an initiative to facilitate the emergence of Carbon dioxide (CO_2) Capture, Utilisation, and Storage (CCUS) via **translational funding of projects** aimed at accelerating and maturing CCUS technology through targeted innovation and research activities.
* Sixteen countries, regions, and provinces are working together in ACT.

More on Carbon capture, utilisation and storage (CCUS)

* CCUS is group of technologies designed to **reduce the amount of CO_2** released into the atmosphere from coal and gas power stations as well as heavy industry including cement and steel production. Once captured, the CO_2 can be either re-used in various products, such as cement or plastics (**utilisation**), or stored in geological formations deep underground (**storage**).
* **Capture technologies** separate CO_2 from other gases which may be done in three different ways:
  o **Pre-combustion capture**: It refers to capturing **CO_2 generated as an undesired co-product** of an intermediate reaction of a conversion process. A pre-combustion system involves first converting solid, liquid or gaseous fuel into a mixture of hydrogen and carbon dioxide using one of a number of processes such as 'gasification' or 'reforming'.
    ✓ **Gasification** is a process that converts biomass- or fossil fuel-based carbonaceous materials into carbon monoxide, hydrogen and carbon dioxide.
    ✓ **Reforming**, in chemistry, processing technique by which the molecular structure of a hydrocarbon is rearranged to alter its properties.
  o **Post-combustion capture**: It involves **separation of CO_2 from waste gas streams** after the conversion of the carbon source to CO_2 – for example, via combustion of fossil fuels or digestion of wastewater sludge. It includes methods like absorption in solvents, high pressure membrane filtration, adsorption by solid sorbents, including porous organic frameworks, and cryogenic separation etc.
  o **Oxy-fuel combustion**: It can only be applied to **processes involving combustion**, such as power generation in fossil-fuelled plants, cement production and the iron and steel industry. Here, **fuel is burned with pure oxygen to produce flue gas with high CO_2 concentrations** and free from nitrogen and its compounds.
    ✓ **Flue gas** refers to the **combustion exhaust gas** produced at power plants and other industries.
* **Storage**: Suitable storage sites for captured carbon include former gas and oil fields, deep saline formations (porous rocks filled with very salty water), coal bed formations, ocean bed etc.
* **Utilization**: As an alternative to storage, captured CO_2 can be used as a commercial product, either directly or after conversion. Examples of utilisation include-
  o **In the food and drink industry**: CO_2 is commonly used as a carbonating agent, preservative, packaging gas and as a solvent for the extraction of flavours and in the decaffeination process.
  o **In the pharmaceutical industry**: where CO_2 can be used as a respiratory stimulant or as an intermediate in the synthesis of drugs
  o **Concrete building materials**: CO_2 can be used to cure cement, or in the manufacture of aggregates.
  o **Enhanced oil and coal-bed methane recovery**: where the carbon dioxide is injected into depleting oil or gas reserves to increases the amount of recovery.
  o **Production of chemicals, plastics and fuels** such as methanol, urea, polymers, syngas etc.
  o **Remediation of alkaline industrial wastes**
  o **Mineral carbonation**: It is a chemical process in which CO_2 reacts with a metal oxide such as magnesium or calcium to form carbonates.
  o **Biofuels production**: CO_2 can be used to cultivate microalgae used for the production of biofuels.
  o **Generating additional power: Technologies are being developed to use CO_2 for power generation. Example-** CO_2-based steam cycles can help power generation turbines run more efficiently, geologically stored CO_2 could be used to extract geothermal heat for producing renewable geothermal energy.

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Concerns

- **High Costs**: Due to reasons such as, technological limitations, extra energy and materials needed in the process of carbon capturing, transport and infrastructure costs etc., CCUS technologies are still not cost effective and scalable. For example- Oxy fuel combustion requires oxygen which is expensive.
- **Environmental impacts**: Deep sea storage of CO_2 can lead to acidification or eutrophication and harm marine organisms close to injection points. Long term effects of direct CO_2 injection on large ocean areas have not yet been studied.
- **Leakage**: The main concerns with CO_2 storage are its possible leaks and the related damage that a concentrated CO_2 stream would cause if it escaped into the environment.
- **Benefits being partly offset by emissions related to the CCUS life cycle chain:** The extra energy and materials needed for the technology: for example, from fuel extraction, transportation, infrastructure building, burning of fuel, CO_2 capture, solvent production etc., can increase concentration of other gas pollutants and deplete natural resources.

Way Forward

- **Environmental impacts** of CCUS have to be evaluated carefully on a life cycle basis to ensure a positive economic and environmental balance.
- **Further research** is needed to develop **cost-effective and energy-efficient** capture techniques. Focus should be on the development of materials and products with longer lifetimes to enable **long-term storage** of CO_2.
- Governments should establish an **overall policy strategy and pathway for CCUS in industry**, incorporating necessary R&D priorities, **awareness generation**, incentive policy mechanisms and legal frameworks.

3. WATER

3.1. GROUNDWATER POLLUTION

- Due to its low capital cost, **groundwater is the most preferred source of water in India**. According to an estimate, groundwater accounts for nearly 80 per cent of the rural domestic water needs, and 50 per cent of the urban water needs in India.

- However, a **variety of land and water-based human activities** including over exploitation and unscientific extraction are polluting this reliable and safe source of water,making it unsafe and unfit for human use.
  - o **70% of India's water resources are contaminated with one or more heavy metals and chemicals such as Arsenic, Uranium, Fluoride, Nitrate etc.**

- Other reasons of groundwater contamination are:
  - o **Inland Salinity:** Inland salinity in ground water is prevalent **mainly in the arid and semi-arid regions** such as Rajasthan, Haryana, Punjab etc. It is also caused due to practice of surface water irrigation without consideration of ground water status.

Arsenic Contamination
- As per the recently released report by CGWB, **21 states** across the country have **pockets with arsenic levels higher than** the Bureau of Indian Standards' (BIS) stipulated permissible limit of 0.01 miligram per litre (mg/l).
- The states along the **Ganga-Brahmaputra-Meghna (GBM) river basin** Uttar Pradesh, Bihar, Jharkhand, West Bengal and Assam are the **worst affected.**
- Sources of arsenic include Natural processes (**Weathering of rocks and minerals** comprising sand, silt and clay, **followed by leaching and runoff) and Anthropogenic activities** (like intense exploitation of groundwater, application of fertilizers, burning of coal and leaching of metals from coal-ash tailings).
- Treatment technologies based on **oxidation, co-precipitation, adsorption, ion exchange and membrane** process has been developed for removal of arsenic from contaminated water.

  - o **Coastal Salinity: Withdrawal of fresh ground water from coastal aquifers** may result in intrusion of saline water in coastal aquifers. E.g. Problem of salinity ingress has been noticed in Minjur area of Tamil Nadu and Mangrol – Chorwad- Porbander belt along the Saurashtra coast.

- **Drinking of contaminated water leads to various diseases** such as neuro-muscular disorders, gastro-intestinal problems, skin cancers, chronic kidney disease among others.

- In addition to drinking water, regular extraction of contaminated groundwater and its consequent uptake by food crops facilitates the entry of chemicals in foodchain which **increases possibilities of biomagnification**(concentration at higher levels in food chain).

Issues in Tackling Groundwater Contamination and Pollution

- **Inadequacies in monitoring groundwater quality**
  - o **Monitoring agencies** i.e. Central Ground Water Board (CGWB) and state groundwater agencies **lack adequate staff** to carry out their functions.
  - o There are a **few observation stations in the country** that cover all the essential parameters for water quality and hence the data obtained are not decisive on the water quality status.
  - o The **SPCBs perform the dual functions of monitoring pollution and enforcing pollution** control norms. This **creates a disincentive for them to perform the first function** meaningfully.

Uranium Contamination
- Central Ground Water Board noted widespread uranium contamination in groundwater from aquifers across 16 states in India including **Punjab, Rajasthan, Andhra Pradesh, Chhattisgarh, Gujarat, Haryana, etc.**
- A new study has found **uranium contaminating for the first time in the groundwater in 10 districts of Bihar(upto 80 mg/lt).**
- Unlike the limits for arsenic and other toxic or heavy metals specified in the under Bureau of Indian Standards' Drinking Water Specifications, there is **no limit maintained for uranium.** The **permissible limit** according to the World Health Organization (WHO) is **30 microgram per litre.**
- The source of uranium is **naturally occurring**, but human activities like over pumping enhance the uranium problem.
- **Ex situ Treatment** such as **Adsorption and Precipitation and In-situ chemical stabilization such as Redox and Flushing Technologies** are useful in treating Uuranium contaminated water.

- **Lack of effective enforcement of pollution control norms-** due to the fact that cost of pollution is much less than the cost of treatment works as a disincentive for polluters.
- D**ecentralized nature of Ground water use** makes it hard to keep a check on over exploitations and pollution of ground water.

Government Efforts to control the Ground Water Pollution

- **"A Master Plan for Artificial Recharge of Groundwater"** has been developed by the Central Ground Water Board (CGWB) in 2013. According to this plan, over 85 billion cubic metres will be recharged in rural and urban areas in a phased manner by 2023.
- **Legislations and programmes to protect groundwater :** Water (Prevention and Control of Pollution) Act, 1974; Environmental Protection Act, 1986; the creation of Arsenic task force in West Bengal in 2005 and the launch of Salinity Ingress Prevention Scheme in Gujarat in 2008.
- **Atal bhujal Yojna,** a central sector scheme to improve groundwater management and restore the health of country's acquifers.
- **National Project on Aquifer Management (2016):** The project proposes to cover 1.4 million sq km under aquifer mapping between 2017 and 2022.

Way Forward

The CAG (Comptroller and Auditor General) has made the following recommendations with regard to the prevention and control of pollution of groundwater:

- The Ministry of Environment, Forest and Climate change needs to establish **enforceable water quality standards** for lakes, rivers and groundwater to help protect ecosystem and human health.
- **Penalties** need to be levied for violations of water quality standards.
- States need to take measures for **source control of pollutants** through sewage and agriculture runoff entering water bodies in projects for conservation and restoration of lakes.

3.1.1. GROUNDWATER EXTRACTION IN INDIA

Why in News?

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

Background

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

> **Groundwater usage in India**
> - **India uses the most groundwater in the world,** extracting 253 bcm (billion cubic metres) per year. This is approximately 25% of the global groundwater extraction.
> - Almost 22% of groundwater (assessed un- its) in the country has either dried up or is in the 'critical' and 'over-exploited categories (where annual groundwater consumption is more than its recharge).
> - **Majority of the over-exploited units** are concentrated in parts of **Punjab, Haryana, Delhi,** western UP, Rajasthan, Gujarat, Karnataka, Andhra Pradesh, Telangana and Tamil Nadu.
> - According to the country's minor irrigation census 2013-14, **87.86% of groundwater wells are owned by marginal, small and semi-medium farmers** having land holding up to four hectares.
> - **NITI Aayog's "Composite Water Management Index"** (CWMI), held that **21 Indian cities,** including Delhi, Chennai and Bengaluru, will run out of groundwater by 2020.

New Guidelines

- **Regarding NoC:**
  - o **Mandatory No objection certificate (NoC)** for new and existing industries, group housing societies, infrastructure projects, mining projects and bulk water suppliers for withdrawal of groundwater. Such NoC will remain valid for 2-5 years depending upon the entity.
  - o **NoCs in 'over-exploited' areas** will only be granted to micro, small and medium enterprises (MSME).
  - o **Exemption from getting NoC** to

- ✓ individual domestic consumers in both rural and urban areas for drinking water and domestic uses.
- ✓ rural drinking water supply schemes;
- ✓ Armed Forces Establishments and Central Armed Police Forces establishments in both rural and urban areas;
- ✓ agricultural activities;
- ✓ micro and small enterprises drawing groundwater less than 10 cubic m/day.

- **Abstraction and restoration charges** based on the quantum of extraction **to be paid by the NoC holders.**
- **Residential societies will have to install**

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

sewage treatment plants (STPs) for getting NOCs if their groundwater requirement is more than 20 cubic m /day (20000 litres/day) and water from STPs will be utilised for toilet flushing, car washing, gardening, etc.
- **Compulsory annual water audits** for industrial users apart from mandating impact assessment for granting no-objection certificates (NOCs) for groundwater extraction.
- **Registration of Drilling Rigs by the respective** State/UT Governments for maintaining the database of wells drilled by them.
- **Abstraction of Saline ground water would be encouraged:** Such industries shall be exempted from paying ground water abstraction charges.
- **Protection of Wetland Areas:** Projects falling within 500 m. from the periphery of demarcated wetland areas shall mandatorily submit a detailed proposal indicating that any ground water abstraction by the project proponent does not affect the protected wetland areas.
  - Furthermore, before seeking permission from CGWA, the projects shall take consent/approval from the appropriate Wetland Authorities to establish their projects in the area.
- **Environmental Compensation &Penalty:** Extraction of groundwater for commercial use without a valid NOC will be considered illegal and they will be liable to pay environmental compensation of minimum Rs. 1 lakh. Non-compliance of NOC conditions may attract a penalty between Rs 50,000 and Rs 10 lakh.
- **States/UTs are advised** to review their free/subsidized electricity policy to farmers, bring suitable water pricing policy and may work further towards crop rotation/diversification/other initiatives to reduce overdependence on groundwater.

Concerns in Guidelines

- **Exemption of the agriculture sector:** As per official data, 90% of groundwater is used for irrigation and 10% by domestic and industrial consumers**.**
- **Conflict between state and centre:** Water is a state subject; the guideline is expected to generate contestation at a time when the statutory power between states and the Centre is already under great strain.
- **Implementation issues:** The implementation would be difficult as it will raise conflict with single-window clearance of applications for establishing new industries.
- **Impact of mining projects:** Negative hydrological impacts of mining are far more serious than industries and should have been cateogorised separately with detailed guidelines.
- **Not addressing depletion of groundwater**: It will not stop further depletion of groundwater as uninterrupted use of groundwater in 'critical' and 'semi-critical' areas after paying 'abstraction and restoration' charges will defeat the purpose of conservation.

Way forward

- **Promoting recycling and reuse:** While Israel recycles nearly 90% of its water, India's recycling capacity stands at just 30%. The problem is worse at the household level, where not even 5% of the water used is recycled.

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- o Need to incentivise investors to use bulk volumes of rejected groundwater (grey water, black water) available in urban, semi-urban areas for recycling and reuse.
- **Real time data:** The groundwater estimates need to be dumped and migrated to real time modelling.
  - o The first step in this direction is a **national well census** that covers all wells adopting crowd-sourcing technology.
- **Capping water use** by defining the maximum water footprint for various crops.

3.2. DRINKING WATER POLLUTION

- As per the Department of Consumer Affairs' released a report on the **quality of piped drinking water** in major cities in India,
  - o A vast majority of the samples have failed to comply with the requirements of Indian Standard (IS) 10500:2012 (Specification for Drinking Water as set by the BIS) in one or more parameters.
  - o Delhi has abysmal water quality, Chennai and Kolkata rank very low, and Mumbai is the only city with acceptable results.

Causes of poor water quality

- **Focus on chlorination**- chlorination only kills bacteria & other microorganisms but aspects like appearance, smell and taste are ignored. Moreover, dissolved salts, alkalinity, toxic metals in water can't be eliminated by it.
- **Contamination in pipes**- The pipes carrying the water are old and leaking. Moreover, often the water supply line & sewerage lines run side by side which leads to contamination of water.
- **Groundwater pollution** : Contaminated groundwater is often mixed with piped water supply to meet the large demand of the city.

Why Mumbai has clean drinking water?
- The reason why Mumbai's water is relatively safer because generally it is sourced from rainwater (the purest source of water).
- Since 2012-13, the Municipal Corporation of Greater Mumbai (MCGM) has stopped using steel water pipes for surface distribution. The supply is now being channelled through 14 underground concrete water tunnels.
- In several slums, the criss-crossing network of pipes (spaghetti networks) has been replaced with single six-inch pipes.
- **Water testing labs have been upgraded** with the help of the National Environmental Engineering Research Institute (NEERI) and water sampling procedures have also been streamlined to ensure accuracy of results.

Other relevant information
- As per Composite Water Management Index (CWMI) **report**
  - o With nearly 70 percent of water contaminated, India ranks 120th of 122 countries in a global water quality index.
- **Central Ground Water Board** estimates that nearly a fifth of the urban local bodies are already facing a water crisis due to excessive extraction, failed monsoons, and unplanned development.

- **Lack of accountability** of the official agencies- data on water is not made public on the same lines as air quality. Moreover, it is not legally binding on agencies to achieve such standards.
  - o There is an issue of **conflict of interest** as the same agency that provides water, also performs regular testing.
- **Lack of coordination**- between Union, State and Local government since water is a state subject.
- **Other factors**- Rapid urbanization, water pollution due to domestic and industrial waste, contamination and depletion of local water bodies etc.

Consequences of poor water quality

- **Harmful health impacts:** Around 80 per cent of diseases in the developing countries are attributed to poor quality of water supply. This includes bacterial and viral infections, reproductive and endocrinal damage, damage to nervous system , digestive tract cancer etc.

- **High economic cost:** increased out-of-pocket expenditure for healthcare, reduced labour productivity and reduction in tourist inflow.
- **Reinforces pollution positive feedback loop:** Result of poor drinking water is the prime reason for the sale of plastic bottled drinking water. However, this bottled water gives rise to plastic pollution that increases water pollution.
- **Wastage of resources:** The RO (Reverse osmosis) purification systems waste more than double the amount of water that they produce for drinking. Moreover, all the essential minerals and salts are removed during RO process, which have to be artificially added later thereby increasing its cost.

Way Forward

- **Data based support system:** Water quality should be tested frequently and the findings should be made public.
  - This will increase involvement, sensitization & awareness of citizens and accountability of service providers and the government.
- **Mandatory compliance:** Compliance to **Bureau of Indian Standards** for water quality should be made mandatory for local bodies.
- **Pricing for water:** Water can be priced for well-off sections of society so that proper maintenance cost should be recovered. Subsidies given need to be restructured to curtail wastages.
- **Better management:** Long-distance pipelines of water should be discouraged and water treatment should be made more localized.
- **Technological solution:** Up-gradation of the water treatment plant to remove toxic inorganic pollutants and dissolved solids.
- **Rainwater harvesting:** should be encouraged to the maximum extent possible.
- The government's effort to provide piped water to all rural households by 2024 under the **Jal Jeevan mission**, is a step in the right direction.

> **Recent government initiatives in this regard**
> - **Jal Jeevan Mission is the project** launched by union government to ensure HarGharJal (piped water supply) to all **rural households by 2024** under the Department of Drinking Water and Sanitation, Jal Shakti Ministry.
> - **Mission Bhagiratha** is a project for safe drinking water for every village and city household in **Telangana State**. The project will supply clean drinking water sourced from **River Godavari and River Krishna.**

3.3. WATER PRICING

The Centre has allowed gram panchayats and local bodies to decide on water usage charges for supply of potable piped water under the Jal Jeevan Mission.

Need for water pricing in India

India is specially in need of a standardized water pricing regime because of its unprecedented water crisis.

- **Scarcity of water:** About **82% of rural households in India do not have individual piped water supply,** and 163 million live without access to clean water close to their homes. **70% of India's surface water is contaminated.**
- **Failure in efficient management of water resources:** India ranks as the **third-largest exporter of groundwater** through virtual water trade (through agricultural products), while 52% of its wells are facing declines.
- **Low water use efficiency in agriculture**: Agriculture consumes around 80% of our water resources, but water use efficiency continues to be **among the lowest in the world** (25-35 percent as compared to 40-45 percent in Malaysia and 50-60 percent in Israel, Japan, China and Taiwan).

> **Related information**
> **Policy approach towards pricing of Water in Public System in India**
> - The **1987 policy** envisaged that the water rates should reflect the scarcity value of the resource and foster economy in water use.
> - **The 2002 policy** envisaged that the water charges for various uses should cover at least the operation and maintenance charges of providing the service initially, and a part of capital costs subsequently.
> - The **latest 2012 National Water Policy** envisages that pricing of water should reflect its efficient use and reward its conservation.
>
> **Dublin Principles**
> These were adopted at the International Conference on Water and the Environment in Dublin, Ireland, in 1992.
> - **Fresh water is a finite and vulnerable resource**, essential to sustain life, development and the environment.
> - Water development and management should be based on a **participatory approach**, involving users, planners and policy-makers at all levels
> - **Women play a central part** in the provision, management and safeguarding of water
> - **Water has an economic value** in all its competing uses and should be recognized as an economic good
>
> **Role of Local Bodies in water management**
> - Under **11th Schedule (Article 243G)** of the Constitution, Panchayats can be entrusted with the Minor irrigation, water management and watershed development activities, Drinking water.
> - Under **12th Schedule (Article 243W)** of the Constitution, Urban Local Bodies can be entrusted with the Water supply for domestic, industrial and commercial purposes.
> - The state legislatures may devolve these powers and necessary authority to the local bodies to levy tax, fees etc. for the use of these resources.

- **Poor supply infrastructure** as municipalities and urban centres are unable to recover the cost of treatment and supply the drinking water to its residents leading to contamination and wastage of water.

Benefits of Appropriate Pricing of Water

- Tariffs **generate revenues to recover specific costs** (e.g. operation and maintenance costs)
- Tariffs **generate funds for necessary infrastructure development** and expansion as well as for wastewater treatment, hence assuring water quality protection.
- Charges send **appropriate price signals to users** about the relationship between water use and water scarcity and can **encourage people to reduce wasting water.**
- Subsidizing tariffs for low-income groups ensure that poor households also have **sufficient and affordable water services.**

Issues with current water pricing mechanism

Irrigation Water Pricing:	• **Fixing the price:** Prices are fixed on the basis of the mix of social, economic, and political factors. The main criteria for fixing water prices are **farmers' ability to pay**, which is determined by output, area irrigated based on the volume of water used, quality of irrigation, and recovery cost of equipment. • **Water Rates revision:** There is an **inordinate delay** in the revision of water rates. This is due to the lack of linkages between fees collected and funds allocated to irrigation projects, lack of farmers' participation, poor communication, lack of transparency between farmers and irrigation departments, no users' penalties.
Domestic Water Pricing:	• The present water charges are able to recover 22–25 % lower than the O&M costs and do not recover the capital cost or cost for future expansion. • The **actual level of consumption is not known** in many cities and states as metering is negligible and **flat rates** exist. • Overcharging the commercial users and subsidizing the domestic consumption are also creating problems in the existing systems as there are **no norms** for fixing these varying rates. • In addition to the inadequate pricing, the water sector is characterized by **huge inefficiencies** due to unaccounted-for water losses (up to 40 %), poor quality, etc.
Industrial Water Pricing	• The **cost of water has three components**: **water cess** paid to the pollution control boards, **cost of buying water** from the suppliers (municipalities), and **cost of extracting water** from rivers and groundwater. There is **no consensus** on the range of industrial water demand, price elasticity, and sensitivity of the water demand to other factors, such as input prices and output levels. • Industries are not only consuming water but also **pollute the water resources**. However, the **rate of cess is very low** and the **purpose of the cess** is not to encourage efficient use of water but to collect resources for financing state pollution control boards.
Other cross sectoral issues:	• **Federal Challenges:** Constitutionally, **water is a state subject whereas regulation and development of water is a Union subject**. The Central government does not have an approved framework for water pricing. However, the **draft National Water Framework Bill, 2016** lays down the principle of water pricing. • **Water Regulator:** The water charges for industries and the domestic sector vary widely across States. There is **no independent statutory water regulatory authority** in any State barring Maharashtra. Even here, its mandate, however, only covers water for irrigation leaving the pricing of water for domestic and industrial use at the behest of the State agencies. • **Groundwater:** The Centre for the first time issued a notification, in December 2018, for the levy of **Ground Water Conservation Fee (GWCF)** by industry and domestic users for consumption beyond a certain limit. It is yet to come into effect. • **Inherent design problems** associated with water pricing. This is because the government does not **exercise control over the sources of water as it does over other natural resources,** eg. groundwater.

Framework to determine the water pricing

The National Water Policy Statement of 2012 regarding Water Pricing advocates the following:

- **Statutory Water Regulatory Authority (WRA):** Pricing of water should be arrived at through independent statutory Water Regulatory Authority, set up by each state, after wide ranging consultation with all stakeholders.

Mains 365 – Environment

- **Volumetric Pricing:** In order to meet equity, efficiency and economic principles, the water charges should preferably/as a rule be determined on volumetric basis. Such charges should be reviewed periodically.
- **Wastewater Pricing:** Recycle and reuse of water, after treatment to specified standards, should also be incentivized through a properly planned tariff system.
- **Differential Pricing:** The principle of differential pricing may be retained for the pre-emptive uses of water for drinking and sanitation; and high priority allocation for ensuring food security and supporting livelihood for the poor.
- **Role of Water Users Associations:** Water Users Associations (WUAs) should be given **statutory powers** to collect and retain a portion of water charges, manage the volumetric quantum of water allocated to them and maintain the distribution system in their jurisdiction. WUAs should be given the **freedom to fix the rates** subject to floor rates determined by WRAs.
- **Groundwater:** The over-drawl of groundwater should be minimized by regulating the use of electricity for its extraction. Separate electric feeders for pumping ground water for agricultural use should be considered.

3.4. VIRTUAL WATER TRADE

Experts are suggesting virtual water trade as one of the alternatives to ensure sustainable water consumption.

What is Virtual Water Trade?

- Virtual water (VW) is the water 'embodied' in a product, not in real sense, but in virtual sense. It refers to the water needed to produce a product.
  - Every product has a unique **water footprint** defined as the total volume of fresh water used to produce the goods and services consumed by the individual or community or produced by the business. For eg. on an average, 3000 liters of water are required for producing 1 kg of rice.
- **Virtual water trade (VWT) refers to the import and export of hidden water in the form of products** such as crop products, textiles, machinery and livestock — all of which require water for their production.

> **VWT in India:**
> - According to the Water Footprint Network (WFN) database, India had the **lowest virtual imports of water** in the world.
>   - **India is a net virtual water exporter** because of agricultural products.
>   - India exported 26,000 million litres of virtual water on an average every year between 2006-2016.
>   - Rice was the highest exported food product, followed by buffalo meat and maize.
> - As a result, **the amount of water taken out of Indian rivers is way more** than that goes back in through natural rainfall and melting snow.
> - **Inter-state VWT,** especially of food grains, has revealed an **unsustainable pattern of water usage** in certain parts of India.
> - Punjab and Haryana, despite being among the most water stressed regions in the country, have been the source of a majority of water intensive food grains trade to water stressed states like Maharashtra and Tamil Nadu.
> - Furthermore, food grains have also been exported from Punjab and Haryana to states that have more favourable agro-climatic conditions and water endowments for the cultivation of food grains, such as Assam and the Northeastern states.
> - This 'perverse' direction of inter-state VWT in India has further intensified water scarcity in the already water stressed regions.

  - The concept of virtual water trade was introduced by Tony Allan in 1993 to explain the imports of water intensive products in arid and semi-arid regions in the Middle East and North Africa, and has its foundations in the notion of comparative advantage (CA) propounded by David Ricardo.
    - ✓ In comparative advantage theory, nations should export products in which they possess a relative or comparative advantage in production, while they should import products in which they possess a comparative disadvantage.

Significance of VWT concept

- **Optimising domestic water use:** Through imports of water intensive agriculture products, water stressed regions can optimise the use of their already scarce water resources. The water 'saved' through VWT can be used towards other ends such as for drinking, sanitation purpose, among others.

- **Conservation of water resource:** Knowing the virtual water content of products creates awareness of the water volumes needed to produce the various goods, thus providing an idea of which goods impact most on the water system and where water savings could be achieved.
- **To achieve water security:** It would direct virtual water flows from relatively wet to relatively dry regions. Net import of virtual water in a water-scarce nation can relieve the pressure on the nation's own water resources. Virtual water can be seen as an alternative source of water.
- **Alternate to mega project:** It will act as an alternate to mega **project such as** Interlinking of Rivers **(ILR) in India to alleviate regional water scarcity**.
  - It will save huge economic and environment cost as it is estimated that $125 to $200 billion is the construction cost of the ILR project.

Challenges

- **Quantifying the virtual water content of products:** because there are many factors influencing the amount of water used in a production process.
  - It does not express the social, environmental nor economic value of the water to local communities. For example: one cubic meter of soil water to produce pasture in the Netherlands for dairy and then export cheese, cannot be compared easily with one cubic meter of groundwater in the desert of Ica in Peru
- **Quantifying virtual water trade flows:** Quantitative research on global virtual water trade has started only very recently and there are no universally accepted norms.
  - Though it is estimated in various studies that dominant virtual water exporters are the USA, Canada, Australia Argentina and Thailand globally. Countries with a large net import of virtual water are Japan, Sri Lanka, and Italy.

Conclusion

VWT from relatively high to low water productivity regions would result in real water savings. For this, Virtual water accounting must take place in national and regional water and agricultural policy analysis. Optimal use of water resources must be made based on the prioritisation of various types of needs and demands for water, including ecosystem needs.

4. PLASTIC

4.1. SINGLE USE PLASTIC POLLUTION

Why in News?

India has **held off imposing a blanket ban** on single-use plastics to combat pollution.

About Single use plastic

* Single-use plastics, often also referred to as **disposable plastics**, are commonly used for plastic packaging and include items **intended to be used only once** before they are thrown away or recycled. These include, among other items, grocery bags, food packaging, bottles, straws, containers, stirrers, styrofoam cups or plates etc.
* According to Un-Plastic Collective Report, an estimated **8.3 billion tonnes of plastic has been produced** since the early 1950s, about **60% of which has ended up either in a landfill or the natural environment.**
* **India alone generates 9.46 million tonnes of plastic** waste every year, around **43% of which comprises single-use plastic.**

Impacts of single use plastic (SUP)

* **Environmental pollution**: A staggering total of it remains uncollected causing choking of drainage and river systems, littering of the marine ecosystem, soil and water pollution, ingestion by stray animals, and open air burning leading to adverse impact on environment.
* **Disposal issue**: They do not biodegrade instead they slowly break down into smaller pieces of plastic called microplastics which again causes more issues. It can take up to thousands of years for plastic bags and Styrofoam containers to decompose.
* **Human health**: The toxins, poisons and persistent pollutants present in some of these plastic products leach and enter human bodies where they cause several diseases, including cancer and can damage nervous systems, lungs and reproductive organs.
  * Humans may be consuming anywhere from 39,000 to 52,000 microplastic particles a year **through fish (contaminated with microplastics) alone.**
* **Marine life & climate change**: Plastic waste is at epidemic proportions in the world's oceans with an estimated 100 million tonnes dumped there to date.
  * Plastic kills an estimated 1 million sea birds every year and affects around 700 species which get infected by ingesting plastics.
  * Single-use plastics make up on **average 49% of beach litter**.
* **Increasing Carbon dioxide**: If the production, disposal and incineration of plastic continues on its present day growth trajectory, by 2030 these global emissions could reach 1.34 gigatonne per year — equivalent to more than 295 coal-based power plants of 500-MW capacity.
* **More impact on developing countries**: The ubiquitous plastic seems to be a curse for the third world countries, because poor countries, especially in Asia, not only have their own plastic dump to deal with but also the plastic trash that lands on their shores from developed countries.
  * India has imported 99,545 MT plastic flakes and 21,801 MT plastic lumps from South America, Africa, Middle East, Europe and Asia.
  * Recently, Malaysia has decided that 450 tonne of contaminated plastic waste would be shipped back to where it came from — Australia, Bangladesh, Canada, China, Japan, Saudi Arabia and the US.

LIFE IN PLASTIC

Plastic consumption has rapidly shot up across the world, necessitating a complete rethink of its role in society and the economy.

Size of the plastic processing industry (mn tonnes/year)

13.4 (2015)   22 (2020*)
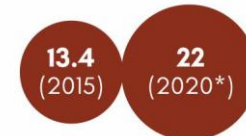
Per capita consumption of plastic (kg/year)

2015   11
2020*   20
*Projected

Per capita consumption of plastic in 2014–15(kg/year)

US 109   Europe 65   China 38   Brazil 32   Global average 28   India 11
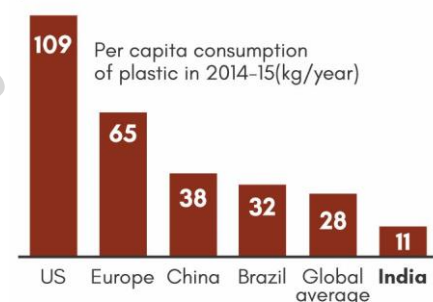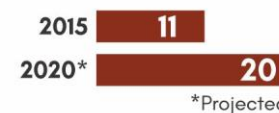
Challenges with banning single use plastic

- **No immediate alternatives:** It is difficult to ban the product which is of immense use to the public, without thinking of a sustainable and equally utilitarian alternative product.

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  Global steps
  - United Nations Environment Program (UNEP) had declared the theme for **World Environment Day 2018 as 'Beat Plastic Pollution'**.
  - **G20 Implementation Framework for Actions on Marine Plastics Litter** which is aimed at facilitating further concrete action on marine waste, though on a voluntary basis.

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  - o For e.g. Single-use plastic helps keep medical equipment sterile and safe to use.
  - o There is no alternative to plastic yet and sectors like pharmaceuticals, hardware, toys, food processing, food delivery will be in total chaos.
  - o While there is increased awareness in urban area, the challenge will be to find a suitable cost effective alternatives in tier II and tier III towns and remote locations.
- **Impact on packaging industry:** It impacts most industries since SUP forms part of packaging and hence is linked to all industries directly or indirectly.
  - o If plastic sachets made from multi-layered packaging are banned, it can **disrupt supplies of key products** such as biscuits, salt and milk etc which has made life easier for the poor in terms of affordable small packs and convenience.
  - o Ban will **increase the price of most FMCG products** as manufacturers would try and shift to alternative packaging (which can be costlier).
- **Loss of jobs and revenue:** Ban can lead to loss of revenue as well as job loss in the plastic manufacturing industry.
  - o India's plastic industry officially employs around 4 million people across 30,000 processing units, out of which 90% are small to medium-sized businesses.
  - o Plastics also support thousands employed informally such as ragpickers as well as street food and market vendors who are reliant on single-use plastic.
- **Attitudinal change:** It is difficult as no one takes the responsibility for the single use plastic thrown by them and behaviour change towards the shift from non-using of single use plastic is difficult

Way forward

- **Define single use plastic**: It will help to categorise items according to both their "qualitative and quantitative aspects" as well as "technical attributes".
- **Effective waste management with focus on segregation, collection and recycling:** India uses about 14 million tonnes of plastic annually but lacks an organised system for management of plastic waste, leading to widespread littering.
  - o There is a need to invest heavily in improving source segregation of waste and supporting end-to-end segregation of waste to strengthen processing.
- **Policy framework for phased ban:** There is need for a National Action Plan or guidelines that focus on implementing plastic ban in a phase-wise manner in terms of urgency.

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Innovative practices
- **India**
  - o **Rice for plastic:** Andhra Pradesh launched 'Rice for Plastic' drive to eradicate single-use plastic while feeding the hungry.
  - o **Conversion into fuel:** Council of Scientific and Industrial Research (CSIR) in 2014, developed a unique process of converting plastic waste like polyethylene and polypropylene to either gasoline or diesel.
  - o **Degrading plastic:** IIT Madras has demonstrated an environment-friendly strategy to degrade the chemically inert and physically stable plastic-polytetrafluoroethylene (PTFE) by continuous stirring it in water containing glucose and metal ions for about 15 days at 70°C.
- **Global**
  - o **Ireland:** They introduced a tax on plastic bags at points of sale, known as the "PlasTax". The levy was set six times higher than the estimated willingness to pay. It aimed to trigger behaviour change in consumers.
  - o **Norway deposit refund system:** Since 1999 Norway has used a deposit refund system for its beverage bottles and cans where public can return them at reverse vending machines to receive the deposit back.

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  - o This means products that have alternatives available should be phased earlier than the items which do not have alternatives, simultaneously reinforcing research and development funding for different alternatives and eco-friendly products.

- **Effectively implement Extended Producer Responsibility (EPR):** There is need to clear about which items should be included in EPR. Ideally it should include all plastic packaging items that are not collected and become waste instantly, such as multi-layered plastics, PET, milk pouches, sachets, etc.
  - Also, companies are getting together and setting up their own plastic waste collection and recycling schemes for items such as PET, that have a high recycling value (about 90 per cent), but an approach that integrates industry, informal sector and ULB would lead to better implementation of EPR.
- **Focus on innovation in designs:** Government should invest money in encouraging the setting up of ventures that provide sustainable products as an alternative to current non-recyclable products.

4.1.1. EXTENDED PRODUCERS RESPONSIBILITY

Why in news?

Recently, government released draft of 'uniform framework for Extended Producers Responsibility(EPR)' under Plastic Waste Management Rules (PWMR) 2016.

EPR puts the financial and/or physical onus on manufacturers i.e. plastic producers, importers and brand-owners--for the treatment, recycling, reuse or eco friendly disposal of products after a consumer has used and disposed of them.

About draft Extended Producers Responsibility (EPR) framework

- EPR framework under PWMR 2016 has proposed three models:
  - **Plastic credit model**
    - ✓ In this **producer is not required to recycle** their own packaging, **but to ensure that an equivalent amount of packaging waste has been recovered and recycled** to meet their obligation.
    - ✓ Producers and processors/ exporters **may exchange plastic credits** for a financial transaction at a price and other terms as negotiated between them.
  - **Producer Responsibility Organisations (PROs)**
    - ✓ Under this an **organisation will manage the waste** on behalf of producers.
    - ✓ **Municipal bodies can also register** as PRO or waste collector.
    - ✓ There will be a **National PRO Advisory Committee** to govern plastic waste management in the country.
  - **Fee-based mechanism**
    - ✓ Under this, the **producers will contribute to the EPR corpus fund** at the central level, each producer contributes **based on generation of plastic waste vis-a-vis efforts required.**
- It also has **provisions to impose penalties** on producers if they fail to meet their targeted collection. This money shall be used for creating infrastructure for plastic waste management.
- It recommends a **graded approach for achieving the targets**, starting with 30% in the first year and moving up to 90% in five years.
- Includes provisions for **Information, Education and Communication** (IEC) to achieve an effective waste segregation, collection, transportation and recycling.
- A **single national registry** will be created to enlist all stakeholders to **improve monitoring and help bring transparency** in plastic waste management system.
- The **monitoring** of the entire mechanism of the EPR will be the **responsibility of the Central Pollution Control Board (CPCB).**

Benefits of EPR framework

- Due to **closed loop approach** under EPR, waste generated is used to **produce another product.** This significantly leads to **lower cost of production for the new product** by using waste.
- Also, it helps to **reduce the hazardous environmental impact** of the waste generated. A 2017 report by CPCB pegs the amount of plastic waste generated in India at 25,940 tonnes per day.
- Since EPR has **shifted the burden of waste disposal to these product manufacturers**, it has driven the adoption of innovative production techniques tec.
- EPR policies will be instrumental in **ensuring 3R principle (Reduce-Reuse-Recycle)** hence facilitating a circular economy, extending life cycle of product.

Concerns about EPR framework

- Current framework of EPR put **high regulatory cost and fines** on companies for non-adherence to guidelines.
- There is a **lack of formalized reverse logistics system,** hence setting up a collection network could be extremely complex and expensive.
- The **informal sector manages around 90% of waste management** streams and upgrading them into the formal sector while ensuring their adherence to compliances will be challenging.
- Even after implementation of EPR framework, **social awareness and responsibility are key concerns** in successfully managing waste.
- **Segregation of waste at source will be challenging** due to lack of technological methods and involvement of unorganised and unaware manpower.

Plastic Waste Management Rules 2016 (amended in 2018)

- **Defines minimum thickness** of plastic carry bags i.e. 50 microns. This would increase the cost and the tendency to provide free carry bags would come down.
- **Responsibility of local bodies**: Rural areas are brought under the rules since plastic has reached rural areas as well. The gram sabhas have been given responsibility of implementation.
- **Extended Producer Responsibility**: Producers and brand owners have been made responsible for collecting waste generated from their products.
- **Producers are to keep a record** of their vendors to whom they have supplied raw materials for manufacturing. This is to curb manufacturing of these products in unorganised sector.
- **Responsibility of waste generator**: All institutional generators of plastic waste shall segregate and store their waste as per Solid Waste Management Rules, and handover segregated wastes to authorized waste disposal facilities.
- **Responsibility of street vendors and retailers**: Not to provide such carry bags or fine would be imposed. Only the registered shopkeepers on payment of a registration fee to local bodies would be allowed to give out plastic carry bags on charge.
- **Promote the use of plastic for road construction or energy** recovery.
- A **Central Registration System** for the registration of the producer/ importer/ owner.
- **Phasing out of Multi-layered Plastic (MLP)** that are "non-recyclable or non-energy recoverable or have no alternate use".

Way forward

- **Adoption of Circular Economy**, which aims to eliminate waste, not just from recycling processes, but throughout the lifecycles of products and packaging it maximize value and eliminate waste by improving the design of materials, products and business models.
- **Provide incentives to industry** by introducing tax rebates or other conditions to support its transition to phase out use of plastic.
- **Need to integrate the informal sector,** and increase **citizens' environmental awareness** and promote efficient coordination and communication between stakeholders involved.

4.2. MARINE PLASTIC POLLUTION

Why in news?

A report titled "Breaking the Plastic Wave"- 'A Comprehensive Assessment of Pathways Towards Stopping Ocean Plastic Pollution' pointed that the annual flow of plastic into the ocean could triple by 2040 to 29 million metric tonnes per year, without immediate and sustained action.

Issue of plastic in oceans

- **Gravity of the situation:** Over 300 million tons of plastic are produced every year, half of which is used to design single-use items such as shopping bags, cups and straws. Out of this, **at least 8 million tons of plastic end up in our oceans every year.**
    - **Waste plastic makes up 80% of all marine debris** from surface waters to deep-sea sediments.
    - Plastic has been **detected on shorelines of all the continents**, with more plastic materials found near popular tourist destinations and densely populated areas.
    - Under the influence of solar UV radiation, wind, currents and other natural factors, **plastic fragments into small particles, termed microplastics** (particles smaller than 5 mm) or nanoplastics (particles smaller than 100 nm). This **disperses plastic even farther and deeper into the ocean,** where it invades more habitats and becomes effectively impossible to retrieve.
- **Sources of plastic:** The main sources of marine plastic are land-based, from urban and storm runoff, sewer overflows, beach visitors, inadequate waste disposal and management, industrial activities,

construction and illegal dumping. Ocean-based plastic originates mainly from the fishing industry, nautical activities and aquaculture.

- **Impacts:**
  - **On marine environment: Ingestion, suffocation and entanglement of hundreds of marine species** such as seabirds, whales, fishes and turtles.
  - **On food and health:**
    - ✓ **Toxic contaminants accumulate on the surface of plastic materials** which when ingested by marine organisms, enter their digestive systems, and overtime accumulate in the food web and leads to the transfer of contaminants between marine species and humans through consumption of seafood.

  > **Concerns with Bio-degradable plastics (particularly those made from plants)**
  > - These are promising alternatives to conventional plastics under the right conditions, but these **conditions are generally not found** in the natural environment, and especially not in the Ocean.
  > - They are also **energy intensive and expensive** to produce.
  > - Even in ideal conditions, biodegradability **does not resolve critical issues such as entanglement**, or ingestion by marine animals.

    - ✓ **Carcinogenic chemicals present in the plastic materials interfere with the body's endocrine system**, causing developmental, reproductive, neurological, and immune disorders in both humans and wildlife.
  - **On tourism:** Plastic waste damages the aesthetic value of tourist destinations, leading to decreased tourism-related incomes and major economic costs related to the cleaning and maintenance of the sites.

Existing challenges in dealing with the issue

- **Long residual period of plastic:** once the plastic waste enters into the ocean, there is very little we can do to collect it at a meaningful scale, particularly on the ocean floor several kilometres deep.
- **Lack of compliance with laws and conventions** partly due to limited financial resources to enforce them. The most important are the **1972 Convention on the Prevention of Marine Pollution** by Dumping Wastes and Other Matter (or the London Convention), the **1996 Protocol to the London Convention** (the London Protocol), and the **1978 Protocol to the International Convention for the Prevention of Pollution from Ships** (MARPOL).

> **Case in India and its efforts in dealing with the issue**
> - The country dumps about **600,000 tonnes of plastic waste into the oceans** annually. With a coastline of 7,500 kms, India faces a huge challenge in cleaning up its seas.
> - Scientists have found that 414 million plastic waste items, weighing 238 tonnes, polluting Cocos Keeling Islands, a remote archipelago in the Indian Ocean.
>
> **Efforts taken:**
> - India is a **signatory to MARPOL** (International Convention on Prevention of Marine Pollution). In addition, Prevention of Marine Pollution is also dealt with by Merchant Shipping Rules, 2009 under the Merchant Shipping Act, 1958.
> - **Periodic surveys of Indian flag vessels** to ensure compliance to the above rules. Foreign vessels are likewise inspected under Port State Inspection regime and heavy penalty is levied in case of non-compliance.
> - **Steering committee with stakeholders from all the concerned Ministers and Departments** has been constituted by the Ministry of Environment, Forests and Climate Change. The Committee will co-ordinate the activities, examine proposals and provide guidance to Ministries, State and UT Governments with regard to research, policy planning, deployment of technology, public outreach and education and other facets of the problem of marine plastic littering.
> - The government has announced a **number of steps to phase out single-use plastics** with the eventual goal of stopping all usage to reduce the country's plastic footprint **under the Plastic Waste Management (Amendment) Rules 2018.**
> - **BIS has come out with an Indian standard** according to which plastic microbeads of diameter 5 mm or less, that are insoluble in water, and solid plastic particles used to exfoliate or cleanse in personal care products are banned.
> - **State level practice:**
>   - **Kerala's Suchitwa Mission**, under which fishermen are engaged in finding and collecting plastic from the oceans.

- **Structural flaws:** Under linear plastic system, **95 per cent of the aggregate value of plastic packaging is lost to the economy after a single use cycle** and that many plastic products are placed in markets that lack the capacity to collect and treat them economically after use.
  - Globally, only 71 per cent of plastic produced is formally collected, and less than 15 per cent is actually recycled.

- **Lack of data:** Consistent definitions and conventions for plastic waste data and metrics are lacking, and there is insufficient transparency regarding the plastic being placed on the global market (type, chemical additives, etc.), trade flows, waste production, consumption, and post-use patterns.

What needs to be done?

- **Multi-pronged approach:** Stemming the tide of plastics entering the Ocean will require a combination of approaches, including limiting plastic use, improving waste collection, infrastructure, and management, and expanding recycling, particularly in the countries where most of the plastic originates.
- **Existing international legally binding instruments should be further explored** to address plastic pollution.
- **Strengthening Collaborations:** between Governments, research institutions and industries to find appropriate technological, behavioural and policy solutions to plastic usage and their disposal.
- **Transition from linear to circular economy:** where resources, such as plastics, are used, recovered and reused over and over again, instead of heading directly to the landfill or the Ocean.
- **Individual's responsibility** to limit plastic usage through carrying reusable water bottle, cloth bag, buying second-hand products etc. as the most effective way to have less plastic in the Ocean is to use less plastic in the first place.

5. SUSTAINABLE DEVELOPMENT

5.1. DRAFT ENVIRONMENT IMPACT ASSESSMENT (EIA), 2020

Why in news?

Ministry of Environment, Forest and Climate Change (MoEF&CC) has published the draft Environment Impact Assessment (EIA) Notification 2020, which replaces the existing EIA Notification, 2006 brought under the Environment (Protection) Act (EPA), 1986.

Background

- **India legislated an umbrella Act for environmental protection in 1986** i.e. the EPA after being a signatory to the Stockholm Declaration (1972) on Environment and Bhopal gas leak disaster in 1984.
- **Under the Act, the country notified its first EIA norms in 1994** setting in place a legal framework for regulating activities that access, utilise, and affect (pollute) natural resources.
- **Every development project has been required to go through the EIA process** (under Section 3 of the EPA) for obtaining prior environmental clearance ever since.
- The **1994 EIA notification was replaced with a modified draft in 2006.** The government redrafted it again in 2020 to incorporate the amendments and relevant court orders issued since 2006, and to make the EIA "process more transparent and expedient."
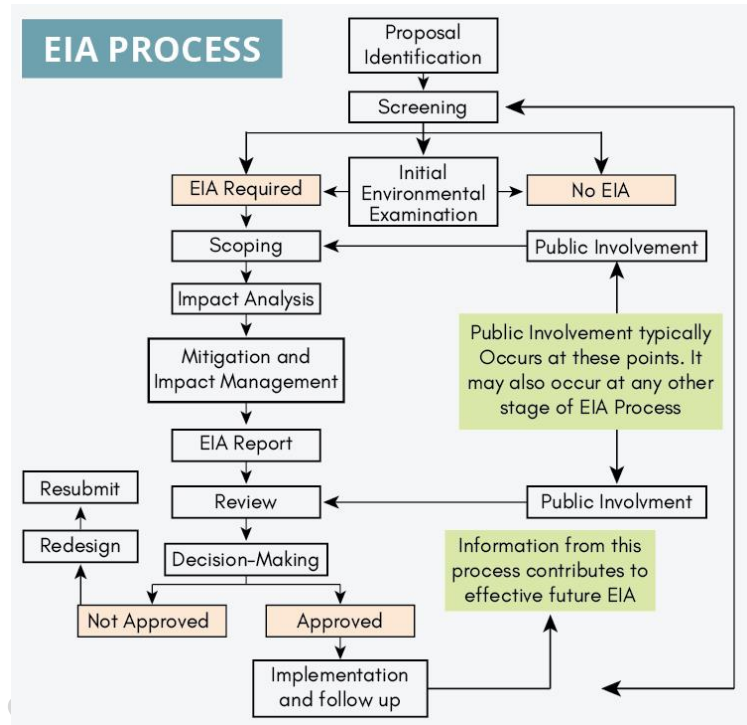
What is EIA?

- Environmental Impact Assessment or EIA is the process or study which
  - **predicts** the effect of a proposed industrial/infrastructural project on the environment.
  - **prevents** the proposed activity/project from being approved without proper oversight or taking adverse consequences into account.
  - **compares** various alternatives for a project and seeks to identify the one which represents the best combination of economic and environmental costs and benefits.
- Any project requiring environmental clearance, first needs to undergo a **thorough screening and scoping process by the regulatory authorities** and thereafter a draft EIA report is sent for public consultation(refer infographic).
- Under the existing 2006 law, **projects are categorised into category A and B** where all projects in the **category A need to undergo the process of EIA.** Category B projects are further classified into category B1 and B2, on the basis of their scope and potential impact and only the projects under **B2 are exempted.**

Issues with the provisions of draft Environment Impact Assessment (EIA), 2020

- **Public Consultation**
  - It **proposes to reduce** the period of **public consultation hearings to a maximum of 40 days**, and reduces from **30 to 20 days the time provided for the public to submit their responses** during a public hearing for any application seeking environmental clearance.
  - This can particularly pose a problem to those affected people who are forest dwellers or otherwise do not have access to information and technology and those that are not aware of the process itself. Unless a public hearing is meaningful, the **whole EIA process would lack transparency and credibility.**

- **Wide discretionary powers to government**
  o It also allows the central government to declare some areas **as "economically sensitive areas" without a public hearing or environmental clearance,** and several "red" and "orange"-classified toxic industries could now operate as close as 0-5 km from a Protected Area.
  o The government also gets to decide on the "strategic" tag for any projects for which no information on such projects shall be placed in the public domain. This opens a window for **summary clearance for any project deemed strategic** without having to explain why.
- **Provisions for post-facto project clearance:**
  o Projects that have commenced operations – by way of construction, installation, excavation, production, etc – without obtaining necessary clearances can be legalised after payment of a penalty
  o **Post facto clearance is the violation of the fundamental principles of environmental jurisprudence** and is contrary to both the precautionary principle as well as the need for sustainable development.
- **Extended period of clearances:** The increased validity of the environment clearances for mining projects (50 years versus 30 years currently) and river valley projects (15 years versus 10 years currently) **raises the risk of irreversible environmental, social and health consequences** on account of the project remaining unnoticed for long.

- **Exemptions:** The new draft **exempts a long list of projects** from public consultation and prior clearance. For example, linear projects such as roads and pipelines in border areas will not require any public hearing. All inland waterways projects and expansion/widening of national highways including roads that cut through forests and dredging of major rivers, will be exempt from prior clearance.

> **Other issues with EIA in India**
> Though established to safeguard the environment, the EIA process, argue activists, often achieved the opposite by offering a façade of legal paperwork for a range of de facto concessions enjoyed by industries. For example,
> - **Reports on projects' potential (damaging) impact** on the environment are **frequently shoddy** and consultant agencies that prepare those reports for a fee are rarely held accountable.
> - **Lack of administrative capacity** to ensure compliance often renders long lists of clearance conditions meaningless.
> - **Periodic amendments** exempting one category of industries or the other from scrutiny.
> - On the other hand, **developers complain that the EIA regime dampened the spirit of liberalisation**, leading to red tape and rent-seeking.
>
> **Recent industrial mishaps due to faulty/inefficient EIA:**
> - **Blowout in Gas Well of Oil India Limited** at Baghjan, Tinsukia District, Assam.
>   o Recent processes for expansion and modification of the project (situated only a few kilometres away from protected forest) apparently took place without fresh environmental clearance.
> - **Gas leak at LG Polymers'** Visakhapatnam plant.
>   o The plant had been operating without a valid environmental clearance for decades.

- **Baseline data:** The latest draft EIA notification **does away with the need to carry out studies covering all seasons in a year.** This will lead to less reliable data and projections for pollutants and will mask the full environmental impact of a project.

- **Private consultation:** The notification **allows project proponents to engage private consultants for preparing the EIA reports** propelling a situation where expertise and technicalities would be adopted to obscure the process and make it difficult to understand – something that should have been open and comprehensible to the communities for the process to be remotely transparent.

- **Compliance Report Issue:** The draft notification **reduces the frequency of compliance reports** required from project owners **from once every six months to once every year.** During this period, certain irreversible environmental, social or health consequences of the project could go unnoticed.

Conclusion

Various provisions of Draft EIA aimed at facilitating the government's doctrine of "ease of doing business". Though the Environmental regulation must balance damage to the environment with sustainable development and possible benefits. Government must incorporate the concerns of all stakeholder before finalising the regulation.

5.2. WASTE MANAGEMENT

5.2.1. BIOMEDICAL WASTE

Disposal of biomedical waste including used masks, PPE kits, gloves, blood bags etc. worn by healthcare professionals and public became a challenge during the ongoing COVID-19 pandemic. Four years after Biomedical Waste Management Rules were notified in India, implementation has improved in certain areas but continues to remain jiffy on key parameters. **COVID-19 has brought the need for extremely careful handling of biomedical waste into renewed focus.**

According to a report filed by the Central Pollution Control Board (CPCB), **India generates about 101 Metric Tonnes per day (MT/day) of COVID-19 related bio-medical waste** in addition to the regular bio-medical waste generation of about 609 MT per day.

Central Pollution Control Board (CPCB) has released revised guidelines for Biomedical waste management generated from COVID-19.

Challenges with COVID-19 biomedical waste

- **Health risk:** This waste has created new biomedical waste crisis and **posing a health risk to sanitation workers and garbage collectors. E.g.** Over 40 sanitation workers have tested positive for COVID-19 and 15 have lost their lives in Delhi.
- **Lack of segregation:** Municipalities pick up COVID-19 biomedical waste from houses, but it **often has other household waste mixed in it**. This decreases the efficiency of the incinerators at waste treatment plants as it results in greater emissions and unburnt ash.
- **Guidelines not being followed properly:** Due to the gravity of the situation, some states are not following the CPCB guidelines on Covid-19 related waste and the existing bio medical waste management rules further increasing the risk.

> **Key features of Bio-medical Waste Management Rules 2016 (amended in 2018)**
>
> - **Pre-treatment of waste:** Waste generated in laboratories, microbiological waste, blood samples and blood bags to be pre-treated through disinfection or sterilisation on-site in the manner as prescribed by WHO.
> - **Phasing out** of use of chlorinated plastic bags, gloves and blood bags.
> - **Better segregation:** Bio-medical waste has been classified into **4 categories:** Untreated human anatomical waste, Animal anatomical waste, Soiled waste and Biotechnology waste.
> - **Storage of waste:** Provision within the premises for a safe, ventilated and secured location for storage of segregated biomedical waste.
> - **Regular Training and Immunisation** of all health care workers.
> - **Ensure proper Transportation and handling of waste** without any adverse effect to the human health and the environment.
> - **Record maintenance and monitoring** of the activities related to bio-medical waste management.
> - **Establish GPS and Bar-coding facility at** Common biomedical waste treatment facility.

- **Overburdened disposal Capacity:** PPE are being used everywhere, from hotels to hospitals, railway stations to airports, crematoriums to burial grounds so, the **disposal mechanisms available in the cities are not equipped to deal with this huge volume.**
- **Investment in incinerators** is also a problem, as this infection (COVID-19) is episodic, the machines may not be useful once cases start decreasing.

Way forward

- Stringent actions and **penalties shall be imposed** in case of non-adherence of guidelines.
- Deploying **private agencies for the jobs** and monitoring by respective pollution control boards so as to address shortage of human resources and funds.
- Information Education Communication (**IEC**) **campaigns create awareness among public on waste segregation, safety measures,** and steps to ensure safety of frontline functionaries shall be taken on priority.

5.2.2. E-WASTE

E-Waste **refers to** all items of electrical and electronic equipment (EEE) and its parts that have been discarded by its owner as waste without the intent of re-use.

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- The **biggest contributors** to the level of e-waste at present are household appliances such as irons, vacuum cleaners, washing machines and fridges. But the rapidly-growing **"Internet of things" - internet-connected gadgets - is expected to generate e-waste at a faster rate**, as connectivity becomes embedded into everyday items.

According to a UN report, the **50 million tonnes of e-waste generated every year** will more than double to 110 million tonnes by 2050, making it the fastest growing waste stream in the world.

- **India is the third largest electronic waste generator in the world after China and the USA** as per the Global E-waste Monitor 2020.

The issue of electronic waste is overlooked, as **electronic items that could be fixed easily go to waste instead**, contributing to pollution and increasing the demand for components like rare earth elements, which can have a damaging impact on the environment when sourced.

Issues with E waste

- **Hazardous to human health: E-waste consists of** toxic substances such as liquid crystal, lithium, mercury, nickel, polychlorinated biphenyls (PCBs), selenium, arsenic, cadmium, cobalt, copper, lead etc. These pollutants are not taken care of properly, or they are taken care of by an informal sector and recycled without properly protecting the workers.

> **E-Waste management in India**
> - The government passed the **first law on e-waste management in 2011**, based on Extended Producer Responsibility. However, it did not set collection targets
> - Thereafter, **the E-Waste (Management) Rules, 2016 were enacted in supersession of the 2011 Rules**.
>   - A manufacturer, dealer, refurbisher and Producer Responsibility Organization (PRO) were also brought under the ambit of these Rules.
>   - PRO is a professional organization authorized or financed collectively or individually by producers, which can take the responsibility for collection and channelization of e-waste generated from their products to ensure environmentally sound management.
> - The **E-Waste Management Rules, 2016 have been amended by the Centre in 2018.**
>   - **E-Waste (Management) Amendment Rules, 2018** objective is to channelize the e-waste generated in the country towards authorized dismantlers and recyclers in order to further formalize the e-waste recycling sector.
> - **India's first E-waste clinic** is going to be set up **in Bhopal** that would enable segregation, processing and disposal of waste from both household and commercial units.

- **Environmental effects of e-waste:**
  The toxic materials from electronic devices are released into bodies of water, groundwater, soil and air, affecting both land and sea animals.
  - Improper management of e-waste also contributes to **global warming**. A total of 98 Mt of CO_2-equivalents were released into the atmosphere from discarded fridges and air-conditioners that were not managed in an environmentally sound manner.

- **Low recycling capacity:** Almost all e-wastes contain some form of recyclable material, including plastic, glass, and metals; however, due to improper disposal methods and techniques these materials cannot be retrieved for other purposes.
  - **Only 17.4%** of the total e-waste was collected and recycled globally.

- **Dumping in Developing countries:** A large amount of E-waste from developed countries is dumped into developing countries impacting the environment the health of the people there.

> **Basel Convention on the Control of Transboundary Movements of Hazardous Wastes**
> - It was adopted in 1989 and it came into force in 1992.
> - The Convention aims to protect human health and the environment against the adverse effects resulting from the generation, transboundary movements and management of hazardous wastes and other wastes.
>
> **Best practice**
> In October 2019, the EU adopted **new Right to Repair standards,** which means that from 2021 firms will have to make appliances longer-lasting, and will have to supply spare parts for machines for up to 10 years.

  - Even with International treaties such as **Basel Convention on the Control of Transboundary Movements of Hazardous Wastes,** illegal shipment and dumping of e-wastes continue to take place.

Measures to Manage E waste

- **Formal collection of e waste** by designated organizations, producers, and/or the government via retailers, municipal collection points, and/or pick-up services.

- **Recycling e-waste:** Recycling e-waste enables us to recover various valuable metals and other materials from electronics, saving natural resources (energy), reducing pollution, conserving landfill space, and creating jobs.
    o The value of raw materials in the global e-waste generated in 2019 is equal to approximately $57 billion USD.
- **E-waste Legislation:** Governments around the world are developing national e-waste policies and legislation that lay out plans or courses of action and indicate, in a non-binding manner, what can be achieved by a society, institution, or company.
    o **India** passed the first law on e-waste management in 2011
- **E-waste data:** Understanding the quantities and flows of e-waste provides a basis for monitoring, controlling, and ultimately preventing illegal transportation, dumping, and improper treatment of e-waste.
- **Create awareness:** on the environmental benefits of recycling among consumers.
    o Ministry of Electronics and Information Technology (MeitY) has initiated an **e-waste awareness programme under Digital India**, to create awareness among the public about the hazards of e-waste recycling by the unorganised sector, and to educate them about alternate methods of disposing their e-waste.

Conclusion

There is a **need to extend the life cycle of the products by promoting the concept of circular economy** which involves sharing, leasing, reusing, repairing, refurbishing and recycling existing materials and products as long as possible. This **requires a departure from the traditional, linear economic model,** which is based on a take-make-consume-throw away pattern and relies on large quantities of cheap, easily accessible materials and energy.

5.2.3. TREATMENT OF WASTEWATER

Wastewater is one of the most under-exploited resources we have. Recently study by the **United Nations University - Institute for Water, Environment and Health (UNU-INWEH),** noted that efficiently treating wastewater can help meet SDGs.

- The **world generates about 380 trillion litres (tl) wastewater every year**, which is projected to rise roughly 51 per cent by 2050 to 574 tl.
- **Asia** contributed the most at **42 per cent of global wastewater generation,** followed by Europe and North America (18 per cent each) in 2015.

Water management however faces a global challenge by a rapidly increasing global urban population, intensifying agricultural practices and expanding industries. The effects of climate change on water supply further exacerbate pressure imposed on availability and quality of water resources around the world.

Wastewater as a resource

- **Addressing nutrients demands in Agriculture:** Nutrients such as **nitrogen, phosphorous and potassium** recovered from wastewater produced annually can offset 13.4 per cent of global demand to produce fertilisers.
- **Source of renewable energy:** Energy can be recovered from such wastewater in the form of methane by anaerobic digestion of wastewater. This methane can be used as green fuel or to generate electricity.
- **Source of new and usable water:** Usable water reclaimed from wastewater can irrigate up to 31 million hectares of agricultural land apart from usage in various other activities.
    o Nearly **90 percent of wastewater in Israel is treated for reuse.**

Need for Wastewater management in India

- As per NITI Aayog's composite water management index, **India is facing one of its major and most serious water crises.** Its water demand is projected to be twice the available supply by 2030. While almost **80% of water supply flows back into the ecosystem as wastewater.**
- In India, **70% of states treat less than half of their waste water** .
- **Scarcity of water in most of the cities** (due to rise in population and fall in water availability)**, can be addressed** by waste water management**.** E.g. According to a study, **waste water recycling can meet more than 20 per cent of the Bangalore's daily needs.**

- **Irrigation needs:** In India, **more than half of** the cultivated land is rain-fed and treated water can be used to tackle water demands, and climate change impact.
- **To check water contamination** due to untreated water entering surface and ground water sources. India is currently ranked **120 among 122 countries in the water quality index. 21% of communicable diseases** in India are from usage of unsafe water.
- **To maintain Food security:** Due to contaminated soil and water, agricultural productivity reduces, which directly affects food security.

Way forward

- Adoption of strategies like **environmental taxes, pollution levies, polluter pay principle** and **circular approach (use, treat, reuse)** to manage wastewater.
- **Strict legal and regulatory framework** to regulate and treatment of industrial waste.
- **Knowledge, innovation and capacity building** on wastewater can be promoted by policy-makers and researchers.
- According to NITI Aayog **water regulatory framework** for wastewater management should be established in all states firmed timelines for implementation.
- To shift to wastewater recycling, finance and technology constraints need to be sorted out by promotion **Public-Private Partnership**.

Steps taken for waste water management

- **Initiatives by NITI Aayog**
  - NITI Aayog's **Composite Water Management Index** which ranks state includes **water treatment capacity as parameter** to enable effective water management.
  - NITI Aayog under **Urban Management Programme** on 'Water Recycling and Reuse' is working on capacity building for **Urban Water Cycle Management for Sustainable and Resilient Water Infrastructure and Healthy Cities.**
- **National Policy on Faecal Sludge and Septage Management (FSSM)** to be implemented under Swachh Bharat Mission, AMRUT and Smart City Mission.
- Construction of **Sewage Treatment plants (STPs)** to treat sewage generated by domestic and industrial waste. Also, **Common Effluent Treatment Plants (CETPs)** for cluster of small-scale industries.
- **'Namami Gange Programme'** under 'Ganga action plan' was launched for effective abatement of pollution, conservation and rejuvenation of National River Ganga and **Yamuna Action Plan'** to restore river Yamuna.
- Ministry of Jal Shakti has initiated the '**National Water Mission Awards'** to recognize excellence in water conservation, efficient water use and sustainable water management practices.
- **Best practices:**
  - **Avadi Sewage Treatment Plant:** Tamil Nadu Police Housing Corporation has successfully constructed an **off-grid sewage treatment plant** that not only solved the problem of sewage disposal but also provided a pond of treated water for fishing, vegetable cultivation and recharging of groundwater.
  - **Sewage-fed aquaculture system of Kolkata**: Farmers around Kolkata city in India developed a technique of using domestic sewage for fish culture and other agricultural purposes.
  - **Singapore's NEWater** is reclaimed water, purified using dual-membrane (via microfiltration and reverse osmosis) and ultraviolet technology, can be used for **potable and non-potable purpose.**

Conclusion

Wastewater should be considered a resource whose effective management is essential for future water security. This **would produce a high rate of return in direct support of SDG 6, 7 and 12,** but also be highly relevant to the achievement of other development goals, including climate change adaptation and attempts to move 'net-zero' energy processes towards a green economy.

5.3. ENERGY- WATER-AGRICULTURE NEXUS

Recently, the NITI Aayog and the World Bank organized a one-day workshop on "**Energy-Water-Agriculture Nexus: Grow Solar, Save Water, Double the Farm Income**" in New Delhi.

Advancements in technology and falling prices, particularly of solar panels, have opened enormous opportunities of not only **shifting the current vicious cycle of this nexus into a virtuous cycle** but also transforming rural livelihoods. India can also increase farm incomes, making agriculture climate resilient, and reducing agro-dependence of rural India by using this nexus virtuously.

Understanding the present Energy-Water-Agriculture Nexus

- India has been trapped in the energy-water-agriculture nexus for last several decades. The **Green Revolution** of the 1960s helped ensure food security for the starving millions. However, the economics of crop pricing and markets associated with the Green Revolution had damaging and far-reaching consequences on the country's water, energy and land resources.
  - The agricultural sector uses the **maximum amount of freshwater** in the country (around 85%). About 90% of the groundwater extracted is used by irrigation.
  - Groundwater irrigation is also **highly energy intensive**. The **policy of free power supply for agriculture** led to worsening situation by **promoting water intensive crops** such as rice and also encouraging wasteful use of water for irrigation.
  - Schemes such as **Minimum Support Price (MSP)** and the **Public Distribution System (PDS)** have ensured a economic preference for rice and wheat based diets. This has led to a **shift from traditional millets** and the resultant increase in micronutrient deficiency.
- The **sub-optimal use of water and energy** in agriculture has not contributed to any significant increase in agricultural production but has seriously hit the industrial and other sectors of the economy in terms of the availability of these resources and their resultant economic output.

Challenges from this nexus

- **Conflict between hunger and resource exploitation-** On one hand, increased agricultural production is needed to end hunger and malnourishment. On the other hand, resources like water are limited and also face contamination due to agricultural runoffs.
- **Conflict between resources-** People need access to food and also need access to energy, especially clean energy.
- **Population growth-** which will require all these resources and mandate production of more food with less energy.

> **Best practices**
> - **Gujarat-** A scheme was offered to individual farmers for installation of solar irrigation system on selected feeders if more than 70% farmers on a feeder opt for the scheme.
>   - The DISCOM borrows on behalf of the farmer and farmers' debt is serviced out of payment due for surplus electricity sold by the farmer (a sort of on-bill financing).
> - **Rajasthan-** has used twin concepts of "**value of water in agriculture**" and "Drought Premium in case of grid-connected solar irrigation".
>   - These demonstrate pricing policies for surplus electricity generated by grid-connected solar could encourage water conservation.
> - **Maharashtra-** sub-station level solar generation.

Converting the nexus into virtuous cycle

- **Role of agriculture-** It is the **deciding factor** in the energy-water-agriculture nexus.
  - By giving free power, the agriculture distress will be passed on to next generations because of the over extraction of the ground water.
  - Adopting modern techniques like **drip and sprinkler irrigation** systems can help significantly in conserving water in irrigation.
  - **Incentives at community level** will also have impact on ground water saving.
  - To achieve crop diversification, it is critical that **farmers are linked with right markets**.
- **Grid-connected solar irrigation for agriculture and rural electricity supply-** holds immense potential to achieve the trifecta of saving water, doubling farmer income, and saving electricity.
  - It could lead to increase in groundwater extraction, especially in the areas where groundwater is shallow such as in eastern Uttar Pradesh, and parts of Bihar, Assam, and West Bengal.

- **Involving ground level functionaries-** such as state agriculture universities as they are more familiar with ground level conditions, challenges and solutions. They can also help **generate awareness among farmers**.
- **Design of schemes-** Some flexibility in scheme design and implementation should be provided to the states to help them adapt the interventions as necessary.

> Ministry of New and Renewable Energy (MNRE) has launched the **Pradhan Mantri Kisan Urja Suraksha evem Utthan Mahabhiyan (PM KUSUM) Scheme** for farmers. KUSUM scheme has **three distinct components**, each of which is a self-standing scheme:
> - **Component A:** sub-station level solar power plant between 0.5 MW to 2.0 MW to be installed through private sector, power utility, or farmers collective
> - **Component B:** off-grid solar irrigation
> - **Component C:** grid-connected solar that could convert the existing electric tube-wells to farmer-led solar pumps.
> Government has set separate target for each of these schemes.

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o Scheme on **surface water** is needed for its better utilization to release some pressure on the ground water resources.
o **KUSUM Scheme** - Farmer Enterprise (FPO/cooperative/FPC) model at the feeder level is most effective for the success of KUSUM-C. Further, the scheme should be linked with various water conservation techniques like micro irrigation and pond development.

Conclusion

The integrated nexus modelling approach provides opportunities for optimization of the water and energy resources in a given state under different scenarios, which may yield improved outcomes from all the sectors of the economy. As the conditions of nexus may vary at the state level, greater understanding can help in classifying the regions and the nexus.

5.4. ECOSYSTEM RESTORATION

Why in news?

The United Nations General Assembly (UNGA) proclaimed **2021–2030** as the **Decade on Ecosystem Restoration.**

About UN Decade on Ecosystem Restoration

- The UN Decade on Ecosystem Restoration aims to **massively scale up the restoration of degraded and destroyed ecosystems** as a proven measure to fight the climate crisis and enhance food security, water supply and biodiversity.
- It seeks to:
    o **Showcase successful government-led and private initiatives** to halt ecosystem degradation and restore degraded ecosystems.
    o **Enhance knowledge exchange** to implement restoration at scale.
    o **Connect initiatives** working in the same landscape, region, or topic, to increase efficiency and impact.
    o **Create links between ecosystem restoration and businesses** interested in sustainable production and impact investment.
    o **Bring a wider spectrum of actors on board**, especially from non-traditional sectors, by demonstrating the importance of environmental and socio-economic benefits of ecosystem restoration.

> **International Decades**
> - The United Nations (UN) **designates specific days, weeks, years and decades** as occasions to **mark particular events or topics** in order to promote, through awareness and action, the objectives of the Organization.
> - **Some decades ending in 2020 are**-
>   o United Nations Decade on Biodiversity
>   o Decade of Action for Road Safety
>   o United Nations Decade for Deserts and the Fight against Desertification.

- **Ecosystems addressed** include forests, grasslands, croplands, wetlands, savannahs, inland water, coastal and marine ecosystems, and even urban environments.
- On land, restoration of **at least 350 million hectares of degraded landscapes by 2030** is targeted.
    o A target for coasts and oceans has yet to be set.
- This endeavour builds on regional efforts such as:
    o **Initiative 20×20 in Latin America** that aims to restore 20 million hectares of degraded land by 2020,
    o **AFR100 African Forest Landscape Restoration Initiative** that aims to bring 100 million hectares of degraded land under restoration by 2030.
- **UN Environment and the Food and Agriculture Organization (FAO)** will lead the implementation.

What is Ecosystem Restoration (ER)?

- It is the **process of assisting the recovery of an ecosystem** that has been degraded, damaged or destroyed.
    o An ecosystem is a functional unit of nature, where living organisms interact among themselves and also with the surrounding physical environment.
- **Restoration activities** may be designed to replicate a pre-disturbance ecosystem or to create a new ecosystem where it had not previously occurred.
    o It involves practices such as restoring vegetation, planting native trees, clearing invasive species, regenerative (perennial) agriculture, agroforestry etc.

- The concept has gained importance due to the **unprecedented pace of degradation** of world's landscapes and ecosystems because of over-exploitation of natural resources.
- **Benefits associated with Ecosystem Restoration includes:**
  - o **Socio-Economic Benefits**
    - ✓ **Poverty Alleviation:** Restoring 350 million hectares of degraded landscapes by 2030 can present a boost to rural economies **worth US$9 trillion** in ecosystem services.
    - ✓ **Food security:** Healthy soils can store more nutrients and produce higher quality plants.
    - ✓ **Enhanced tourism:** through revival of natural landscapes.
    - ✓ It can prevent **conflict and migration** triggered by environmental degradation.
  - o **Ecological Benefits**
    - ✓ **Climate change mitigation:** Restoration could also remove **13 to 26 gigatons of greenhouse gases** from the atmosphere through healthy ecosystems such as forests, mangroves and peatlands.
    - ✓ **Biodiversity Conservation:** Protecting and restoring ecosystems can help save the 1 million animal and plant species currently threatened with extinction.
    - ✓ **Reviving coastal and marine biodiversity hotspots on Earth:** These ecosystems also provide storm protection, fisheries and carbon storage.
  - o **Fulfilling international commitments:** ER can help achieve targets under agreements such as 2030 Agenda for Sustainable Development, the Paris Climate Agreement, Aichi Biodiversity Targets etc.

Why there is a need for ecosystem restoration?

- **Terrestrial Ecosystems:**
  - o **Declining Forest Cover:** World's forest area decreased from 31.6% of global land area in 1990 to 30.6% in 2015 and around **70 million hectares of forests has been lost since 2000**. This has led to reduction in carbon sink and loss of habitat for a wide variety of species.
  - o **Declining land fertility:** About **20 per cent of the planet's land area has seen a decline in productivity** with fertility losses linked to erosion, soil depletion and pollution. This affects vegetative cover of forests, croplands, grasslands and rangelands.
  - o **Economic impact of Land degradation:** Land degradation across the world causes loss of biodiversity and ecosystem services worth more than **10 per cent of annual global gross domestic product**.
- **Aquatic Ecosystems:**
  - o **Decrease in wetland areas:** Around 70 per cent of wetlands have been lost over the last century, leading to localized biodiversity losses and acute water shortages.
  - o **Impact on oceans and coasts:** Climate change and human activities such as over-fishing, pollution, damaging coastal development, degradation of the seabed etc. have severely impacted marine ecosystems. It has led to-
    - ✓ **Decline in Sea grasses** on which dugongs and other marine animals depend.
    - ✓ **Rise in Dead zones** around major river deltas which affect fishing industry.
    - ✓ **Coral reefs are projected to decline** by a further 70 to 90 per cent at a temperature increase of 1.5 degrees Celsius, with larger losses at 2 degrees Celsius.
  - o **High Carbon emissions:** Between 20 and 50 percent of global **blue carbon ecosystems** (blue carbon is the carbon captured by the world's ocean and coastal ecosystems) have already been converted or degraded.
    - ✓ Their loss and degradation cause higher CO2 emissions as compared to terrestrial deforestation because of their high carbon stocks per hectare.

Challenges associated with ecosystem restoration

- **High initial financial Investment:** It will take around $ 800 billion to restore 350 million hectares of land.
- **Time taking process:** ER needs continuous and long-term efforts to generate desired results.
- **Lack of coordination:** Usually ecosystems do not confer to geographical boundaries and thus international coordination is a necessity for restoration efforts.
- **Poor understanding of ecosystem characteristics:** ER without conducting proper research and study of specific ecosystems can have undesirable results and cause further degradation.
- **Impact on economic activities:** ER involves conscious efforts to limit economic activities involved in over exploitation of natural resources.

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Way forward

- **Restoring terrestrial ecosystems through afforestation**: It should follow certain principles such as:
  o Planting trees on former forest land rather than converting other natural ecosystems such as grasslands, peatlands or wetlands to forest.
  o Planting native tree species that are well adapted to the local climate and soil.
  o Involving local community and consulting experts in the field of ER.
- **Fostering political will:** to provide momentum for ER at the global, regional, national and local levels.
- **Encouraging global scientific research**: to develop and promote good practices in ER.
- **Mainstreaming ecosystem restoration into policies and plans:** to address current national development priorities and challenges due to the degradation of marine and terrestrial ecosystems, biodiversity loss and climate change vulnerability.
- **Raising financial resources:** by dispersing funds for ER through existing funding mechanisms of international agreements or establishing separate funds.
- **Priority to conserving and preventing further degradation of ecosystems**: ER must be viewed as complementary to these efforts.

5.5. ECOLOGICAL FISCAL TRANSFERS

Why in news?

A paper published by the Center for Global Development (CGD) analyses the state budgets to examine whether ecological fiscal transfers (EFTs) has impacted state forestry expenditures.
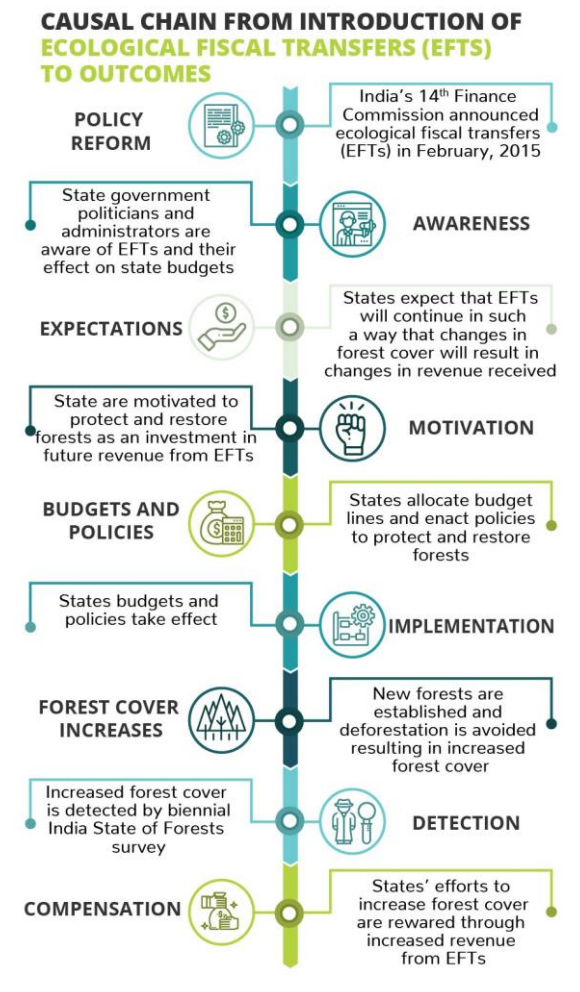
Concept of Ecological Fiscal Transfer

- Ecological Fiscal Transfer, is a **type of conditional environmental payments which** involves conditional payments from higher levels of a country's government (e.g. national) to lower levels (e.g. state or local).
  o **EFTs distribute a share of intergovernmental fiscal transfers** and revenue sharing schemes **according to ecological indicators** such as protected areas or watershed management areas etc. These conservation areas thus become a source of income for the receiving governments.
  o Biodiversity-related fiscal transfers are a powerful means of **reconciling the conservation costs** encountered at local level with the benefits of biodiversity conservation at higher levels of governance.
  o **EFTs are thus seen as an innovative policy instrument for providing incentives to local governments** to maintain or increase biodiversity conservation activities which provide ecological benefits to society in general.
- **EFTs have several potential advantages over REDD+ and PES-**
  o Payers can take **advantage of already-established structures for fiscal transfers** between levels of government, avoiding the need to design new institutions or assign new property rights.

CGD study-2019 on EFTs in India finds that
- **States increased their forestry budgets by 19%** in three years after the introduction of EFTs relative to three years prior.
- However, this increase is considerably less than the 42% overall budget increase over the same time period.
- The states that benefit most from EFTs didn't systematically increase their forestry budgets.

These results could be attributed to the causal chain as shown below

CAUSAL CHAIN FROM INTRODUCTION OF ECOLOGICAL FISCAL TRANSFERS (EFTS) TO OUTCOMES

POLICY REFORM — India's 14th Finance Commission announced ecological fiscal transfers (EFTs) in February, 2015

AWARENESS — State government politicians and administrators are aware of EFTs and their effect on state budgets

EXPECTATIONS — States expect that EFTs will continue in such a way that changes in forest cover will result in changes in revenue received

MOTIVATION — State are motivated to protect and restore forests as an investment in future revenue from EFTs

BUDGETS AND POLICIES — States allocate budget lines and enact policies to protect and restore forests

IMPLEMENTATION — States budgets and policies take effect

FOREST COVER INCREASES — New forests are established and deforestation is avoided resulting in increased forest cover

DETECTION — Increased forest cover is detected by biennial India State of Forests survey

COMPENSATION — States' efforts to increase forest cover are rewarded through increased revenue from EFTs

- o EFTs can **potentially mobilize larger volumes of finance than PES**, raising the possibility of achieving both broad coverage and substantial dollar-per-hectare incentives.
- o The **EFTs pay across all forested areas**; not just contracted areas as in PES, or reductions in forest loss as in REDD+.
- o **EFTs could solve, in part, the challenge faced in REDD+** of translating incentives from national governments to more local levels. EFTs could potentially operate in tandem with international REDD+ payments, with payments from external funders to national governments for reducing emissions, and EFTs from national to state- and local-level governments for protecting and restoring forest cover.
- **However, EFTs also have limitations as an incentive mechanism**.
  - o Money from the EFTs is **untied to forestry budgets** and **can be spent in any sector** (e.g. health, education, infrastructure) at the discretion of state governments.
  - o They **may be designed to equalize budgets across local governments** or to compensate local governments for forgone resource use. Thus, there may be **only limited freedom to design EFTs as incentive mechanisms** for the increased provision of ecosystem services.
  - o Furthermore, EFTs are **limited to public sector recipients** and don't directly transfer incentives to individual households as PES can.

> **Other modes of conditional payments** for environmental conservation**:**
> - **Payments for Ecosystem Services (PES)** focuses on the 'beneficiary pays principle' and therefore provides an opportunity to put a price on previously un-priced ecosystem services.
> - **Reducing Emissions from Deforestation and forest Degradation Plus (REDD+):** It aims to compensate the local people for preserving the loss of forests or their degradation.

Development of EFTs in India

- In the 1990s **Brazil became the first country to introduce EFT** to compensate municipalities for land-use restrictions imposed by protected areas (PA).
- Until 2014 the few examples of EFTs mostly involved protected areas. **In FY 2014-15, the world's first EFTs for forests were enacted in India** when the 14th Finance Commission (FC) added forest cover to the formula used to determine the amount of annual tax revenue distributed by central government to each state.
- The **14th FC** introduced states' forest cover around 2013 as an element of the horizontal devolution formula among the states, comprising **7.5% of the tax revenue to be transferred to states from 2015-16 through 2019-20**.
- It was done primarily to compensate states for the "fiscal disability" caused by forgone opportunities to convert forests to other uses resulting from implementation of the **1988 National Forest Policy**-an issue consistently raised in the Commission's consultations by states with high forest cover concentrated in the Northeast.
- **Forest-cover-proportional funds had previously been made available to states by the 12th and 13th Finance Commissions, but the recommendations of the 14th FC differed from those of its predecessors in three important respects-**
  - o The 14th FC recommended a **quantum of finance some 30 to 250 times larger**.
  - o The release of three-quarters of the funds granted by the 13th FC was contingent on the preparation of workplans and other pre-conditions; in contrast the release of the EFTs was automatic with **no pre-conditions**.
  - o Grants from the 12th and 13th FCs had to be spent by states on forest-related budget items, whereas the EFTs operate as a pure transfer into states' general budgets-part of a broader pattern by the 14th FC of shifting Centre-to-state payments from earmarked grants to general purpose transfers.

5.6. SAND MINING

Why in news?

The Ministry of Environment Forest & Climate Change (MoEFCC) has released the Enforcement & Monitoring Guidelines for Sand Mining (EMGSM-2020).

- This Guideline is supplemental to the existing SSMG-2016, and these two guidelines viz. EMGSM-2020 and SSMG-2016 shall be read and implemented in sync with each other.

Need for the Guidelines

- Despite **Sustainable Sand Management Guidelines (SSMG) 2016** to curb the practice, illegal and unsustainable sand mining has continued to be common.
  - According to Ministry of Mines, in 2015-16, there were over 19,000 cases of illegal mining of minor minerals, which including sand
- **National Green Tribunal (NGT)**, in many of the cases, stressed on **the need of regulating sand mining** and passed several orders. The court in some cases even expressed concern over the death of officials who tried to stop illegal mining.
- Also, a **high-power committee (HPC) constituted by NGT** submitted certain recommendations on enforcement requirements and monitoring essentials to prevent illegal sand mining.
- It is felt necessary to identify the minimum requirements across all geographical regions to have a **uniform protocol for monitoring and enforcement of regulatory provision** prescribed for sustainable sand and gravel mining.
- To promote the use of latest **remote surveillance and IT services** helps in effective monitoring of the sand mining activity.

About Sand Mining

- Sand mining is a practice that is used to extract sand, mainly through open pit mining.
- Main sources of sand are agricultural fields, riverbeds and floodplains, coastal and marine sand, lakes and reservoirs. It is also done on beach, inland dunes and dredged from ocean beds and river beds.

Enforcement & Monitoring Guidelines for Sand Mining (EMGSM-2020)

- All district to prepare a **comprehensive mining plan for the district** as per the provision of **District Survey Report (DSR)** and identify and **define** the **mining and no mining zones** considering environmental and social factors.
- **Abandoned stream channels** on the floodplains should be **preferred** rather than active channels and their deltas and floodplains.
- **Replenishment study** should be conducted on regular basis to nullify the adverse impacts of sand extraction.
- **Mining depth** should be **restricted to 3 meters**.
- No riverbed mining operation allowed in monsoon period.
- It suggested the **use of technology such as drones, mobile application and/or bar code scanners** etc. for checking illegal mining, reserves estimation, quantity estimation, land use monitoring.
- **Annual audit of each mining lease** shall be carried out.
- State Government should develop an **online portal for sale and purchase** of sand and river-bed material.
- **District Level Task Force (DLTF)** under the Chairmanship of District Magistrate/Collector to keep regular watch.

Sustainable Sand Mining Management Guidelines, 2016

- It allows environment clearances for sand and minor minerals for up to five hectares of mine lease area by the District Environment Impact Assessment Authority, by States for up to 50 hectares, while the Centre would give permissions for areas larger than 50 hectares.
- It calls for use of technology for stringent monitoring of sand mining through tools such as bar coding, remote sensing etc.
- It calls for promotion of manufactured sand, artificial sand, fly ash and alternative technologies in construction materials and processes for reducing the dependence on naturally occurring sand.
- It also calls for training of architects and engineers, new laws and regulations, and positive incentives to initiate a shift for lowering dependency on sand.

- Under the Mines and Minerals (Development and Regulation) Act, 1957 (MMDR Act), **sand is a minor mineral** and sand mining is regulated by the respective state governments and **empowers state governments to frame rules** to prevent illegal mining, transportation and storage of minerals (both major minerals and minor minerals) and for purposes connected therewith.

Issues with sand mining

- **Loss of revenue** for exchequer due to cartelization among mining companies during auction.
- Higher prices of sand in many cities due to non-availability there and absence of robust monitoring mechanism or regulation by the Government. This leads to **illegal sand mining.**

Consequences of illegal sand mining

Impacts on	Description
Biodiversity	Impacts on related ecosystems (for example fisheries)
Land losses	Both inland and coastal through erosion
Hydrological function	Change in water flows, flood regulation and marine currents
Water supply	Through lowering of the water table and pollution
Infrastructures	Damage to bridges, river embankments and coastal infrastructures
Climate	Directly through transport emissions, indirectly through cement production
Landscape	Coastal erosion, changes in deltaic structures, quarries, pollution of rivers
Extreme events	Decline of protection against extreme events (flood, drought, storm surge)

- **Mixing of low-quality sand with usable sand** leading to construction of weak buildings.

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- **Desert sand and sea sand not suitable for construction** which makes river-sand a highly demanded mineral.

Importance of sustainable sand mining

- **To ensure the conservation of the river equilibrium and its natural environment** by protection & restoration of the ecological system.
- **To avoid aggradation at the downstream reach** especially those with hydraulic structures such as jetties, water intakes etc. and to ensure the rivers are protected from bank and bed erosion beyond its stable profile.
- **To ensure there is no obstruction to the river flow,** water transport and restoring the riparian habitats.
- **To avoid pollution of river water** leading to water quality deterioration.
- **To prevent ground water pollution** by prohibiting sand mining on fissures where it works as filter prior to ground water recharge.

> **Steps taken by government to Promote Sustainable Mining**
> - **Pradhan Mantri Khanij Kshetra Kalyan Yojana (PMKKKY):** funds collected under District Mineral Foundations (DMF) are utilised for the welfare and development of the mining affected areas.
> - **Mining Surveillance System (MSS):** Ministry of Mines, through the Indian Bureau of Mines (IBM), has developed the MSS to use the space technology to check illegal mining.
> - **Mining Tenement System (MTS):** It will facilitate end to end national scale accounting of all the minerals produced in the country through automation from the pithead to its end use, reducing the scope for illegal mining.

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6. CONSERVATION EFFORTS

6.1. SUPER YEAR FOR BIODIVERSITY

Why in news?

The year 2020 is the **"Super Year For Biodiversity"**, as the **Strategic Plan for Biodiversity** with 20 global **Aichi targets adopted in 2010 ends in 2020.**

About Strategic Plan for Biodiversity 2011-2020 (SPB 2011-2020)

- SPB 2011-2020 was adopted by the parties to the CBD, during the tenth meeting of the Conference of the Parties (COP10) in 2010 in **Nagoya, Japan**, with the purpose of inspiring **broad-based action in support of biodiversity** over the next decade by all countries and stakeholders.
- The Strategic Plan is comprised of a shared vision, a mission and **20 targets organized under 5 strategic goals,** collectively known as the **Aichi Biodiversity Targets (ABTs).**

India's efforts towards SPB 2011-2020

- India prepared its **first National Biodiversity Action Plan (NBAP) in 1999** which was revised and updated into **NBAP, 2008** to bring the biodiversity agenda in alignment with the National Environment Policy (NEP), 2006.
- The NBAP, 2008 was updated with **Addendum 2014 to NBAP, 2008** in order to integrate it with the SPB 2011-20.

Convention on Biological Diversity (CBD)

- The CBD is an **international multilateral treaty** which was opened for signature in 1992 at the United Nations Conference on Environment and Development (**the Rio "Earth Summit"**).
- It has 3 main **objectives**:
  o The conservation of biological diversity.
  o The sustainable use of the components of biological diversity.
  o The fair and equitable sharing of the benefits arising out of the utilization of genetic resources.
- The CBD has **196 parties** and **India is one of them.**
- CBD has following supplementary agreements-
  o **The Nagoya Protocol on Access and Benefit-sharing:** It aims at sharing the benefits arising from the utilization of genetic resources in a fair and equitable way.
  o **The Cartagena Protocol on Biosafety:** It aims to ensure the safe handling, transport and use of living modified organisms (LMOs) resulting from modern biotechnology that may have adverse effects on biological diversity and human health.
  o **The Nagoya – Kuala Lumpur Supplementary Protocol on Liability and Redress to the Cartagena Protocol on Biosafety:** It aims to contribute to the conservation and sustainable use of biodiversity by providing international rules and procedures in the field of liability and redress relating to LMOs.
- **India has signed and ratified all 3** of these protocols.

Related News

key initiatives towards conservation of biodiversity:

- **Biodiversity Samrakshan Internship Programme** to engage postgraduate students to support the projects of National Biodiversity Authority.
- **UNEP Campaign on Illegal Trafficking of Endangered Species** launched by the **Wildlife Crime Control Bureau,** with UNEP to address environmental challenges related to illegal trafficking.
- **A Webinar Series on 'Biodiversity Conservation and Biological Diversity Act, 2002'.**
- **WWF Model Conference of Parties (MCoP)** that engages the younger generation in conversations around impact of humanity's footprint on biodiversity
- **An awareness campaign supported by WWF.**

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  o Accordingly, India developed **12 National Biodiversity Targets (NBTs)** which cover all the 20 ABTs.
  o For overseeing and monitoring the implementation of these targets, agencies were identified on the basis of their mandate, domain areas and geographical coverage in the country.
  o Indicators and monitoring framework were also developed for each NBT.
- According to India's **6th National Report,** India is on track to achieve 9 out of its 12 NBTs.
- **Progress so far:**
  o **Increased area under biodiversity conservation:** The number of Protected Areas under Wildlife Protection Act in the country has increased from a total of 771 in 2018 to 870 in 2019.
  o **Operationalising the Nagoya Protocol on access and benefit sharing (ABS):** India has since then published highest number of certificates under the protocol.
  o **Developing an extensive policy and legislative framework:** to achieve its NBTs.
    ✓ **Major policies**- National Forest Policy, 1988, National Environment Policy, 2006 National Policy on Marine Fisheries (NPMF), 2017, National Intellectual Property Right Policy, 2016 etc.

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- ✓ **Major acts**- Biological Diversity Act, 2002, Indian Forest Act, 1927, Environment Protection Act, 1986, Wetlands (Conservation and Management) Rules, 2017, Wildlife Protection Act, 1972 etc.
- o **Implementation of Biological Diversity Act, 2002:** About 2 lakh Biodiversity Management Committees (BMCs) at local levels have been constituted as of 2019 and 7567 Peoples Biodiversity Registers (PBRs) have been prepared as of 2019.
  - ✓ PBRs document local biological resources and associated traditional knowledge (TK).

Challenges faced by India in its efforts

- **Low awareness regarding government programmes**: especially among tribal communities due to issues such as language barrier.
- **Forest Fires**: About 21.40% of forest cover in India is prone to fires as per a report by the Forest Survey of India (FSI). They cause long term damage through loss of biodiversity, ozone layer depletion, loss of habitat for wildlife and soil erosion etc.
- **Threat of Invasive alien species:** They can change the community structure and species composition of native ecosystems directly by out-competing indigenous species for resources and indirectly through changes in nutrient cycling, ecosystem function and ecological relationships between native species.
- **Poor capacity building at local level**: Institutions of local governance, such as Biodiversity Management Committees (BMCs) created under Biological Diversity Act, 2002, are often ill equipped to take informed decisions regarding biodiversity related issues.
- **Data collection**: India lacks human and technical resources that are needed to compile and analyze data for implementation and monitoring of NBSAP.

CBD strategic goal		Aichi Target	
Address underlying causes	1	Improve awareness of biodiversity	
	2	Mainstream biodiversity	
	3	Reform incentives	
	4	Implement plans for sustainability	
Reduce pressures and promote sustainable use	5	Reduce habitat loss and degradation	
	6	Fish sustainably	
	7	Make farming and forestry sustainable	
	8	Reduce pollution	
	9	Tackle invasive species	
	10	Minimise climate change impacts	
Safeguard ecosystems, species and genes	11	Protect and manage critical sites	
	12	Prevent extinctions	
	13	Maintain genetic diversity	
Enhance benefits from biodiversity and ecosystems	14	Safeguard ecosystem services	
	15	Restore degraded forest	
	16	Implement access and benefit sharing	
Enhance implementation through planning, knowledge management and capacity building	17	Implement NBSAPs	
	18	Protect traditional knowledge	
	19	Share biodiversity knowledge	
	20	Increase conservation finance	

Way Forward

- **Creation of toolkits in local dialects:** for building capacities of traditional communities for equipping them with skills to negotiate with users seeking access of traditional knowledge and enabling them to undertake best practices regarding conversation.
- **Additional funding, resources and technical support**: for initiatives such as MoEFCC scheme "**Forest Fire Prevention and Management**" that provides supports to states to tackle forest fires.
- **Intensive and sustained training and capacity building:** of institutions of local governance such as Municipal and Panchayat bodies and BMCs.
- **Developing a nationally coordinated system of Invasive alien species management**: which brings together domain experts such as botanists, foresters, wildlife biologists, researchers, engineers, ecologists, hydrologists, and communication experts to make areas and species-specific strategies.
- **Creating a central database for tracking NBTs**: through additional financial, technical and human resources.

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6.2. LAND DEGRADATION

6.2.1. COP 14: UN CONVENTION ON DESERTIFICATION

Why in news?

Recently, the 14th Conference of Parties (CoP14) of the United Nations Convention to Combat Desertification (UNCCD) was **convened in India for the first time.**

About UNCCD

- It is **one of the three Conventions that came out of the historic 1992 Earth Summit** in Rio de Janeiro including UN Framework Convention on Climate Change and Convention on Biological Diversity.
- Established in 1994, it is **sole legally binding international agreement that links environment & development to sustainable land management.** It addresses specifically arid, semi-arid and dry sub-humid areas.
- The convention **obliges national governments to take measures** to tackle the issue of desertification and **focuses on having a bottom-up approach** to achieve its goals, by involving the local communities.
- The convention's **2018 – 2030 Strategic Framework** is a comprehensive international commitment **to attain Land Degradation Neutrality (LDN)** aiming at:
  o The restoration of productivity of degraded land.
  o Enhancing the livelihoods of people dependent on them.
  o Mitigating the impact of droughts on vulnerable populations.
- Lessons learnt while implementing 2008-2018 framework-
  o Need to focus on capacity building - there exists significant gap between the current capacity-building initiatives and the required capacity to implement the action programmes.
  o Other limitations - insufficient financing in comparison with the two other Rio conventions, weak scientific indicators and measurement mechanisms, insufficient advocacy and awareness among various stakeholders, and institutional weaknesses and challenges in reaching consensus among the members on various key issues (e.g - North-South environment debate).
- India **ratified the Convention to Combat Desertification in 1996** and Ministry of Environment, Forest and Climate Change is the nodal ministry for the convention.
- India is also a part of the **Bonn Challenge**, which is an international effort to bring 150 million hectares of the world's degraded and deforested land into restoration by 2020, and 350 million hectares by 2030.

Key takeaways at COP-14

- **Adoption of Delhi Declaration:** Commitment for a range of issues, including gender and health, ecosystem restoration, taking action on climate change, private sector engagement, **Peace Forest Initiative** and **recovery of five million hectares** of degraded land in India.
  o Countries have agreed to make the **SDG target of achieving land degradation neutrality by 2030,** a national target for action.
  o **Peace Forest Initiative:** It is an initiative of South Korea to use ecological restoration as a peace-building process and aims at addressing the issue of land degradation in **conflict-torn border areas**.
- **Drought Toolbox:** It is a sort of knowledge bank which contains tools that strengthen the ability of countries to anticipate and prepare for drought effectively and mitigate their impacts.
- **International coalition for action on Sand and Dust storms (SDS): SDS source base map** will be developed with the goal of improving monitoring and response to these storms.
- **Sustainability, Stability and Security (3S) initiative:** Launched by 14 African countries to address migration driven by land degradation and aims at restoring land and creating green jobs for migrants and vulnerable groups.
- **Youth Caucus on Desertification and Land** convened its first official gathering in conjunction with the UNCCD COP14 to bring together youth advocates from different parts of the world, to build their capacity, share knowledge, build networks and to engage them meaningfully in the UNCCD processes.

About Land Degradation

- Land degradation refers to the **loss of life supporting land resource** through soil erosion, desertification, salinization, acidification, etc. Deforestation accounts for the major land degradation problem as it results in severe soil erosion, food, and loss of fertile soil.

- It **results in** loss of biodiversity, water and food insecurity, decline in economic productivity, conflict over access to resources, increased GHG emissions and population migrations.
- India faces a severe problem of land degradation. About 2**9.32% of the Total Geographical Area** of the country is undergoing the process of desertification/land degradation.
- A **2016 report by the ISRO** found that about **29% of India's land (in 2011-13) was degraded,** this being a 0.57% increase from 2003-05.
- At the COP-13, India had committed to restoring 13 million hectares of degraded and deforested land by the year 2020 and an additional 8 million hectares by 2030.
- In **eight states**—Rajasthan, Delhi, Goa, Maharashtra, Jharkhand, Nagaland, Tripura and Himachal Pradesh—around 40 to 70 per cent of land has **undergone desertification.**
- **Loss of soil cover, mainly due to rainfall and surface runoff**, is one of the b**iggest reasons for desertification.** It is responsible for **98 per cent of desertification in the country.**
- **In the COP 14,** India has announced its commitment to restore nearly 50 lakh hectares of degraded land in the next ten years and set up a Centre of Excellence at the Forest Research Institute, Dehradun, for providing technical assistance to meet the challenges.

Land Degradation Neutrality (LDN)

- UNCCD defines LDN as a **state whereby the amount and quality of land resources** which is necessary to support ecosystem functions and enhance food security, **remains stable or increases** within specified temporal and spatial scales and ecosystems.
- It is a unique approach that **counterbalances the expected loss of productive land with the recovery of degraded areas.**
- The overarching principle for LDN includes:
  - **Avoid:** Land degradation can be avoided by addressing drivers of degradation and through proactive measures to prevent adverse change in land quality and confer resilience, via appropriate regulation, planning and management practices.
  - **Reduce:** Land degradation can be reduced or mitigated on agricultural and forest land through application of sustainable management practices.
  - **Reverse:** Where feasible, some of the productive potential and ecological services of degraded land can be restored or rehabilitated through actively assisting the recovery of ecosystem functions.
- Land cover and land cover change, land productivity and soil organic carbon are the **three indicators** used by the pilot countries **to set the land degradation baseline,** identify potentially negative trends and formulate corrective measures.

> **Steps taken to achieve LDN**
> - **LDN Target Setting Programme:** Under this, UNCCD is supporting interested countries in the national land degradation neutrality (LDN) target setting process, including the definition of national baselines, targets and associated measures to achieve LDN.
> - **Creation of an LDN fund** to invest in bankable projects on land rehabilitation and sustainable land management worldwide including sustainable agriculture, sustainable livestock management, agroforestry, etc.
> - **Global Land Outlook** by UNCCD demonstrates the central importance of land quality to human wellbeing, assesses current trends in land conversion, degradation and loss, identifies the driving factors and analyzes the impacts etc.
> - **In India:**
>   - **National Action Plan (NAP) to combat desertification** was launched in 2001 for 20 years.
>   - **Desertification and Land Degradation Atlas (2016)** of entire country was prepared by ISRO and 19 other partners using Indian remote sensing satellites data in GIS environment.
>   - **Schemes** like Integrated Watershed Development Program, Per Drop More Crop, National Afforestation Program, National Green Mission, etc. have components to tackle Land degradation.

6.2.2. SOIL ORGANIC CARBON

Why in News?

The United Nations Convention to Combat Desertification (UNCCD)'s Committee on Science and Technology release a report which **emphasises the importance of soil organic carbon (SOC) in preventing land degradation and desertification.**

What is Soil Organic Carbon?

- Soil organic carbon (SOC) is the carbon associated with **soil organic matter (SOM).**

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- o SOM comprises the remains of plants and animals in the soil at various stages of decomposition, along with the microbial biomass and several by-products of complex biotic metabolic processes.
- It **affects many soil properties** such as hydrology, structure, and habitat and tends to be concentrated in the **topsoil**.
- **SOC is usually measured in the laboratory** on soil samples collected from the field.
- SOC is one of the **three global indicators of Land Degradation Neutrality (LDN).** Hence, predicting and monitoring change in SOC is vital to achieving LDN targets.

Factors affecting soil carbon level

- **Temperature:** Decomposition normally occurs more rapidly in the tropics than in temperate areas. During decomposition, SOC is lost from soil because microorganisms convert about half of the SOC to carbon dioxide gas (CO_2).
- **Erosion of Surface soil:** Losses of SOC from erosion of surface soil can have a large impact on the amount of SOC stored in soil.
- **Soil Moisture and water saturation:** Soil organic matter levels commonly increase as mean annual precipitation increases. Conditions of elevated levels of soil moisture result in greater biomass production, which provides more residues, and thus more potential food for soil biota.
- **Soil Texture:** Soil organic matter tends to increase as the clay content in soil increases.
- **Salinity and Acidity:** Salinity, toxicity and extremes in soil pH (acid or alkaline) result in poor biomass production and, thus in reduced additions of organic matter to the soil.
- **Vegetation and biomass production:** The rate of soil organic matter accumulation depends largely on the quantity and quality of organic matter input.

Beneficial impacts of SOC on soil health and functionality

Factor	How SOC helps
Water management	Water conservation, soil temperature moderation, root system proliferation
Soil fertility	Nutrient retention and availability, reduced losses by leaching, volatilization and erosion. High nutrient use efficiency
Soil health	Disease-suppressive soils, high soil biodiversity, improved plant growth and vigour, soil resilience
Soil tilth or suitability for growing crops	Low risk of crusting and compaction, better soil aeration, favourable porosity and size of distribution
Production	Sustainable agronomic production, assured minimum yield, better nutritional quality.

Measures to improve Soil organic Carbon

- **Stop carbon loss:** Protect peatlands through enforcement of regulations against burning and drainage.
- **Promote carbon uptake:** Identify and promote best practices for storing carbon in ways suitable to local conditions, including through incorporating crop residues, cover crops, agroforestry, contour farming, terracing, nitrogen-fixing plants, and irrigation.
- **Monitor, report and verify impacts:** Track and evaluate interventions with science-based harmonised protocols and standards.
- **Coordinate policies:** Integrate soil carbon with national climate commitments to the Paris Agreement and other policies on soil and climate.
- **Provide support:** Ensure technical assistance, incentives to farmers, monitoring systems, and carbon taxes to promote widespread implementation.

Conclusion

The 2015 Status of the **World's Soil Resources report highlights that more carbon resides in soil than in the atmosphere and all plant life combined**. However, roughly 33% of the world's soils are degraded, which has led to large losses of SOC. Capturing carbon in the soil helps improve soil health and productivity, stabilize the global carbon cycle, and ultimately help to mitigate climate change.

6.3. NAMAMI GANGE MISSION

Why in news?

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

- **Six sewage treatment plants** were inaugurated at Haridwar, Rishikesh, Muni-ki-Reti and Badrinath worth over Rs 500 crore.
  - Haridwar-Rishikesh zone contributes about 80% wastewater load into the River Ganga.
- **Ganga Avalokan Museum** was also inaugurated which is the first of its kind on the River Ganga at Haridwar.
  - Museum would be a special attraction to pilgrims and it would further enhance the understanding of the heritage associated with Ganga

About Namami Gange Mission

- It is an **Integrated Conservation Mission for river Ganga,** approved as 'Flagship Programme' by the Union Government in 2014 with budget outlay of Rs.20,000 Crore.
- It is being **implemented by the National Mission for Clean Ganga (NMCG),** and its state counterparts—State Programme Management Groups.
  - The **aims and objectives** of NMCG is to accomplish the mandate of National Ganga River Basin Authority (NGRBA)
    - To **ensure effective abatement of pollution and rejuvenation of the river Ganga** by adopting a river basin approach to promote inter-sectoral co-ordination for comprehensive planning and management and
    - To **maintain minimum ecological flows in the river Ganga** with the aim of ensuring water quality and environmentally sustainable development.

> **Status of Namami Gange Mission**
> - National Mission for Clean Ganga (NMCG) has so far managed to spend just 29% of the sanctioned budget to complete 37% of the projects.
> - A bulk of the projects sanctioned, 152, pertain to putting in place sewage infrastructure, like sewage treatment plants (STPs) — one of the most crucial components to keep the river clean.
>   - Of these 152 STPs, only 46 have been completed as of January, 2020.

- Under the Environment (Protection) Act, 1986, **a five- tier structure** has been envisaged at national, state and district level to take measures for prevention, control and abatement of environmental pollution in Ganga
  - **National Ganga Council** under chairmanship of Prime Minister (replaced National Ganga River Basin Authority).
    - NGC would have on board the chief ministers of five Ganga basin states—Uttarakhand, Uttar Pradesh (UP), Bihar, Jharkhand and West Bengal—besides several Union ministers and it is supposed to meet once every year.
  - **Empowered Task Force (ETF)** on river Ganga under chairmanship of Union Minister of Jal Shakti.
  - **National Mission for Clean Ganga (NMCG)**.
  - **State Ganga Committees** which would be the nodal agency to implement the programmes in a state. Besides, these committees would conduct safety audits of the river and take remedial measures**.**
  - **District Ganga Committees** in every specified district abutting river Ganga and its tributaries in the states
- **Implementation of the program has been divided** into entry-level activities (for immediate visible impact), medium term activities (to be implemented within 5 years of time frame), and, long-term activities (to be implemented within 10 years)
  - **Entry-level activities** includes river surface cleaning to address the floating solid wastes; rural sanitation to arrest the pollution (solid & liquid) entering through rural sewage drains and construction of toilets; etc.
  - **Medium-term activities** will focus on arresting the municipal and industrial pollution entering into the river.
  - **Under the long-term,** providing adequate flow to the river is envisioned through determination of e-flow, increased water-use efficiency, and improved efficiency of surface irrigation.
- **Main pillars of the mission are:**
  - River front development
  - Conservation of Aquatic life and biodiversity
  - Improvement of coverage of sewerage infrastructure in habitations on banks of Ganga.
  - River Surface cleaning for collection of floating solid waste from the surface of the Ghats and River
  - Afforestation
  - Industrial Effluent Monitoring

- o Development of Ganga Gram
  - ✓ To develop model village, that will exhibit itself as comprehensive and harmonious package of economic, historic, cultural and sanitized unit, on banks of Ganga, which is self –sustaining.
  - o Creating Public Awareness
- **Ganga River Basin Management Plan:** The Plan is being prepared with the objectives of taking comprehensive measures for restoration of the wholesomeness of the Ganga ecosystem and improvement of its ecological health, with due regard to the issue of competing water uses in the river basin.
  - o The wholesomeness of the river can be grasped in terms of four defining concepts: "Aviral Dhara" (Continuous Flow"), "Nirmal Dhara"("Unpolluted Flow"), Geologic Entity, and Ecological Entity.

- **4-battalion Ganga EcoTask Force** has been created to spread awareness about pollution and protecting the river.

Issues faced in cleaning ganga river

- **Inadequate Sewage treatment:** In the Ganga basin approximately 12,000 million litres per day (mld) sewage is generated, for which presently there is a treatment capacity of only around 4,000 mld.
- **Decreased ecological flow:**
  - o Due to restrictions and decrease in flow, the velocity of water decreases and siltation increases and therefore minerals of the water settle down at the riverbed.

> **Related: Environmental Flow (E-flow) norms for River Ganga**
> - E-flow norms were **recently notified by the National Mission for Clean Ganga (NMCG).**
> - E-flow refers to the **minimum flow of water** considered necessary for protecting the structure and function of an ecosystem and its dependent species.
> - The ecological quality of rivers must be maintained by **maintaining a minimum flow**. Rivers must not dry-up or have their physical regimes significantly altered in order to **conserve the hydrological and ecological functions** of their drainage networks
> - The e-flow norms stipulate the volume of water that dams and barrages must release to **allow the river to naturally clean itself and protect its aquatic biodiversity.**
> - It means **enough water is to be released in the downstream** of the river system after utilizing the water for the development projects in order to ensure downstream environmental, social and economic benefits.

  - o The decrease in flow has led to an increase in groundwater extraction for various uses.
- **Sludge control:** About 180 mld sludge would be generated in five Ganga basin states when they become ODF and if proper faecal sludge management is not in place, it would invariably pollute the Ganga.
- **Cost overruns:** An IIT report predicted the cost of treating sewerage to be about 1 paisa per litre at 2010 price levels. However, the cost would escalate due to the fact that deadlines are not met.
  - o Clean Ganga fund is a fund under which entities or a commoner can contribute for the Ganga clean up. However, NMCG could not utilise any amount out of the Clean Ganga Fund and the entire amount was lying in banks due to non-finalisation of action plan.
- **Lack of coordination:** The cleaning of the Ganga requires seamless coordination between the agencies responsible for carrying out different tasks. Jal Shakti ministry signed MOUS with 10 ministries for better implementation of Namami Gange. However, till date no detail is available as to how these ministries are functioning for better convergence.

Way Forward

- **Organic agriculture:** The cumulative use of pesticides has doubled in the last one decade and most of it runs off in our rivers. Agriculture along the entire riverbed should be organic.
- **Integration of strategies:** Many of the strategies (river-linking, riverfront development projects, access to toilets, making villages open defecation free, piped water supply in rural areas, to name a few) need to integrate long-term ecological and sustainability goals.
- **Promote decentralised sewage treatment plants (dSTP)** at the colony level. Reuse treated wastewater for irrigation and empty into natural drains. For all upcoming cities, smart cities and for those, whose master plans are not in place, earmark land for dSTPs.
- **Develop and restore local storages** (ponds, lakes, wetlands) as permanent solutions to both floods and droughts. Only 10 per cent of water received during monsoon rainfall is harvested. Restoration of ponds, lakes and wetlands should be an integral part of river restoration and conservation strategy
- **Restoring lower order streams** and smaller tributaries in the Ganga Basin.

- **Restore base flows through groundwater recharge**: There is a need to have robust planning and regulation of withdrawal and recharge of groundwater across all orders of the river streams to make rivers perennial.

6.4. WETLANDS (CONSERVATION AND MANAGEMENT) RULES, 2017

Why in news?

Ministry of Environment, Forest and Climate Change (MoEF&CC) has notified the **Guidelines for implementing Wetlands (Conservation and Management) Rules, 2017.**

Wetlands

- According to Ramsar Convention, wetland is defined as, "areas of marsh, fen, peat land or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed 6 metres".
- Wetlands can be defined as lands transitional between terrestrial and aquatic eco-systems where the water table is usually at or near the surface or the land is covered by shallow water.
- India has over 7 lakh wetlands, covering **4.5%** of the country's **area,** yet **none** of the wetlands has been notified under domestic laws.

> **Ramsar Convention on Wetland**
> - The Convention on Wetlands, signed in Ramsar, Iran, in 1971, is an international intergovernmental treaty for conservation of wetlands.
> - India is a party to the treaty.
> - It provides framework for national action and international cooperation for the conservation and wise use of wetlands and their resources.
> - **Major obligations of countries which are party to the Convention are:**
>   - Designate wetlands for inclusion in the List of Wetlands of International Importance.
>   - Promote, as far as possible, the wise use of wetlands in their territory.
>   - Promote international cooperation especially with regard to transboundary wetlands, shared water systems, and shared species.
>   - Create wetland reserves.

Key Features of the Guidelines

- **Prohibits conversion** for non-wetland uses, setting up or expansion of industries in wetland areas.
- **Prohibits disposal of construction and demolition waste** within the wetlands.
- Each state and Union Territory will have to set up **wetland authority** that will define strategies for wetlands conservation.
- The authority should also **enhance awareness among stakeholders and local communities.**

Significance of Wetlands

- Wetlands are a critical part of our natural environment. They **mitigate floods, protect coastlines** and **build community resilience to disasters, reduce the impacts of floods, absorb pollutants** and **improve water quality.**
- Wetlands are critical to human and planet life. More than 1 billion people depend on them for a living and 40% of the world's species live and breed in wetlands.
- They are a **vital source for food, raw materials, genetic resources for medicines,** and **hydropower.**
- They play an important **role in transport, tourism and the cultural and spiritual well-being of people.**

Problems associated with Wetlands

- Wetlands are under threat of disappearing because of **ongoing human activities** like encroachment, pumping out of water from the wetland, conversion of the wetland into agricultural land, pollution due to agricultural runoff and lack of educational and environment awareness among locals.
- **Restoration and conservation of wetlands becomes impossible once they are destroyed,** as these are neither identified nor categorized.
- States, in coordination with the central government, **failed to perform their statutory duty of identifying all wetlands** in their respective jurisdiction as per the Wetlands (Conservation and Management) Rules, 2010.
- Presently, **only notified wetlands are given protection.** Small wetlands get ignored in the process.
- **No data bank is available on wetlands** except on the Ramsar sites. Without data the extent of wetlands is not ascertained and thus encroachment becomes easier.

- The **Municipal bodies** that are currently responsible for implementation of the rules related to wetlands **lack technical expertise to identify a wetland.**

6.5. CORAL RESTORATION

Why in news?

The Zoological Survey of India (ZSI), with help from Gujarat's forest department, is attempting for the first time a process to restore coral reefs using the bio rock technology. A bio rock structure was installed one nautical mile off the Mithapur coast in the Gulf of Kachchh.

Coral Reefs

- Coral reefs are one of the most biologically diverse marine eco-systems on the Earth.
- Ecologically, coral reefs are important because they are the **counterpart to the tropical rain forest** in terms of species diversity and biological productivity in the Ocean.
  - Coral reef enables the formation of associated eco-systems which allow the formation of essential habitats, fisheries and livelihoods.

About Bio rock technology
- Bio rock is the name given to the substance formed by **electro accumulation of minerals dissolved in seawater on steel structures** that are lowered onto the sea- bed and are connected to a power source.
- The technology works by passing a small amount of electrical current through electrodes in the water.
- When a positively charged anode and negatively charged cathode are placed on the sea floor, with an electric current flowing between them, calcium ions combine with carbonate ions and adhere to the structure (cathode).
- This results in calcium carbonate formation. Coral larvae adhere to the $CaCO_3$ and grow quickly.
- The fragments of broken corals are tied to the bio-rock structure, where they are able to grow at least four to six times faster than their actual growth as they need not spend their energy in building their own calcium carbonate skeletons.

- In addition, coral reefs are **climatologically** important because they provide an **accurate long-term record of the climate change** and help in extending our knowledge of seasonal climate variability in many remote tropical oceans.
- In India, Coral reefs are present in the areas of **Gulf of Kutch, Gulf of Mannar, Andaman & Nicobar, Lakshadweep Islands and Malvan (Maharashtra)**.

Major threats for the corals

The vast diversity of animal and plant species that contributes to its system and genetic heritage that it represents are increasingly at risk, since the last few decades.

- **Natural:** Environmental-Temperature, Sediment Deposition, Salinity, pH, etc.
- **Anthropogenic:** Mining, Bottom Fishing, Tourism, pollution, etc.

Coral bleaching

- Coral bleaching occurs when coral polyps expel algae that live inside their tissues.
- Coral species live within a relatively narrow temperature margin hence low and high sea temperatures can induce coral bleaching.
- When corals are exposed to high concentrations of chemical contaminants or pathogens, coral bleaching happens.
- Some of the common factors behind coral bleaching are-
  - **Run off from agricultural land and chemical pollution** results in eutrophication and subsequent oxygen depletion.

Consequences of Coral Bleaching
- It will impact **marine ecosystem**, as coral reefs are some of the most bio diverse and productive ecosystems.
- Reefs act as **natural barriers to shorelines**, protecting them from the effects of moving water. As coral reefs die, coastlines become more susceptible to damage and flooding from storms, hurricanes, and cyclones.
- Without coral reefs, **ocean will not be able to absorb as much CO_2**, leaving more CO_2 in atmosphere.
- Loss of the coral reefs will have a devastating impact on **tropical countries' economies**, food supplies, and safety of their coastal communities.

  - **Destructive fishing and boating practices** lead to habitat destruction and disintegration of reef ecosystem.
  - **Marine Pollution:** Incidents such as increase in sea transport, oil spill etc. destroy coral reefs
  - **Uncontrolled tourism activities** lead to breakage of coral colonies and leads to tissue damage.

- o **Coastal construction and shoreline development** results in heavy sedimentation, which can lead to coral reef destruction.
- o **Introduction of invasive species** in ocean by humans too lead to change in the coral ecosystem.
- o **Coral mining:** Live coral is removed from reefs for use as bricks etc.
- o **Ocean acidification-** With increased pollution, Carbon Dioxide is absorbed by Ocean leading to rise in Carbonic acid in water. As Coral has Calcium carbonate as main component, it reacts with Carbonic acid and slowly dissolves down.
- According to a study, since 1982 three mass bleaching events occurred in 1998, 2010 and 2016 have occurred in India.

It is in this context that coral restoration activities are being taken up.

Measures taken for Coral Restoration

Global Measures

- **Chapter 17 of "Agenda 21"** specifically addresses the protection and sustainable development of the marine and coastal environment within the context of the United Nations Convention on the Law of the Sea (UNCLOS).
- **International Coral Reef Initiative (ICRI)-** is an **informal partnership** between Nations and organizations which strives to preserve coral reefs and related ecosystems around the world.
  - o It had declared **2018 as the third International Year of the Reef (IYOR)** to strengthen awareness globally about the value of, and threats to, coral reefs and associated ecosystems. **1997 was declared the first IYOR**, in response to the increasing threats on coral reefs and associated ecosystems, such as mangroves and sea grasses around the world.
- **UN Environment World Conservation Monitoring Centre (UNEP-WCMC)-** It works with scientists and policy makers worldwide to place biodiversity at the heart of environment and development decision-making to enable enlightened choices for people and the planet.

Measures taken in India

- Government of India has taken steps to protect its coral reefs under Coastal Ocean Monitoring and Prediction system (**COMAPS**), Land Ocean Interactions in Coastal zones (**LOICZ**) and Integrated Coastal and Marine Area Management (**ICMAM**).
- Government of India has notified Coastal Regulation Zones (**CRZ**) and has setup National Coastal Zone Management Authority and State Coastal Zone Management Authority to protect coral reefs.
- **Coral Bleaching Alert System (CBAS)-** a service initiated from **INCOIS** uses the satellite derived Sea Surface Temperature (SST) in order to assess the thermal stress accumulated in the coral environs.
- **Coral Reef Recovery Project-** is a joint venture of Wildlife Trust of India and the Gujarat Forest Department, supported by Tata Chemicals Limited (TCL).
  - o In Mithapur, the project envisions the creation of a model public-private-managed coral ecosystem of international standards using global benchmarks to restore degraded reefs through activities including coral transplantation and natural recruitment.
- **ReefWatch India**- An NGO, has taken up two projects —**Re(ef)Build** and **Re(ef)Grow** - to conserve the reefs.
  - o **Re(ef)build** involves the restoring and rehabilitation of coral reefs at the Andamans by rescuing naturally broken coral fragments that would otherwise get smothered in the sand and die, and re-attaching them to a robust substratum.

6.6. WATERSHED DEVELOPMENT

Why in news?

The **National Bank for Agriculture and Rural Development (NABARD)** announced a concessional refinance facility for watershed development projects.

More on news

- The **refinance facility** is up to Rs 5,000 crore for banks and financial institutions for on-lending to beneficiaries in its **2,150 watershed development projects**.

- The scheme will help the **reverse migrants,** who have returned to their villages from urban areas following the COVID-19 pandemic, take up new occupations.

What is Watershed Development?

- A watershed is all **the land and water area, which contributes runoff to a common point**. In watershed approach, development is **not confined just to agricultural lands** alone but covers the area starting from the highest point of the area to the outlet of the natural stream.
- **Watershed development** refers to the conservation; regeneration and the judicious use of all the natural resources particularly land, water, vegetation and animals and human development within the watershed.
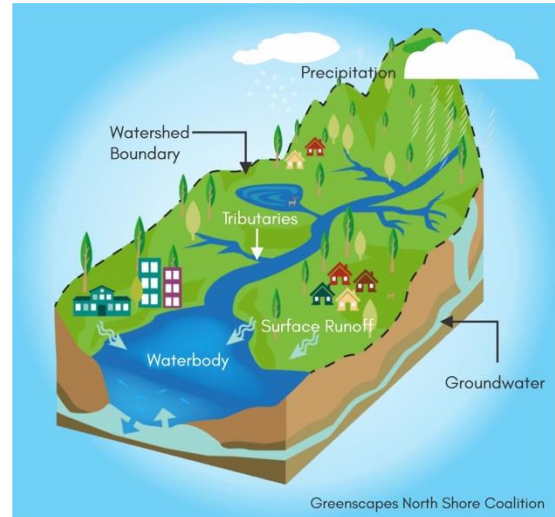
Benefits of Watershed development

- **Ecological Health**: A healthy watershed conserves water, promotes streamflow, supports sustainable streams, rivers, lakes, and groundwater sources, enables healthy soil for crops and livestock, and also provides habitat for wildlife and plants.
- **Human Health:** A healthy watershed provides safe drinking water, provides food, enables us to adapt to the impacts of climate change more easily by cooling the air and absorbing greenhouse gas emissions, and provides natural areas for people to keep active and recharge our batteries.
- **Economic Health:** A healthy watershed produces energy and supplies water for agriculture, industry and households. Forests and wetlands help to prevent or reduce costly climate change and flooding impacts, manages drought, contributes to tourism, fisheries, forestry, agriculture and mining industries.

Limitations of Watershed Development in India

- **Lack of holistic approach:** Most of the watershed management programmes in India do not consider the groundwater in the planning and the sole focus is placed on the surface water.
- **Top down approach:** Programmes are undertaken on a highly **regulatory, centralized and target driven approach** and are controlled and regulated from top to bottom.
- **Lack of community participation**: A total lack of ownership of these programmes among the local people and highly mechanistic interventions without paying much attention to community mobilization and social Organisation.
- **Multiple organizations**: At present in India, there are a number of national, international and nongovernment organizations working on watershed development related projects creating both overlaps and gaps.

Way forward

- **Watershed mapping** for all India planning to include all the watersheds as each one affects the other. E.g. All India Soil and Land Use Survey Organisation has released **a Micro watershed Atlas of India** in 2019.
- **Integrated approach:** The larger goals of protecting and conserving hydrologic services and/or managing negative downstream and groundwater impacts remained to be addressed as the micro-watershed approach was carried out in isolation.

Major government steps towards Watershed development:
- **Drought Prone Area Programme (1973–74):** Mainstreaming of drought prone areas through soil and moisture conservation measures.
- **Integrated Wasteland Development Programme (1989-90):** Regenerate degraded non-forest land through silvipasture and soil and water conservation.
- **National Watershed Development Project for Rainfed Areas (1990-91):** Restore the ecological balance, reduce regional disparities, and create sustained employment.
- **Mahatma Gandhi National Rural Employment Guarantee Scheme (2005):** Enhance livelihood security in rural areas by providing guaranteed wage employment in developing watershed.
- **Neeranchal** (2016-17 to 2021-22): World Bank assisted national watershed management project.
- **Prime Minister Krishi Sinchayee Yojna** (Watershed Development Component): Main objectives are to restore the ecological balance by harnessing, conserving and developing degraded natural resources such as soil, vegetative cover and water.

- **Creating local ownership:** Some examples such as **Naigaon and Jalgaon watershed management project** where the community participation with **"Pani Panchayats"** created a sense of ownership among the people.
- **Involving NGOs** to mobilize and build the capacities of the villagers and also bring the requisite technical and managerial expertise. E.g. Sujala (for Karnataka Watershed Development) and Gramya (Uttarakhand watershed development) projects.
- **Social Inclusion** by involving all stakeholders in project design and formulation and mainstreaming of women, the poor and vulnerable groups into the decision-making processes is crucial to the sustainability of the project.

6.7. BIRDS CONSERVATION

Why in news?

Recently, the Government of India has placed the draft "**Visionary Perspective Plan (2020-2030) for the conservation of avian diversity, their ecosystems, habitats and landscapes in the country**" in public domain.

Challenges faced in conservation of birds in India

- **Pressure of anthropogenic activities-** leading to destruction of their natural habitat and factors like environmental degradation, changes in land use like rapid urbanisation and pollution poses a serious threat to their survival.
- **Prevalent bird trade-** despite a complete ban on export of live birds (indigenous and captive-bred exotics).
  o In India, over 370 bird species are reportedly traded in more than 900 markets, making the country the third highest in bird trade globally.
- **Low conviction rate-** due to lack of legally admissible evidence with respect to authenticity of species identification by enforcement agencies.
- **Bird epidemics-** as there is inadequate study and appropriate mechanisms to control bird diseases. E.g. Over 17,000 birds at Sambhar Lake were reported to have succumbed to avian botulism caused by Clostridium botulinum.

Key highlights of the Vision Plan

- **Bird surveys in select landscapes-** to identify new **IBAs** for conservation of birds and other biodiversity. It calls for comprehensive strategies for restoration of bird habitats in select IBAs outside the protected areas and monitoring of avifaunal responses.
  o **Quantifying the economic value** of ecosystem goods, services, and functions mediated through the establishment of the IBAs.
- **Species recovery programmes of critically endangered birds-** The plan has envisaged **landscape approach** to control their declining population and protect birds in urban areas, and protection of their habitats from turning into wastelands.
- **Conservation of migratory birds-** through species-specific action plans, setting up of a national database on migratory birds and their habitats, assessment of threats to migratory birds and their habitats etc.

Scenario in India
- There are 554 'important bird and biodiversity areas' (**IBAs**) in the country. Out of which, 506 sites have globally threatened species.
- The MoEFCC had also come out with '**India's National Action Plan for Conservation of Migratory Birds and their Habitats along the Central Asian Flyway (2018-2023)'.**

BIRD SPECIES IN NUMBERS

No. of bird species in India: **1,317**
No. of species endemic to India: **72**
No. of species classified as 'threatened': **100**
No. of species classified as 'endangered': **20**
No. of species fall under 'rare category' due to sparse population: **270** (21% of total bird species in India)

Bird species categorised as rare, endangered and threatened: **Raptors, Pheasants, Bustards, Hornbills, Cranes, Storks and others**

Significance of Bird Conservation
- Birds **perform various ecosystem services and functions** such as control of insect pests in agriculture and forestry, rodent control, pollination of plants, seed dispersal and forest regeneration and scavenging.
- Decline in bird population leads to **ecological imbalances** like increase in insect and rodent populations, vector-borne diseases, etc.
  o E.g. the population decline of vultures, which are carrion feeders, led to an alarming increase in the population of stray dogs especially in urban areas across the country.

- **Study the impact of anthropogenic activities**- such as discharge of wastes and untreated sewage, disposal of solid wastes including plastics, oil spills and discharge of ballast water, trawling, etc and impacts of invasive and alien species and pathogens on coastal biotic communities with an emphasis on bird populations.
  - o An **assessment of the marine debris** including macro-plastics that affect coastal bird population by choking or accidental foraging.
- **Awareness generation and crowd sourcing**- by developing a **national network of birdwatchers** for effective dissemination of information and success stories on bird conservation through citizen science initiatives and electronic media.

> - The **Salim Ali Centre for Ornithology and Natural History (SACON)** in Tamil Nadu is one of the centres of excellence of the MoEFCC.
> - SACON's mission is "To help conserve India's biodiversity and its sustainable use through research, education and peoples' participation with birds at the centre stage".

- **Implementing Agencies**- It will be implemented by different stakeholders including ministries, with the **Salim Ali Centre for Ornithology and Natural History (SACON)** being the nodal institution for this purpose. **Ministry of Environment, Forest & Climate Change (MoEFCC) is the focal Ministry.**

Way Forward

It is crucial that this plan is implemented in its spirit, given the huge development pressure on the environment ministry. It becomes more important because, in the hierarchy of conservation actions, birds come well below major species like tigers.

6.8. WILDLIFE TRADE

Why in news?

With the recent outbreak of Corona virus epidemic, speculations around the link between illegal wildlife trade and zoonotic diseases are doing rounds, which has brought the **issue of illegal wildlife trade into the limelight.**

Background

- As per Worldwide Fund for nature, "illegal wildlife trade is estimated to reach $20 billion per year, which makes **wildlife trafficking the world's fourth largest illicit trade**, after narcotics, human trafficking and trade in counterfeit goods.
- There are **variety of products which are demanded by the trade and poaching** includes Exotic pets and Luxuries, Bush meat, Traditional Medicines, Clothing & Jewellery made from animal fur, tusks, fins, shells, skins, horns and internal organs.
- **Impacts of illegal wildlife trade**
  - o Threat to conservation of species
  - o Risks to human health
  - o negatively impacts a country's natural resources and local communities

IWT in India: A brief overview

- India is only 2.4 % of world's land area, but contributes about 8 % of known global wildlife, including over 45,000 species of plants and 91,000 species of animals.
- In India, the **illegal wildlife trade includes diverse products** including mongoose hair; snake skins; Rhino horn; Tiger and Leopard claws, etc.
- **State of India's Environment 2017** highlights a 52 % spike in poaching and wildlife crimes between 2014 and 2016.
  - o In 2018, **TRAFFIC India** released a study which revealed that at least 5,772 **pangolins** were captured in India from 2009 to 2017 for illegal trade.
- The **main reason for the unabated wildlife trafficking across India** is its porous international land borders.
- The **main consumer markets** are China and South East Asia, but wildlife is also smuggled to the Gulf, Europe and Northern America. Beyond India, the main transit countries are Nepal, Bangladesh, Bhutan, Sri Lanka and Myanmar.

Mains 365 – Environment

Steps taken in India to counter IWT

- **Constitutional safeguard:** Under **Article 51A (g),** it is a fundamental duty of every citizen of India to protect and improve natural environment including forests, lake, rivers and wildlife and to have compassion for living creatures.
- **Laws and Government Initiatives:**
  - Trade in over 1800 species of wild animals, plants and their derivative are prohibited under **the Wildlife (Protection) Act, 1972.**
  - **The Prevention of Cruelty to Animals Act 1960** empower authorities to penalize and jail those who harm wildlife.
  - **Indian Penal Code, 1860:** Section 428 and Section 429 reads that killing, poaching, maiming, poisoning or torturing an animal is a cognizable offence and the punishment for such act is rigorous imprisonment which may extent to five years or fine or both.
  - **Wildlife Crime Control Bureau (WCCB)** is a statutory multi-disciplinary body established by the Government under the Ministry of Environment and Forests, to combat organized wildlife crime in the country, under **Wild Life (Protection) Act, 1972.**
- **Other initiatives:**
  - **Participation of local community:** Five crore, people living around national parks and sanctuaries are working as partners in environment conservation.
    - ✓ A **15-year National Wildlife Action Plan (2017-31)** with a special focus on peoples' participation has been launched.
  - **Demand-reduction campaigns:** In May 2019, the WCCB launched a campaign in collaboration with the UN Environment named **'Not all animals migrate by choice' campaign launched to raise awareness on illegal wildlife trade** at airports across India.
    - ✓ Tiger, Pangolin, Star Tortoise and Tokay Gecko featured in the campaign.

> **International Organizations for control of Wildlife Trafficking:**
> - **TRAFFIC,** established in 1976, is a wildlife trade monitoring network and a **joint programme of WWF** and **IUCN.**
>   - It works closely with the National and the State Governments and various agencies to help study, monitor and influence action to curb illegal wildlife trade and bring wildlife trade within sustainable levels.
> - **CITES,** (the Washington Convention), signed in 1973 provides a mechanism to regulate the trade in wildlife. Under its guidance, governments all over the world have taken steps to prevent this illegal trade and bring it under control.
>   - **India is a member.**
> - **IFAW:** The International Fund for Animal Welfare is one of the largest animal welfare and conservation charities in the world. The organization works to rescue individual animals, safeguard populations, preserve habitat, and advocate for greater protections.

Way Ahead

- **There is an urgent need for knowledge and action** to bring legal wildlife trade within sustainable levels and stop all illegal wildlife trade that has threatened and even pushed many species towards extinction.
- **Need for greater investment in wildlife forensic science as a discipline to deal with the enormity of the crime so that** evidence get evaluated quickly, accurately scientifically, strongly.
  - For example, wildlife forensic scientists in the U.K., have developed techniques that can lift fingerprints off feathers and eggshells.
- Unless **governments and civil societies work together** to alter mindsets, the world's biodiversity will continue to dwindle, thus collaboration is needed, along with **community participation**.
- The **need for the effectiveness of IWT investments** to be better **monitored and evaluated,** and for investments to be aligned more clearly with **defined needs** identified on a country-by-country basis.

6.9. COMPENSATORY AFFORESTATION

Why in news?

Forest Advisory Committee (FAC) has recently proposed to **overhaul the compensatory afforestation process by introducing the Green Credit Scheme.**

Proposed Green Credit Scheme

- It will allow agencies to **identify appropriate non-forest land and begin growing plantations**.
  - These agencies could be private companies, village forest communities or NGOs. m

> **Forest Advisory Committee** (FAC)
> - It is a body under the Union **Ministry of Environment, Forest and Climate Change** (MoEF&CC) and is responsible for **regulating forest diversion**.
> - It comprises of official members from the forestry division and independent experts, who are non-official members.

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- After three years, the land would be **eligible to be considered as compensatory forest land** if it meets the criteria set by the Forest Department.
- An industry that is in a need of forest land could then approach the agency and pay it for parcels of such forested land and this would then be **transferred to the Forest Department** and be recorded as forest land.
- FAC believes that this will **encourage plantations outside the traditional forest area**. It will help in contributing towards meeting the international commitments of the country such as Sustainable Development Goals and Nationally Determined Contributions.
- However **various concerns** have been raised against this scheme:
  o It will allow the Forest Department to **outsource** one of its responsibilities of reforesting to non-government agencies.
  o This could allow for "**forests**" to be **traded** as a **commodity**. It could lead to the **privatisation** of multi-use forests into **monoculture** plantations, and even their destruction, along with **loss of biodiversity** and **violation** of **land rights**.
  o If the economic value of these plantations becomes lucrative, it can pose a serious **threat** to **agricultural land,** by diverting the latter for plantations.
  o If the company raising the plantation does not wish to trade, it can retain and **harvest** the plantation for **timber**, once ready. This goes **against** the **rehabilitative principle** of compensatory afforestation which seeks to restore the ecological imbalance.
  o The crisis of **fragmentation of forests** and the **spike in man-animal** conflict will augment.

Compensatory Afforestation (CA) process in India

- The Forest (Conservation) Act, 1980 provide that whenever a forest land is to be diverted for non-forestry purposes like mining or infrastructure development, the equivalent non forest land has to be identified for compensatory afforestation and funds for raising compensatory afforestation are to be imposed.
- The government enacted **Compensatory Afforestation Fund Act 2016** to provide a proper institutional mechanism for compensatory afforestation matters.
- The project proponent identifies land for CA and also pays the current economic value of the diverted forest land- **'Net Present Value'**. This money which is transferred to the forest department gets collected in the **Compensatory Afforestation Fund**.
- The forest department then undertakes appropriate plantation work on that land, which grows into forests over time.

Issues with the Act

- **Compromising community forest rights:** The land identified for compensatory afforestation would be under forest department's jurisdiction thus, having adverse consequences for the hard-won rights of tribals and forest dwellers.
- **Lack of monitoring mechanism for expenditure** from funds.
- **Scarcity of land** as land is a limited resource, and is required for multiple purposes, such as agriculture, industry, etc. The problem is compounded by unclear land titles.
- **Inadequate Capacity of state forest departments** for planning and implementation. Still utilisation of 90% of funds depend on it.
- **Low quality forest cover:** Compensatory afforestation cannot make up for the ecological value lost by cutting the existing forests. Also, computing the appropriate Net Present Value of a forest is a challenge.
- **Poor survival rate of plantations** raised under compensatory afforestation also raises serious questions about their effectiveness.
- **Diversion as land banks:** The creation of land banks for CA from revenue forests and degraded forests (on which communities have got traditional rights) further allows for takeover of community land.

> **Key data from India State of Forest Report(ISFR), 2019**
> - It was jointly released recently by United Nations Environment Programme (UNEP) and Food and Agriculture Organization (FAO) The Total Forest and Tree cover is 24.56% of the geographical area of the country.
> - The **Total Forest cover is 7,12,249 sq km which is 21.67%** of the geographical area of the country.
>   o The Tree cover is 2.89% of the geographical area of the country.
> - As compared to ISFR 2017 the current assessment shows an increase of
>   o 0.65% of forest and tree cover put together, at the national level

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- o 0.56% of forest cover
- o 1.29% of tree cover
- **Change in Recorded forest Area/Green Wash (RFA/GW)** as compared to previous assessment of 2017.
  - o Forest cover within the RFA/GW: a slight decrease of 330 sq km (0.05%).
  - o Forest cover outside the RFA/GW: there is an increase of 4,306 sq km.
- The **top five States** (UT) in terms of increase in forest cover: Karnataka>Andhra Pradesh>Kerala>Jammu & Kashmir>Himachal Pradesh.
- **Mangrove cover in the country has increased by 1.10%** as compared to the previous assessment.
- **Wetlands cover 3.83% of the area within the RFA/GW** of the country. Amongst the States, Gujarat has the largest area of wetlands within RFA in the country followed by West Bengal.
- **Dependence of fuelwood on forests is highest in the State of Maharashtra**, whereas, for fodder, small timber and bamboo, dependence is highest in Madhya Pradesh.

6.10. URBAN FORESTRY

Why in News?

Recently, Ministry of Environment, Forest and Climate Change (MoEF&CC) selected Arunachal Pradesh capital **(Itanagar) for implementation of the 'Nagar Van' or Urban Forest scheme.**

About Nagar Van Scheme

- It envisages creating forests in **200 urban cities across the country in next five years** with a renewed focus on people's participation and collaboration between Forest Department, Municipal bodies, NGOs, Corporates and local citizens.
  - o Pune's Warje forest offer good model for growth.
- Forest once established **will be maintained by State Government.**

About Urban Forestry

- It is an integrated, city wide approach to the **planting, care and management of trees, forests, and natural systems** in the city to secure multiple environmental and social benefits for urban dwellers.
- It **concentrates on all tree dominated as well as other green resources** in and around urban areas, such as woodlands, public and private urban parks and gardens, urban nature areas, street tree and square plantations, botanical gardens and cemeteries.

Importance of urban Forestry

- **Environmental Benefits:**
  - o It includes **reduction in temperature rise in urban areas,** removal of other air pollutants, recharge of groundwater and stabilization of soil.
  - o India has pledged to **create an additional carbon sink** of 2.5 -3.0 billion tonnes of CO2 equivalent through additional forest and tree cover by 2030 and urban forestry will have an important contribution towards achieving it.
- **Social and Psychological Benefits:**
  - o Urban trees enhance the **beauty and environmental quotient of city** and are among the most important features contributing to the aesthetic quality of residential streets and community parks.
  - o Urban parks and peri-urban forests are an **important recreational facility.** Urban green spaces can enhance cultural activities by providing venues for local festivals, civic celebrations, political gatherings and theatrical performances.
  - o It can **reduce stress and improve physical health** for urban residents
- **Economic Benefits:**
  - o Landscaping with trees can **increase property values and commercial benefits.** In Delhi, poor people gain income from the harvesting and sale of a number of products from trees growing on land owned by the Municipal Corporation.

Urban Forestry in India
- Existing availability of per capita open spaces **varies from 0.81 sq m in Chennai to 278 sq m** in Greater Noida.
- Most of the Indian cities, **are far behind per capita forest availability in comparison to European/US cities (20 to 40% of total geographical area).**
- Chandigarh has more than 35% of its geographical area under forest and tree cover, making it one of the greenest cities of India.
- 2014 Urban and Regional Development Plans Formulation and Implementation guidelines suggest a **norm of 10-12 square metres of open space per person.**

o Urban forest offers significant benefits in reducing building air-conditioning demand and **reducing energy consumption.**

o **Saves municipal expenditures** for storm water management infrastructure, ozone non-attainment and other costs associated with asthma and other illnesses related to poor air quality.

Potential issues with Urban Forestry

- **Expensive approach:** Urban forestry initiatives conducted on a scale beyond small homegardens can cost a large amount of money to implement. This is particularly the case if instant results are wanted as maintenance costs can be very high in such situations.

- **Structural damage:** The roots of street trees often cause the cracking of roads and pavements and sometimes water pipes. Urban trees can also cause structural damage to buildings.

- **Threats to Human safety:** Poorly planted or inappropriate tree species can serve as a hazard to urban inhabitants, either directly (through falling branches or the falling over of the entire tree) or indirectly.

> **Constraints in India**
> - **Shortages of green space** as most of the spaces are utilized for residential or business purposes due to huge population pressure.
> - **Unequal spatial distribution of green space** as several areas of the city have absolutely no parks while majority of the total green space are concentrated in some select ward areas.
> - **Other factors** are lack of funding, weak linkages with other resource management programs, and improper planning that fails to consider the surrounding ecosystem, the community, and the regional context.

Way forward

- Initiatives such as **engagement of NGOs, civil society, media and corporate groups** are necessary to extend urban green cover.

- Species must be selected by **considering climate, soil type and topography.** In recent times, trees are largely planted for their high growth rate and decorative appearance.

- Need to **plant trees that provide multiple benefits to individual and society,** particularly in-house compounds for providing edible pods, flowers, fruits, leaves etc. and in median strips between roads for shades and ground water recharge.

- **Riverside beautification** as well as tree plantation can solve the problem of lack of space. Tree plantation on the shores of river or water channel can increase the urban green cover and provide space for city dwellers.

- Plan for urban forestry **should be integrated into overall planning of the urban areas** in advance otherwise greening of the urbanized area becomes more difficult once the settlement takes place.

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7. DISASTER MANAGEMENT

7.1. RECENT CASES OF DISASTERS

7.1.1. COVID-19

- COVID-19 is the **first pan India biological disaster** being handled by the legal and constitutional institutions of the country.
- It is for the **first time** that a **pandemic** has been recognised as a **'notified disaster'** in the country by the Ministry of Home Affairs (MHA).
- Subsequently the **Disaster Management (DM) Act has also been invoked for the first time in India** to impose lockdown and effectively manage this crisis.
- The crisis has **provided an opportunity to look into the loopholes of our disaster management strategy** and relevant provisions under the DM Act. The knee jerk and haphazard responses to current disaster are further compounded by local level conflicts between different departments of the same State which end up hampering relief measures.

> **Disaster Management (DM) Act, 2005**
> - The **National Disaster Management Authority (NDMA)** under the DM Act is the **nodal central body** for coordinating disaster management, with the **Prime Minister as its Chairperson**. The NDMA lays down policies, plans and guidelines for management of disaster.
> - Similarly, State, District and Local level Disaster Management Authorities were established, manned by high functionaries. All these agencies are envisaged to work in coordination.
> - NDMA so far formulated 30 Guidelines on various disasters including the **'Guidelines on Management of Biological Disasters, 2008'**.
> - The **2019 National Disaster Management Plan** issued also deals extensively with Biological Disaster and Health Emergency. This is the broad legal framework within which activities to contain COVID-19 are being carried out by the Union and State governments.

Issues with Current Framework of COVID-19 Disaster Management

- **Issues with legal framework**:
  o DM Act was meant to be used in a situation where a state government was unable, on its own, to cope with the result of a natural disaster. It was never meant to be a legal mechanism to **control the otherwise functional state governments.**
  o Taking a cue from the central guidelines on lockdown, the State governments and authorities exercised powers under the Epidemic Diseases Act of 1897 to issue further directions. This led to **confusion among the masses,** especially the vulnerable population (migrants, slum dwellers etc.).
- **Over-centralisation of powers:** A **top-down approach** adopted by the central government left states with **no manoeuvring space** that could be used to design and enforce lockdowns keeping cultural and social norms in mind.
- **Management of a health crisis has become an issue of law and order:** Major notifications and guidelines relating to COVID-19 are being issued by the MHA and not the Ministry of Health and Family Welfare. The **language used is still one of law and order:** "lockdowns," "curfews," "fines" and "surveillance."
- **DM Act is not suitable to deal with fake news/false warning** being spread through social media and internet as it was passed in 2005 and then social media had not been as accessible or as available as it is now.
  o Section 54 in the DM Act makes it a **punishable offence to circulate a false alarm or warning** about a disaster or its severity or magnitude.
- **Absence of a consolidated, pro-active policy approach :** There has been **ad hoc and reactive rulemaking**, as seen in the way migrant workers have been treated. Migrants issue has also exposed the **lack of co-ordination between the Union and State governments.**

Learnings from present management of COVID-19 disaster

- **Inclusion of 'Restriction' and 'Refrain' in Disaster Management Strategy:**
  o **So far, focus of disaster management** has been primarily on what one must do to abate a crisis. Accordingly, the emphasis has been on the **three 'R's of disaster management- 'Rescue, Relief and Recovery'.**

o However, there is a need to **give due prominence to what one must not do** to effectively mitigate a calamity. Hence there is need to **incorporate two more R's** in disaster management - 'Restriction' and 'Refrain'.
  ✓ The **inclusion of 'Restriction'** is necessary not only to highlight the importance of the legal prohibitions which exist in the DM Act but also to caution people of possible legal action, which will deter them from spreading fake news.
  ✓ Apart from legal restrictions it is also necessary to **instill a culture of 'Refrain' false warnings at the community level.** Accordingly, aside of imposing regulations to curb fake news, people must be trained to realise the authenticity of the news.
- **Ground Level Implementation and Federalism**
  o Contrary to the centralised structure of DM Act, India's disaster response must be decentralised.
  o Varied **capacity of different states** necessitates a lot more **agile and differential approach** of disaster management.
  o Disaster of a national magnitude necessitates a **close administrative and political coordination,** led by Centre and followed by State governments, Disaster Management Authorities, district administration and local self-governments and other stakeholders. In the true spirit of DM Act and federal structure, national and state political and administrative agencies should be more collaborative and consultative.
- **Role of Courts**
  o In times such as these, **constitutional courts must play its role.** There are complaints of discrimination, police excesses, starvation, lack of medical aid etc. from various corners of the country.
    ✓ There is **bar on jurisdiction of courts and there is no grievance redressal mechanism under DM Act.**
  o The constitutional courts must **suo motu register PILs** and closely monitor the implementation of DM Act, ensure rule of law and protection of human rights as guaranteed under the Constitution even during the disasters.

7.1.2. CYCLONE

Why in news?

Recently, Cyclone 'Amphan' wreaked havoc in the eastern coastal states - West Bengal and Odisha – of India.

- The storm is only the **second super cyclone(wind speed > 222 km/hr)to form in the Bay of Bengal** since 1999.
- The rapid intensification of Amphan is an indication of warming of Bay of Bengal which registered maximum surface temperatures of 32-34°C. This is a **consequence of anthropogenic global warming.**

Cyclone Management in India

What are Tropical Cyclones?
- They are **violent storms that originate over oceans in tropical areas** and move over to coastal areas bringing about large scale destruction caused by violent winds, very heavy rainfall and storm surges.
  o They are low pressure weather systems in which winds equal or exceed speeds of 62kmph.
  o Winds circulate around in anti-clockwise direction in the Northern Hemisphere and in clockwise direction in the Southern Hemisphere.
- Tropical cyclones striking India **generally originate in the eastern side of India**.
  o **Bay of Bengal is more prone to cyclone** than Arabian Sea because it **gets high sea surface temperature, low vertical shear winds and has enough moisture** in middle layers of its atmosphere.
  o The frequency of cyclones in this region is **bi-modal**, i.e., Cyclones occur in the months of **May–June** and **October–November**.

Conditions for Cyclone Formation (Cyclogenesis)
- A **warm sea surface (temperature in excess of 26° –27° C)** and associated warming extending up to a depth of 60m with abundant water vapour.
- **High relative humidity** in the atmosphere up to a height of about 5,000 metres.
- **Atmospheric instability** that encourages the formation of cumulus clouds.
- **Low vertical wind between the lower and higher levels of the atmosphere** that do not allow the heat generated and released by the clouds to get transported from the area.
- The presence of **cyclonic vorticity** (rate of rotation of air) that initiates and favours rotation of the air cyclonically.
- **Location over the ocean,** at least 4–5° latitude away from the equator.

- India has a coastline of 7,516 km, of which **5,700 km are prone to cyclones** of various degrees.

- About 8% of the Country's area and one-third of its population live in 13 coastal states and UTs who are, thus vulnerable to cyclone related disasters.
- **Loss due to cyclones:** Loss of lives, livelihood opportunities, damage to public and private property and severe damage to infrastructure are the resultant consequences, which can disrupt the process of development.
- In India, **National Disaster Management Authority (NDMA) has responsibility of formulating National Guidelines** for Management of Cyclones and **India Metereological Department (IMD) is the nodal agency for providing cyclone warning services** to communities and important officials in affected areas.

NDMA guidelines for the Management of Cyclones

- **Non – Structural Measures**
  - **Early Warning Systems:** It consists of Automatic Weather Stations, Doppler radars, High Wind Speed Recorders, Ocean buoys, Unmanned Aerial Vehicles etc. They provide critical information for tracking and forecasting intensity of cyclones.
  - **Communication and Dissemination Systems:** They are a pre-requisite for the proper functioning of cyclone warning. It consists of **cellular telephone network, Disaster Warning System (DWS) terminals,** etc.
  - **Management of Coastal Zones:** A holistic approach to Coastal Zone Management (CZM), like proper planning of the coastal areas for locating communities and infrastructure in safer areas, protecting and restoring natural bio-shields etc., can minimise loss of life and damage to property to a considerable extent.
  - **Mangrove forests and shelterbelts** constitute Bio-shields in coastal areas and provide ecological security. Their preservation is to be done by effective implementation of **Coastal Regulation Zone (CRZ) Rules.**
  - **Awareness Generation:** Awareness encompasses a wide range of modes of sensitising communities, neighbourhoods and various functionaries from the local to the national level.
- **Structural Measures**
  - Ensure availability of a**dequate numbers of shelters, community centres/school buildings, places of worship**, etc., which can be utilised for moving people from vulnerable areas to safety.
  - To **provide at least one all-weather link road** for each village that is accessible during cyclone or flooding periods.
  - **Construction of 'saline embankments'** is carried out to protect habitation, agriculture crop and important installations along the coast.
- **National Cyclone Risk Mitigation Project (NCRMP):** Government has drawn up NCRMP to be implemented with World Bank assistance of $300 million.
  - Its objective is to **strengthen the structural and non-structural cyclone mitigation efforts and reduce the risk and vulnerability of the coastal districts** which are prone to cyclones.
  - NCRMP consists of the following **four components**
    - ✓ **Component A:** Improvement of early warning dissemination system of cyclone warnings.
    - ✓ **Component B:** Cyclone risk mitigation investment like construction of cyclone shelters.
    - ✓ **Component C:** Technical assistance for hazard risk management and capacity building.
    - ✓ **Component D:** Project management and institutional support.
- **Disaster Risk Management and Capacity Development**
  - Establishment of a **comprehensive Cyclone Disaster Management Information System** covering all phases of disaster management to provide online services to the states.
  - **Community Based Disaster Management (CBDM)** to building the capacity of communities to assess their vulnerability to both human induced and natural hazards and develop strategies and resources necessary to prevent and/or mitigate the impact.

7.1.3. INDUSTRIAL DISASTER

Why in news?

Styrene gas leaked from Vishakhapatnam based LG Polymers India Pvt Ltd. factory causing multiple deaths. This brought again the issue of Industrial disasters in the country.

Industrial Disasters- A background

- Industrial disasters are **large scale industrial accidents,** large scale environmental pollution, and product injury cases that have the potential for killing, injuring or otherwise affecting large numbers of people and natural environment.
- The ever-growing mechanisation, electrification, chemicalisation and sophistication have made industrial jobs more and more complex and intricate leading to increased dangers to human life in industries through accidents and injuries.

- India has continued to witness a series of industrial disasters especially during the last 3 and a half decades after the Bhopal gas tragedy. **(refer infographic)**
- According to the Labour and Employment Ministry, in three years (2014-2016), more than 3500 workers lost their lives while more than 50,000 were injured in accidents that occurred in factories.

Legal Provisions related to Industrial Disasters

Environment (Protection) Rules, 1986	• Set **discharge and product standards** – source standards for restricting pollution; product standards for manufactured goods and ambient air and water standards – for regulating quality of life and environmental protection.
Hazardous Waste (Management Handling and Transboundary Movement) Rules, 1989	• Industry required to **identify major accident hazards**, take preventive measures, and submit a report to the designated authorities.
Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989	• **Importer must furnish complete product safety information** to the competent authority and must transport imported chemicals in accordance with the rules.
Chemical Accidents (Emergency, Planning, Preparedness and Response) Rules, 1996	• Centre is required to constitute a **central crisis group** for management of chemical accidents; set up quick response mechanism termed as the **crisis alert system**. Each state is required to set up a crisis group and report on its work.
Factories Amendment Act, 1987	• **Extended Risk scope:** 1987 Amendment Act extends the scope of risk from hazardous industries. The narrowly defined scope covering only workers and the premises of the factory was **extended to the general public in the vicinity of the factory**.
Public Liability Insurance Act, 1991	• Imposes a **no-fault liability on the owner of hazardous substance** and requires the **owner to compensate victims** of accident irrespective of any neglect or default. For this, the owner is required to take out an insurance policy covering potential liability from any accident.
National Green Tribunal (NGT)	• NGT was set up by an Act of Parliament in 2010. The Act provides for the **"principle of no fault liability"**, which means that the company can be held liable even if it had done everything in its power to prevent the accident.

> **Judicial Pronouncements w.r.t setting the liability in case of Industrial Disasters**
> - **Doctrine of Absolute Liability:** This concept evolved in India after the case of **M.C Mehta vs Union of India (1986),** famously known as **Oleum Gas Leak case**.
>   o According to this doctrine as defined by the Supreme Court, the **enterprise owes an absolute and non-delegable duty** to the community to ensure that no harm results to anyone on account of hazardous or inherently dangerous nature of the activity which it has undertaken.
> - **The rule of strict liability:** Till the MC Mehta case, India also followed the concept of 'strict liability'. Under the "strict liability principle", a party is not liable and need not pay compensation if a hazardous substance escapes his premises by accident or by an "act of God'" among other circumstances.

Reasons for Industrial Disasters

Apart from natural reasons such as earthquake or a cyclone, major reasons for this can be following-

On Part of Industry

- A lot of chemical manufacturing is in the **small and medium sectors,** whose ability to invest in industrial and environmental safety as well as occupational health is limited.
- There is also an **increasing tendency to skip long-term training and skill development** by resorting to casual labour in the operational area.
  o These contract workers are **not given adequate personal protection equipment (PPE)** and health and safety support
- **Low Level of awareness of safe machinery, unsafe practices** such as quarrying leading to roof collapse in coal mines and working without masks in areas prone to poisonous gas leakage cause fatalities.
- The **poor management systems** and even poorer reporting systems aid to the problem. Many accidents and deaths go unreported.

On part of Government

- **Labour falls in the concurrent list,** so the Centre frames the laws while the states have the responsibility of implementing them. But the **multiplicity of legislations** and **changing regulations from state to state** often pose compliance problems.

- **Relaxation of Industrial Regulations:** Industrial regulations are viewed as a barrier to ease of doing business in India.
- **The inability of states to strengthen their labour bureaus and environment protection units** caused unsafe factories to mushroom to meet the growing demand for industrialization. As per the Central Pollution Control Board, the number of hazardous industries in the country increased threefold from the early 1990s to around 36,000 in 2010.
- **Failure to stop encroachment: Urban populations have encroached** on spaces that were originally demarcated for industry, including the buffer (and green) zones.

Way Forward

National Disaster Management Plan-2019 suggests the following steps to prevent the Chemical (Industrial) Disaster.

- **Understanding the risk: It involves strengthening** Information Systems, Monitoring, Research which include
  - **Zoning/ Mapping of industrial zones** on basis of hazard potential and effective disaster management for worst case scenarios.
  - **Studies on vulnerabilities and capacities** covering social, physical, economic, ecological, gender, social inclusion and equity aspects.
  - Provide technical support and guidance for comprehensive **Hazard Risk Vulnerability and Capacity Assessment (HRVCA).**
- **Inter-Agency Coordination**
  - **Preparation and implementation of Disaster Management (DM) plans** and ensure the functioning of agencies with DM tasks.
  - **Warnings, Information, Data Dissemination:** Effective coordination and seamless communication among central and state agencies to ensure quick, clear, effective dissemination of warnings, information, and data.
- **Investing in Disaster Risk Reduction (DRR) – Structural Measures**
  - Shelters, evacuation, and support facilities
  - Multiple routes for reliable access and escape
  - Decontamination facilities
- **Investing in DRR – Non-Structural Measures**
  - Formulate/ strengthen rules, norms, and laws such as factories rules consistent with that of ensuring greater safety in hazardous industries and to reduce likelihood of disasters.
  - **Review land use norms** for the siting of hazardous industries to ensure greater safety and to ensure buffer zones without human settlements in close proximity of hazardous industries
  - **Empower factory inspectorates** to take legal actions for noncompliance of Manufacture Storage and Import of Hazardous Chemicals (MSIHC) Rules.
  - **Review rules to grant compensation** to chemical accident victims to improve them in favour of victims.

Further, in order to avoid repetition of Vizag gas leak, recently the National Disaster Management Authority (NDMA) has issued guidelines for restarting manufacturing industries after COVID lockdown. Guidelines relate to storage of raw materials, manufacturing processes, storage and guidelines for workers. It also calls for inspection of all equipment as per the safety protocol. Such directives must be strictly adhered to all the times and government must take strict action against the defaulters.

7.1.4. FLOODS

Why in news?

Parts of Assam and Bihar in India have been severely affected by floods almost every year in the last decade.

Floods in India

- Rashtriya Barh Ayog (RBA) had estimated in 1980, total flood-prone area in the country as **40 million hectare** (mha) which was revised further to 49.815 mha.
  - As such, about 39.58 % of the total land area of Assam and 73.63% of the geographical area of North Bihar is considered to be prone to floods.

- Recurring floods in the Assam and Bihar have had **catastrophic effects** such as widespread loss of human and animal life, destruction of crops and private property, displacement of people, and damage to infrastructure which aggravates the already poor drainage system.
  o Average annual loss due to flood in Assam is to the tune of Rs. 200.00 Crores.

Why are floods a recurring phenomenon in these regions?

- **Topographical and Hydrological factors**: Overflowing Rivers is the primary cause of floods in these regions. Brahmaputra and Barak and their tributaries in Assam and Kosi River in Bihar are responsible for majority of floods. The flooding situation in these rivers is often aggravated by:
  o **erosion and silting of the river beds**, resulting in a reduction of the carrying capacity of river channels
  o **earthquakes and landslides** leading to changes in river courses and obstructions to flow
  o **synchronization of floods** in the main and tributary rivers
  o **inflow** from neighboring states
- **Meteorological factors:** 80% of the precipitation in India takes place in the monsoon months from June to September. Concentrated rainfalls in a short span of time and events such as cloud bursts, glacial lake outbursts etc. often cause floods in Himalayan Rivers.
- **Anthropogenic factors**: These include deforestation, drainage congestion, encroachment of natural water bodies, unsustainable mining of river-bed, poorly planned development works and climate change induced extreme weather events.
- **Flaws in Flood management strategies**:
  o **Construction of embankments without proper assessment:** Embankments have been used extensively in Assam and Bihar for managing flooded rivers. Some studies have concluded that in certain cases embankments have enhanced the flood problem.
  o **Absence of an integrated approach by the Centre and the state:** The Brahamaputra Board formed under the Brahmaputra Board Act, 1980, lacks coordination with the state government. Similar lack of coordination can be seen between the Assam Disaster Management Authority and National Disaster Management Authority (NDMA).
  o **Unrealized potential of multipurpose dams:** The dams in Assam and Bihar mainly focus at the hydropower benefits and lack storage space for flood control.
  o **Trans boundary management of rivers**: Absence of real time sharing of hydrological data and poor coordination among river basin nations about river flow management is an issue.
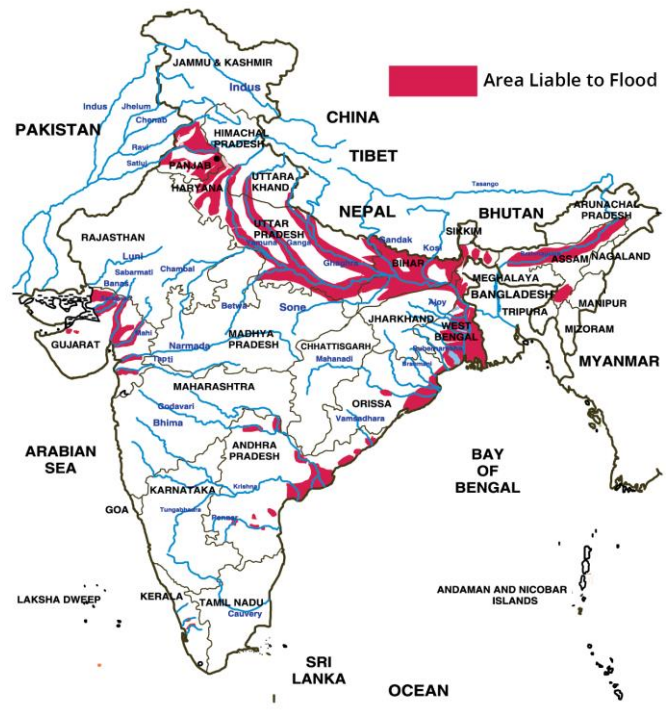
> **Government's efforts towards flood management**
> - **Rashtriya Barh Ayog (RBA)** was constituted in 1976. It submitted its report in 1980 recommending various measures of flood control.
> - **National Water Policy-2012:** It emphasizes construction of large storage reservoirs and other non-structural measures for integrated flood management.
> - **Setting up Ganga Flood Control Commission (GFCC)** at Patna in 1972 and **Brahmaputra Board** in 1980 for advising the Ganga Basin States and North Eastern-States respectively on Flood Management measures.
> - The **Central Water Commission (CWC)** was set up in 1945: It performs flood forecasting activities on major rivers and their tributaries in the country and issues flood forecast at 175 stations.

Way forward

- **Adopting a collaborative approach** involving all stake holders — the Centre, the state, the district administration, Indian Meteorological Department and crucially, the community.
  o It is also important for Assam to **work together with the neighbouring states** like Meghalaya that shares the basin of Brahmaputra.

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- **Shifting the focus from mindless construction of embankments to flood mitigating policies** that complement the existing embankments and accentuate the impact of floods.
  - **National Water policy, 2012,** recommends conducting **morphological studies**, based on which planning, execution and maintenance of revetments, spurs, embankments, etc. could be carried out.
- An **integrated approach to managing floods** is needed that works simultaneously for water management, physical planning, land use, agriculture, transport and urban development as well as nature conservation.
  - **E.g. - Wetlands**, locally known as beels, act as reservoirs and rejuvenating them before monsoon can help in mitigating flood in parts.
- **Incorporating storage space in the reservoirs** as a preventive measure during the floods.
- **Raising awareness among communities** residing in the flood-prone areas and ensuring efficiency of the local authorities could help mitigate the effects of the disaster.
- **Improving Flood forecasting** so that information about floods forecasts reaches the affected villages on time.
- **Managing silt through dredging**: The fine dredged material can be used to supply organic content and nutrients to deficient soils to increase productivity.
- **Flood Plain Zoning (FPZ):** FPZ measures aim at demarcating zones or areas likely to be affected by floods of different magnitudes or frequencies and probability levels and specifying the types of permissible developments in these zones.
  - **Central Water Commission (CWC)** had circulated a **Model Bill on Flood Plain Zoning** to all the States in 1975 to guide of States for enactment of legislation in this regard.
  - **RBA** recommends **scientific assessment** of flood prone areas, flood damage and areas suffering from drainage congestion and water-logging. This should be based on frequency of flooding and period of inundation as gauged by **contour maps and satellite imagery**.

7.1.5. URBAN FLOODING

Why in news?

- Waterlogging — a prelude to urban flooding — is a common sight in urban India during the monsoon. Urban flooding has also become increasingly common, as the changing weather pattern resulted in more high intensity rain in fewer rain days. It is a common monsoon season phenomenon in cities like Mumbai, Delhi, Gurugram, Chennai etc.
- COVID-19 has increased the problem of waterlogging this year as pre-monsoon desilting of drains was not carried out in full capacity.
- Recently, **Ministry of Earth Sciences (MoES) in coordination with Municipal Corporation of Greater Mumbai** developed an Integrated Flood Warning System for Mumbai called **'IFLOWS-Mumbai'**. It will provide **early warning** for flooding specially during **high rainfall events and cyclones** which would include alerts on **rainfall information, tide levels, storm surge for low-lying areas** anticipated to be affected.

About Urban Flooding

- Urban flooding is the inundation of property in a built environment, particularly in densely populated urban areas, caused by intense rainfall (on impermeable surfaces) which **overwhelms the capacity of drainage systems**.
- It is significantly different from rural flooding as urbanisation leads to developed catchments which **increases the flood peaks from 1.8 to 8 times** and **flood volumes by up to 6 times**. Consequently, flooding occurs very quickly due to faster flow times, sometimes in a matter of minutes.
- Urban flooding has wide ranging **impacts**:
  - Damage to vital urban infrastructure causing disruptions in transport and power
  - Loss of life and damage to property
  - Risk of epidemics due to exposure to waterborne and vector borne infections
  - Deterioration of water quality
  - Economic losses due to disruption in industrial activity, supply chains etc
  - Displacement of population in low lying areas
  - Accidents and fires due to short circuit

Factors Contributing to Urban Flooding

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

Way forward

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

NDMA guidelines on urban flooding

It designates **Ministry of Urban Development as the Nodal Ministry** for Urban Flooding. Among key provisions of the Guideline are-

Early Warning System and Communication

- Create a **National Hydro-meteorological Network**- for providing early warning in all urban centres.
- Developing **local networks for real-time rainfall data collection** with a '**Local Network Cell'** in the IMD headquarters.
- **Sub divide Cities/ towns on the basis of watersheds** and develop a protocol for forecasting rainfall for urban areas on the basis of watershed.

Design and Management of Urban Drainage System

- A watershed based and ward-based **inventory of the existing storm water drainage system** to be prepared.
- **Pre-monsoon desilting of all major drains** to be completed by March 31 each year.
- Every building in an urban area must have **rainwater harvesting** as an integral component.
- **Concept of Rain Gardens** to be incorporated in planning for public parks.
- Integrated Planning and interactions between Water and Solid Waste Management.

Urban Flood Disaster Risk Management

- Risk assessment will be carried out with a **multi-hazard concept** leading to **fool proof land use planning**.
- The **research should focus on three key areas**: risk identification, risk pooling and risk transfer. The risk should focus on both property and people.
- **Identification of potential damage areas**, according to the physical characteristics of the area such as land use, topography, drainage area, outfall system and the capacity of the existing stormwater drainage system.
- **National Database for Mapping Attributes**- The database required for mapping different ward/community level attributes will be made accessible to all ULBs and concerned departments/ agencies/ stakeholders
- **National Urban Information System (NUIS)** to cover infrastructure facilities at community level integrated with socio-economic data.

Techno-Legal Regime

- Stormwater drainage concerns will be made a part of all EIA norms
- Growth of urban sprawls be made a part of urban flood management.

Capacity Development, Awareness Generation and Documentation

- Urban Flood Education, Institutional & Community Capacity Development, enhanced Role of Civil Society, Awareness on Insurance etc.
- Role of Public Representatives and Role of Media.

7.1.6. HEAT WAVES

Why in news?

- Heatwave has emerged as one of the major weather hazards in India. There have been **32 heat waves affecting 23 states in 2019**, the **second- longest spell** of high temperatures on record.
  - Rajasthan, Madhya Pradesh and Maharashtra were facing **"extreme"** heat conditions having experienced the longest spell of dry weather this year.
- Recently the **National Disaster Management Authority (NDMA) has released National Guidelines** for Preparation of Action Plan - Prevention and Management of Heat Wave.

Heat Wave in India

Factors affecting Heat vulnerability

- **Quality of housing and built environment**, local urban geographies, resident lifestyle, income levels, employment trends, social networks and self- perceptions of risk.
- **Unplanned urban growth and development**, changes in land use and land cover, densely populated areas and increasing urban sprawl and unique challenges associated with it such as **Urban Heat Island** effect in cities are exacerbating the impact of heatwaves.
- **Climate change** is driving temperatures higher as well as increasing the frequency and severity of heat waves in India.

> **What is Heat Wave?**
>
> - Heat wave is **period of abnormally high temperature, more than the normal maximum temperature**. Heat waves typically occur between March to June, and in some rare cases even extend till July.
> - **According to Indian Meteorological Department (IMD)**, heat wave is considered if maximum temperature of a station reaches at least 40°C or more for Plains, 37°C or more for coastal stations and at least 30°C or more for Hilly regions.
> **Following criteria are used to declare heat wave:**
> - **Based on Departure from Normal**
>   - **Heat Wave:** Departure from normal is 4.5°C to 6.4°C
>   - **Severe Heat Wave:** Departure from normal is >6.4°C
> - **Based on Actual Maximum Temperature (for plains only)**
>   - **Heat Wave:** When actual maximum temperature ≥ 45°C
>   - **Severe Heat Wave:** When actual maximum temperature ≥47°C
> - To declare heat wave, the above criteria should be met at least in 2 stations in a Meteorological sub-division for at least two consecutive days and it will be declared on the second day.

44°C

43-44°C

45-47°C

Rationale for Heat Wave Action Plan (HWAP)

Heat Waves has **not been notified as a Disaster** as defined under the Disaster Management Act, 2005 by the Government yet. Heat wave is **not even notified in the list of 12 disasters eligible for relief under National/ State Disaster Response Fund** norms. This makes HWAP highly relevant to be prepared for following reasons-

- **Widening geographical expanse:** Most of the states across northwest India, Gangetic Plains, Central India and east coast India are affected during the heat wave season.
- **Casualty due to Heatwave:** It is a **silent disaster**. According, to NDMA, heatwave caused more than 24000 deaths since 1992 to 2015 in various states.
- **Vulnerable Population:** Mostly weaker sections of the society have to work in the extreme heat to make their ends meet and are extremely vulnerable to the adverse impacts of heat waves such as dehydration, heat and sun strokes.
- **Evidence based planning with continuous updating:** These heat wave related deaths can be prevented with an evidence- based plan, effective implementation and frequent updating in line with recent scientific development. Hence, there is a need to update the Heat Wave Guidelines of NDMA of 2017.

Key strategies for Heat Wave Management
- **Establish Early Warning System and Inter-Agency Coordination** to alert residents on predicted high and extreme temperatures. Who will do what, when, and how is made clear to individuals and units of key departments, especially for health.
- **Capacity building / training programme for health care professionals** at local level to recognize and respond to heat-related illnesses, particularly during extreme heat events. These training programmes should focus on medical officers, paramedical staff and community health staff so that they can effectively prevent and manage heat - related medical issues to reduce mortality and morbidity.

- **Public Awareness and community outreach -** Disseminating public awareness messages on how to protect against the extreme heat - wave through print, electronic and social media and Information, Education and Communication (IEC) materials such as pamphlets, posters and advertisements and Television Commercials (TVCs) on Do"s and Don"ts and treatment measures for heat related illnesses.
- **Collaboration with non government and civil society** - Collaboration with non-governmental organizations and civil society organizations to improve bus stands, building temporary shelters, wherever necessary, improved water delivery systems in public areas and other innovative measures to tackle Heat wave conditions.

7.1.7. LOCUST ATTACK

Why in news?

Recently, Swarms of desert locusts invaded vast swathes of land in various Indian states which entered via Pakistan's Sindh province.

- The current attack is said to be the **worst desert locust attack in 26 years**.
- **United Nations (UN)** has also warned that armies of locusts swarming across continents pose a "severe risk" to India's agriculture this year.

Reasons for recent locust attacks:

- **Favourable weather conditions:** Most of the attacks by locust swarms in India since 1993 have been localised to Rajasthan.
  - But this time, favourable weather conditions have facilitated locusts' travel from Rajasthan to Gujarat, Madhya Pradesh, Uttar Pradesh and even Maharashtra.
- **Indian Ocean Dipole:** The desert locusts usually breed in the areas in the countries along the eastern coast of Africa in a region known as the **Horn of Africa.**
  - Rising temperatures due to global warming amplified the Indian Ocean dipole and made the western Indian Ocean particularly warm.
  - Heavy rain triggers the growth of vegetation in arid areas where desert locusts can then grow and breed.
- **Cyclones:** The cyclonic storms Mekunu and Luban that struck Oman and Yemen respectively transformed the empty desert tracts into large lakes providing damp soils where the locust swarms breed.
- **Wind Movement:** Locusts generally follow the wind, and are known to be passive flyers.
  - The low-pressure area created by **Cyclone Amphan** in the Bay of

About Desert Locusts
- They belong to the family of **grasshoppers** and have life span of 90 days.
- **Four species of locusts are found in India**: **Desert locust** (Schistocerca gregaria), **Migratory locust** (Locusta migratoria**), Bombay Locust** (Nomadacris succincta) and **Tree locust** (Anacridium sp.).
  - Desert locusts are usually restricted to the semi-arid and arid deserts of Africa, the Near East and South-West Asia that receive less than 200 mm of rain annually.
- **A swarm may contain 40 to 80 million adults** in one square km, and these can fly at 16-19 km an hour, depending on the wind, and cover up to 150 km in a day.
- They are **omnivorous** and one adult desert locust can eat roughly its own weight or about 2 gm of fresh food everyday.

Forecast March-June 2020
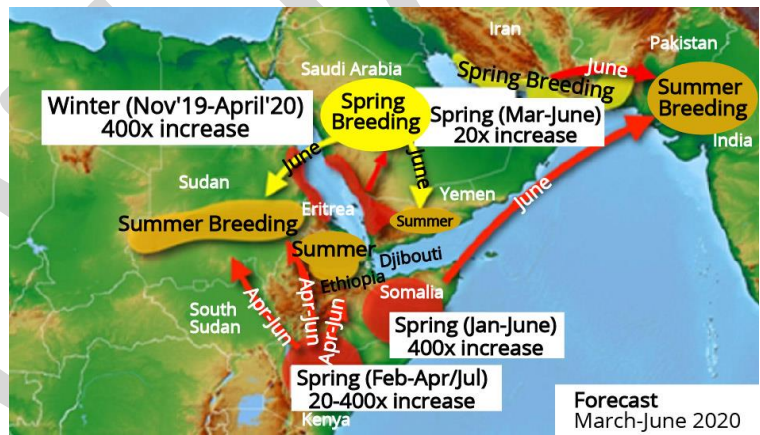
Steps taken by India
- **Locust Warning Organisation (LWO)**, under **Ministry of Agriculture & Farmers Welfare**, is responsible for monitoring, survey and control of Desert Locust in Scheduled Desert Areas mainly in the States of Rajasthan and Gujarat.
- **200 Locust Circle Offices have been set up** to conduct survey & control operations in coordination with District Administration and agriculture field machinery of affected States.
- The country is **procuring pesticide sprayers from the UK** and has deployed fire brigades, tractors and other vehicles for spraying insecticides.
- The Centre has **compensated** some of the farmers who suffered **losses from the National Disaster Response Force (NDRF) Fund**.
- **Hindustan Insecticides Limited** is now in process of production and supply of 25 MT Malathion for supply to locust control programme to Iran under Government to Government arrangement.
- **Drones are used** to spray pesticides on tall trees and inaccessible places for effective control of locusts.
- **Regular coordination with South-West Asian countries** like Afghanistan, Iran and Pakistan where locust attacks are common.

Bengal strengthened the westerly winds which aided the movement of the locusts into South Asia.

- **Westerlies:** The westerlies also brought with them several bouts of rainfall over north and western India which also helped the insects reproduce.

Effects of locust attacks

- **Crop damage:** The desert locust attack has wiped out crops spread over 5,00,000 hectares in Rajasthan. It poses a serious threat to India's food security in the recent future.
  - One square km swarm can eat food in a day upto food equivalent for 35,000 people.
- **Allergies:** Locust swarms often create allergens that aggravate allergies.
- **Harmful pesticides:** The Locust Warning Organisation (LWO) sprayed **Malathion 96** and **Chlorpyrifos**, both organophosphate pesticides, to control the locust swarms across states.
  - Both are extremely toxic and high level of exposure to the pesticides may cause nausea, dizziness and even death. They can also impact soil fertility by altering the ecological balance.
- **Air travel:** Generally locusts are found at lower levels and therefore pose a threat to aircraft especially in the critical landing and takeoff phase of the flight.
- **Effect on trees:** Locusts also destroy the forest and urban vegetation areas if they are unable to find the crops to feed.

Way Forward

- **Use of bio-pesticides:** These are safe ways of controlling them without affecting the health of humans and soil quality.
  - **Aerial spraying** of fertilizers and pesticides is the most potent method of fighting the locusts and helicopters need to be used to cover large areas to control.
  - There are some evidences that **loud noises can effectively divert locusts**. This can be used in areas of food crops to divert the locusts.
- **Cooperation from East African countries to South Asia** including Middle East and Pakistan with India to comprehensively control the growth and spread of locusts.
- **Active role of organisations:**
  - **United Nations Environment Programme's role** is to disseminate the latest science on emerging climate trends to inform cross-sectorial policies and ensure resilience is built in the relevant sectors.
  - **World Meteorological Organization's role** is to forecast the more immediate weather changes that may exacerbate the locusts' attacks.
  - **World Health Organization's role** is to classify potential risks of different chemical agents to enable governments to invest in the safest one.
- **Food and Agriculture Organisation** has also laid out a standard operating procedure to deal with locust menace:
  - Sand areas that have green vegetations are to be monitored constantly to see if locust are present.
  - Desert areas receiving rainfall are to be surveyed for live locus or their eggs
  - Recommended pesticides are to be used to stop their breeding
  - Special attention is to be paid in areas where day temperature ranges between 20 degree celsius and 38 degree Celsius.

7.2. NATIONAL LANDSLIDE RISK MANAGEMENT STRATEGY

Why in news?

The National Disaster Management Authority (NDMA) has released National Landslide Risk Management Strategy (NLRMS).

Background

- India is vulnerable to different types of landslides which cause significant destruction in terms of loss of lives and property.
  - **Kedarnath landslide in Uttarakhand in June 2013,** caused by flash floods that resulted in over 5,000 deaths, was identified as the most tragic such disaster.
- As per Geological Survey of India (GSI), about 0.42 million km² covering **nearly 12.6% of land area** of our country is prone to landslide hazards.

- In recent years, the **incidences of landslides have increased** due to extreme weather events, environmental degradation due to human interference and other anthropogenic activities resulting in heavy losses of human lives, livestock and property.
- This led to a **need for formulation of NLRMS**. NDMA constituted a Task Force for the formulation of national and local level strategy for landslide risk reduction.

Highlights of the strategy

- **Landslide Hazard Zonation:** It recommends Landslide Hazard Zonation maps to be prepared at macro scale and meso level. It focuses on making use of advanced state-of-the-art tools such as Unmanned Aerial Vehicle (UAV), Terrestrial Laser Scanner, and very high-resolution Earth Observation (EO) data.

- A **landslide** is defined as the **movement of a mass of rock, debris, or earth down a slope**. Landslides are a type of **"mass wasting"** which denotes any down-slope movement of soil and rock under the direct influence of gravity.
- **Causes of landslides:**
  o Undercutting of the foot of the hill slope due to river erosion, quarrying, excavation for canals and roads, etc.
  o External loads such as buildings, reservoirs, highway traffic, stockpiles of rocks, accumulation of alluvium on slopes, etc.
  o Increase in unit weight of slope material due to increased water content.
  o Vibrations due to earthquakes, blasting, traffic, etc., causing increase in shearing stresses.
  o Slope changes caused by deforestation.
- The Geological Survey of India has created a landslide zonation map of India. NDMA guidelines are being followed for **Landslide Hazard Zonation (LHZ)** maps and progressively larger scales for specific areas.
  o Landslide Zoning is the division of hill or mountainous areas into homogeneous spatial areas/ slope according to their degrees of actual or potential landslide susceptibility, hazard or risk.

- **Landslide Monitoring and Early Warning System**: Technical recommendation for developing and implementing rainfall thresholds, Numerical Weather Prediction (NWP), Automatic Rain Gauges, etc. have been included.
- **Awareness Programmes**: A **participatory approach** has been defined so that each section of the community is involved in the awareness drive. Since the community is the first to confront the disaster before any aid reaches them, a mechanism of awareness is framed to involve and educate the community.
- **Capacity Building and Training of Stakeholders**: Creation of **Centre for Landslide Research Studies and Management (CLRSM)** to create a techno-scientific pool of expertise in the country.
- **Preparation of Mountain Zone Regulations and Policies**: The strategy describes the formulation of land-use policies and techno legal regime, updation and enforcement of building regulations, review and revision of BIS code / guidelines for landslide management, proposed amendment in town and country planning legislations, regulations for land use zoning for natural hazard prone areas etc.

7.3. DISABILITY INCLUSIVE DISASTER RISK REDUCTION

Why in News?

Recently, Ministry of Home Affairs released **National Disaster Management Guidelines** on **Disability Inclusive Disaster Risk Reduction (DiDRR).**

Need for Guidelines

- **Vulnerability during disaster:** Different populations may face similar risks of exposure to the negative effects of environmental and man-made disasters, but their **actual vulnerability is dependent on their socio-economic conditions**, **civic and social empowerment**, and **access to mitigation and relief resources**.
  o Disaster risk reduction (DRR) is of critical concern to person with disabilities as the **impact of natural disaster from global warming from 1.5° C to 2.0° C will intensify** major fluctuation in weather system with poverty and disadvantages expecting to increase.
- **Disproportionately affected Population:** Individuals with disabilities are disproportionately affected in disaster, emergency, and conflict situations.
- **High mortality rate of disabled people:** They have 2 to 4 times the mortality rate of the general population in acute onset of disasters, with that of women with disability being even higher.

- **Under preparedness**: Their vulnerabilities are also linked to a lack of understanding about disabled citizens' needs in times of disasters, under preparedness of disaster management personnel to serve their needs and their general socio-economic conditions.
- **Social discrimination:** Their capacity to cope is further compromised by the discriminatory social attitudes toward the disabled group.
- In India, of the 2.68 crores **(about 2.1% of total population) persons with disability.**There is pressing **need for transforming the existing Disaster Risk reduction policies** into DiDDR strategies.
  - DiDRR strives to reduce the impact of disasters on affected communities by mitigating and reducing risks.

About Guidelines

- Provide **practical directions to support implementation mechanism of DiDRR** based on established and nationally accepted norms and practices.
- **Principles of disability inclusion**
  - **Strengthen the implementation process** on providing appropriate support to person with disabilities when responding to disasters.
  - **Empower persons with disabilities and their representative organization** to contribute to all aspect of DiDRR so that they are viewed not as passive actors but as decision makers.
- **Key points include:**
  - **Conducting census and survey of people with disabilities** for data & resource mapping.
  - **Inclusion of issues of person with disability and their organization in disaster risk reduction activities** as stipulated in the Right of Person with Disability Act (RPWDA) 2016 has to be institutionalised.
  - **Awareness of DRR planning and services** among person with disabilities has to be universalized.
  - **Adoption of universal design principle, facilitation of accessibility and access to assistive technology .**
  - **Preparedness and mitigation strategies** such as national stockpiling of durable medical equipment, life saving devices etc for **reducing the chance of increasing their disability**.
  - **Early warning system** mechanism for informing person with intellectual disability through repeated and alternative formats such as audio and sign languages.
  - Centre should **earmark specific budgetary allocation towards DiDRR** and state should mobilize and utilize CSR fund and District mineral fund towards implementation of inclusive actions.

Mains 365 – Environment

8. MISCELLANEOUS

8.1. NEW MONSOON DATES IN INDIA

Why in News?

- India Meteorological Department (IMD) had decided to **revise the normal onset and withdrawal dates for the monsoon** in some parts of the country from this year.
- The changed dates are **expected to be announced in April**, when the IMD makes its first forecast for the monsoon.
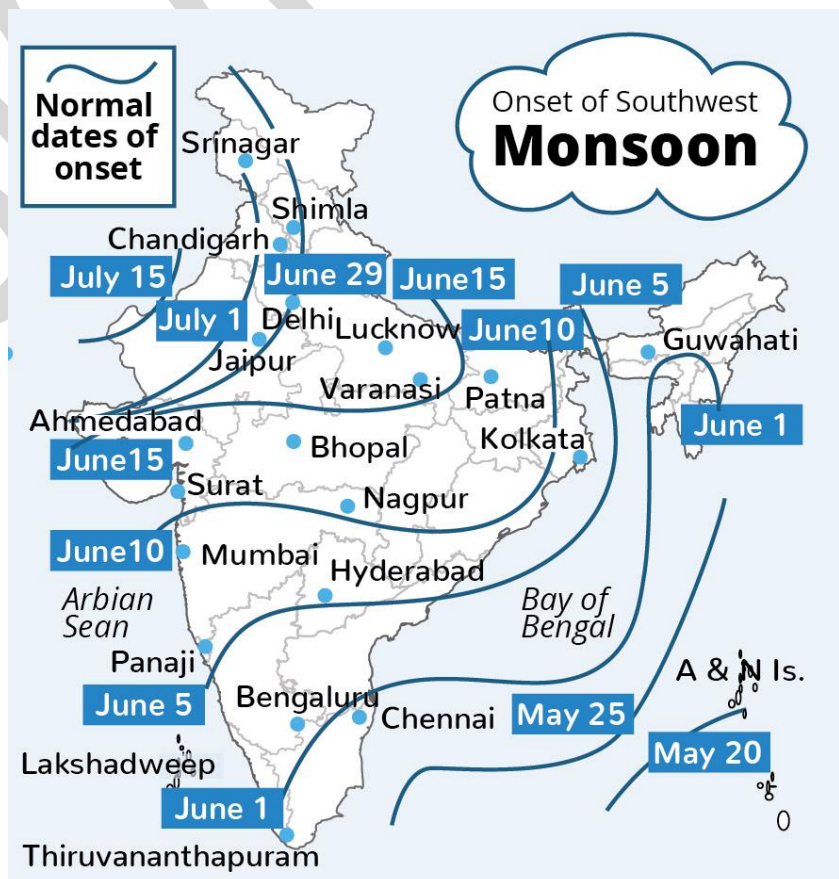
Why was revision in normal dates needed?

- **Changes in precipitation patterns:** Reference dates back to 1940s and it needed to be revised. For example: In the last 13 years, only once has the onset over the Kerala coast happened on June 1. While two or three days of earlier or later onset falls within the yearly variability, in several years the onset happened five to seven days late.
  - Similarly, the commencement of withdrawal has happened in the first week of September only twice during this period.
- **Concentrated rainfall:** Rainfall is getting increasingly concentrated within a narrow band of days within the monsoon season. IMD data shows that over several previous years nearly 95 per cent of monsoon precipitation in 22 major cities of the country had happened over a period of just three to 27 days.
- **Change in patterns of regional variations in rainfall:** Areas that have traditionally received plenty of rainfall are often remaining dry, while places that are not expected to get a lot of monsoon rain have sometimes been getting flooded.
- **Break in monsoon:** During the break period, the monsoon trough shifts towards the north from its usual position and brings rainfall to the Himalayan and north eastern states, while the rest of the country remains mostly dry.
  - It has shifted to July from August. This has increased the amount of rainfall received during August.
  - The monsoon trough is the confluence of winds that causes rainfall during the season and usually extends from Punjab in the west to West Bengal in the east.

Impact of IMD move

- **Better tracking of Monsoon:** and improve its impact-based forecasts, wherein it will inform state governments about what to expect from an extreme weather event to help them prepare better.
- **Adjustment by Farmers:** New dates will likely nudge farmers in some parts of the country to make slight adjustments in the time of sowing and harvesting of their crops.

> **About Monsoon dates**
> - The four-month southwest monsoon season, which brings as much as 70 per cent of the country's annual rainfall, officially begins on June 1, with the onset over Kerala, and ends on September 30.
> - India had been adhering to June 1 and September 1 as 'normal' reference dates for onset and withdrawal of monsoon ever since it was **last set in 1941**.
> - It takes about a month and half after onset on the Kerala coast to cover the entire country.
> - And about a month, beginning from the northwestern parts of the country on September 1, to withdraw completely.

Normal dates of onset — Onset of Southwest Monsoon

Srinagar · Shimla · Chandigarh
July 15 · June 29 · June15 · June 5
July 1 · Delhi · Lucknow · June10 · Guwahati
Jaipur · Varanasi · Patna
Ahmedabad · Bhopal · Kolkata · June 1
June15 · Surat · Nagpur
June10 · Mumbai · Hyderabad · Bay of Bengal
Arbian Sean · A & N Is.
Panaji · Bengaluru · Chennai · May 25
June 5 · May 20
Lakshadweep
June 1
Thiruvananthapuram

- o For example-crops that need transplantation, such as rice, require advance knowledge about the arrival of rain.
- **Effect on water management practices:** Water management agencies, for example those managing the dams in the central plains, should now expect more rain only in the latter part of June.
  - o They would now be prompted to preserve and hold on to some water until later in the month.
  - o Similar adjustments would need to be made towards the end of the monsoon season as well.
- **Heat action plans:** Cities that execute heat action plans, just ahead of the monsoon, would have to factor in the need to be prepared for longer periods of heat.
- **Planning for other activities:** Such as industrial operations,power sector, or those using cooling systems, would also need to change their behaviour.
  - o The power grid can, for example, have more realistic planning for peak periods of electricity consumption in certain months.

Global Warming Altering Global Rainfall Pattern

A recent study shows that the **Indo-Pacific Ocean** is **warming** at a rapid rate and the changes are **impacting global rainfall patterns**.

- This **rapid warming** and increase in sea surface temperature has **altered lifecycle of the Madden Julian Oscillation (MJO)**.
  - o While the MJO clouds are spending lesser (than usual) time over the Indian Ocean, their residence time over the west Pacific has increased.
- This change could drift **warmer surface water** towards the **Bay of Bengal** and trigger **cyclone activity** during post monsoon period.
  - o It could **lead to reduced winter rain in north India**.
- **Global weather patterns** have also been altered:
  - o Rainfall over northern Australia, west Pacific, Amazon basin, Southwest Africa and Southeast Asia has increased.
  - o There is a decline in rainfall over central Pacific, along the west and east coast of US, North India, East Africa and the Yangtze basin in China.

About Madden Julian Oscillation (MJO)
- MJO wave is a global band of low-pressure area moving periodically from West to East and determines the initiation and intensity of low-pressure areas/depressions/cyclones and also oversees monsoon onsets under its footprint.
- It is disturbance of clouds, rainfall, winds, and pressure that traverses the planet in the tropics (between 30°N and 30°S) and returns to its initial starting point in 30 to 60 days, on an average.

8.2. AGROMETEOROLOGY IN INDIA

Why in news?

The Centre for Science and Environment has released a report titled, **'Agrometeorological services in India-An assessment'.**

What is Agrometeorology?

- Agrometeorology is the study and use of weather and climate information to improve the productivity of the agricultural sector.
- In India, **Indian Meteorological Department (IMD)** under the Ministry of Earth Sciences (MoES), is tasked with providing meteorological services. It does so through the **Agrometeorological Advisory Service** program.
- The **three sub-sectors** which work together to provide such services include
  - o **Weather forecasting;**
  - o **Generation of agromet advisories** (identifying how weather forecasts affect farming);
  - o **Dissemination of advisories** (two-way communication with users).

Need for Agrometeorology

- **Weather forecasts:** It plays an essential part in many farming operations. For instance, weeding is best done in a rainless period, planting requires regular but not too heavy rain, spraying pesticides cannot be done in windy weather, etc.
- **Minimise crop loss:** It helps to minimize crop losses due to excess rainfall, cold/heatwaves, cyclones etc. It also helps in better planning for pest attacks.
- **Increasing productivity:** Productivity in agriculture relies on the weather. The growth and harvest of plants is a response both to genetics and the surrounding environment.

- **Need-based services:** For the farmers engaged in cultivation of commercial field crops and horticultural crops like tea, coffee, apple, mango, sugarcane, cotton, grapes, etc.
- **Climate Change:** Current rate of climate change is resulting in an increasing demand for effective and timely agro-meteorological information and services.

Assessment presented by the report

Weather Forecasting	
Current System	**Challenges**

• It involves 2 major components: **Data Collection and Data modelling**
  ○ **Weather data collection**- Data is collected over land surfaces (rain gauges, weather stations etc.), oceans (weather buoys), in the lower atmosphere (weather balloons and sensors on airplanes), and from space (satellites).
  ○ **Weather Data Modeling** uses mathematical models of the atmosphere and oceans to predict the weather based on current weather conditions.
• Both public and private sector provide these services in India.
  ○ IMD, National Institute of Ocean Technology, Chennai; National Institute of Oceanography, Goa; Indian Space Research Organization (ISRO) and state developed networks are involved.
  ○ Also, there are a few private players (Skymet) in the weather forecasting space.
	• **Infrastructure is unevenly distributed:** Consider the difference between Kerala, which has on average approximately one Automatic Weather Station per 87 sq. km, and Assam, which has one for every 472 sq. km.
	• **Data Quality is inconsistent and sharing is limited:** There is lack of quality control of weather stations, lack of attention to maintenance and the lack of a common platform for data collation.
	• **Advanced climate modelling demands better hardware and human resources** which India has only recently begun upgrading in earnest.

Generation of Agromet Advisories	
Current System	**Challenges**
• Localized weather forecasts must be combined with local crop data to generate advice for farmers. This involves coordination of the data and human resources of state and Central government agencies. ○ **Agromet Field Units (AMFUs),** under the IMD's Agrimet Division, are designed to specialize in converting weather information into usable advisories for farmers.	• **Advisories do not always usefully combine weather and agriculture data and are** too general to add any value. • **Micro scale advisories are not available.** • **Lack of trained agro meteorologists**

Dissemination of Advisories	
Current System	**Challenges**

• A variety of dissemination methods are used.
  ○ **Central government a**s part of the **Gramin Krishi Mausam Seva (GKMS) programme,** sends farmers weather forecasts as well as crop and location specific agro advisories via SMSs.
  ○ IMD also disseminates agromet information to farmers through **public-private partnerships** with multiple companies such as Reuters Market Light, IFFCO Kisan Sanchar Limited, NOKIA etc.
  ○ State governments have their own Departments of Agriculture which are first-line executive institutions engaged in agriculture extension, in parallel with KVKs.
	• **Advisories are irregular and unreliable at most occasions.**
	• **Inability or unwillingness to pay for weather information:** 85% of farmers in India are subsistence farmers, and cannot pay for such services.

Way Forward

- Agromet advisories **should be treated as a public good.** State governments need to take more responsibility for investment.
- The Central government must focus on creating a **single platform for high-quality weather data.**
  - **By law, all weather data collected** in the country, public or private, and across government departments and levels, must **flow into a central database.**
  - **The data collected** should be of **sufficient quality**.
- **Capacity needs to be expanded** based on hiring specialists for meteorology, agriculture and extension.
  - State governments need to employ meteorologists at the block level, as well as revive their extension systems to reach advisories to the farmers in most need.
- The **existing hybrid agromet institutions** can be the **site of coordination**—by developing **technological platforms** for combinations of such information or convening specialists on a regular basis.

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