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BIODIVERSITY

1. THE QUESTION OF BIODIVERSITY (RELOCATION OF CHEETAHS)

Context: India is once again home to the majestic presence of cheetah, the world's fastest land animal, this has been done under the 'Action Plan for Introduction of Cheetah in India'. As part of the project, 50 cheetahs are to be introduced (implementation by Wildlife Institute of India + Wildlife Trust of India + MoEFCC) in over five years.

Why does India need Cheetah?

- **Ecosystem boost:** Cheetah reintroduction would help restore the country's biodiversity and ecosystem.
- **Balancing the chain**: Cheetahs, as apex predators, play an important role in maintaining the balance of the food chain and can help control the population of prey species.
- **Economic benefits:** The reintroduction of cheetahs could help boost tourism and create employment opportunities in rural areas.

Issues with the Project

- **Adaptability**: African Cheetahs need long open spaces to run. **Indian parks tend to be much smaller than those in Africa, offering less chance for such free movement.** There are concerns related to their breeding issues. 3 Cheetah has died till now has raised concerns about their adaptability.
- **Coexistence of large predators:** Concerns have been raised about the coexistence of 4 big cats like **cheetahs, lions, tigers, and leopards**. Nowhere such case has been found. Studies has shown that leopard has hunted cheetah. While Kuno NP has 50 Leopards.
- **Rehabilitation Concerns:** Many villages has to be relocated to carry successful implementation of the project. This will certainly impact the locals and cause disturbance and migration.

Cheetahs (*Acinonyx jubatus*)

- They are a large, slender, and fast-running carnivorous mammal that belong to the **Felidae** family.
- **Distribution**: Africa, with the largest populations being in Namibia, Botswana, Zimbabwe, and South Africa. They also occur in several other African countries, including Angola, Kenya, Tanzania, and Zambia.
- Cheetahs have been rapidly heading toward extinction and are classified as a vulnerable species under the IUCN's (International Union for Conservation of Nature) red list of threatened species.

Cheetah Reintroduction Project

- The **Cheetah Reintroduction Project** formally took off on September 17, 2022. Prime Minister Narendra Modi released the cheetahs in **Kuno National Park**. The second batch was released in February 2023 in **Kuno National Park.**
- The **intercontinental movement** of the **feline species** is part of the country's cheetah restoration initiative known as "**Project Cheetah.**"

Why Kuno National Park?

- The Kuno National Park in Madhya Pradesh was identified for reintroduction because of its suitable habitat, adequate prey base, and lack of human settlement.
- It was ready for receiving cheetahs as **previously Asiatic lions were reintroduced** here and thus it required least management interventions and investments.
- The park has an **adequate prey base and is devoid of human settlements.**
- It forms **a part of the Sheopur-Shivpuri deciduous open forest landscape** and serves as an **important wildlife corridor** thus **very suitable for conservation**.

As India is rich in biodiversity and its wild population, **losing out a significant species like cheetah in the past was not dwelling well and thus the reintroduction project** in all its totality is a step in right direction for conservation of **flagship and umbrella species** like cheetah in India. However, some concerns have to be kept in mind given the survival and adaption of cheetah.

Practice Question:

Q. Discuss the concept of species relocation as a conservation strategy, its implications, and the challenges associated with it. Illustrate your answer with suitable examples from different regions of the world.

2. HUMAN ANIMAL CONFLICT

Context: The report, titled, **"A future for all - the need for human-wildlife coexistence"**, by the **World Wide Fund for Nature (WWF)** and the **UN Environment Programme (UNEP)** has stated that conflict between humans and animals is one of the main threats to the long-term survival of some of the world's most iconic species.

Highlights of the Report

- Globally, conflict-related killing affects more than 75 per cent of the world's wild cat species.
- Besides, many other terrestrial and marine carnivore species such as polar bears and Mediterranean monk seals as well as large herbivores such as elephants are affected.
- Global wildlife populations have fallen an average of 68 per cent since 1970.

The numbers

- Data from the **Union Ministry of Environment, Forest and Climate Change** indicates that over 500 elephants were killed between 2014-2015 and 2018-2019, mostly due to human-elephant conflict.
- During the same period, 2,361 people were killed as a result of conflict with elephants. This depicts the grave impact of Human animal Conflicts.

Factors for Human-Wildlife Conflict

HWC results from a variety of ecological and anthropogenic drivers that exert pressures on landscapes where humans and wildlife share space

- **Ecological drivers:** It include seasonal changes, natural calamities, and animals' life cycles, as well as the movement patterns of animals
- **Anthropogenic drivers:** It includes various factors, such as habitat loss, changes in land use, livestock management, expansion of agricultural practices, climate change, resource extraction, infrastructure development, and urbanisation
- **Complex web of interactions** : Each negative impact emerges from a complex web of interactions between drivers, making it extremely difficult, if not impossible, to view the effect of one driver in isolation
- For instance, if forests are cleared for settlements or agriculture, or roads are cut into previously inaccessible areas, habitat loss and fragmentation result, forcing wildlife and people into closer proximity to each other.

Case Study

- **In Sonitpur district in Assam**, destruction of forests had forced elephants to raid crops, in turn causing deaths of both, elephants and humans.
- In response, WWF India had developed the 'Sonitpur Model' during 2003-2004 by which community members were connected with the state forest department.
- They were given training on how to work with them to drive elephants away from crop fields safely.
- WWF India had also developed a low-cost, single strand, non-lethal electric fence to ease the guarding of crops from elephants.

Way forward (the six elements of HWC Management)

- **Understanding the conflict**: Researching all aspects of the conflict profile to understand the context for conflict in any given situation (hotspot mapping, community attitudes, spatial and temporal characteristics, etc.)
- **Mitigation**: Reducing the impacts of HWC after it occurs (compensation, insurance, alternative livelihoods, etc.)
- **Response**: Addressing an ongoing HWC incident (response teams, reporting mechanisms, standard operating procedures, etc.)
- **Prevention**: Stopping or preventing HWC before it occurs (fences, early detection tools, safe working environments, etc.)
- **Policy**: Enabling HWC management through protocols, principles, provisions, and measures stipulated in legislation and undertaken by authorities (international and national law, national and local HWC management plans, spatial plans, etc.)
- **Monitoring**: Measuring the performance and effectiveness of HWC management interventions over time (data collection, information sharing, adaptive management, etc.)

Conclusion

The means to prevent and reduce HWC have changed relatively little over time, but the socio-cultural, economic, and physical geographies of landscapes where conflict plays out have been radically transformed by ever growing human enterprises. Thus, global community should come together and collaborate to implement and scale up integrated and holistic approaches to HWC management.

PYQ

Q. How does biodiversity vary in India? How is the Biological Diversity Act, 2002 helpful in conservation of flora and fauna? (2018)

Practice Question

Q. Human Wildlife conflicts results from a variety of ecological and anthropogenic drivers that exert pressures on landscapes. Discuss

3. JOYMALA'S CASE FLAGS GAPS IN PRIVATE OWNERSHIP NORMS FOR ELEPHANTS

Context The on-going dispute between the Governments of Tamil Nadu and Assam over the alleged mistreatment of a temple elephant named ***Joymala*** has brought into focus the prevailing lacunae over private ownership of elephants in India.

Why private ownership of elephants is a concern?

- As per the MoEFCC, it's illegal to hold elephants in captivity without **ownership certificates**.
- **Kerala, Uttar Pradesh, Karnataka, Assam, Tripura and Madhya Pradesh** account for **96%** of elephants in captivity without ownership certificates.
- Captive elephants are provided a poor diet and inadequate food. Due to a limited diet, elephants can suffer from intestinal infections, lung-related injections, or impactions.
- It also leads to an increase in "**black marketing**" of elephants.
- **Other threats to Elephants:**
  - Escalation of poaching
  - Habitat loss
  - Human-elephant conflict
  - Mistreatment in captivity
  - Abuse due to elephant tourism
  - Rampant mining, Corridor destruction

Asian Elephants:

- There are about **50,000 - 60000 Asian elephants** in the world. More than 60% of the population is held **in India.**
- There are **three s**ubspecies of Asian elephant which are the **Indian, Sumatran and Sri Lankan.**
- The Indian subspecies has the widest range and accounts for most of the remaining elephants on the continent.

Why it is happening?

- Lack of law enforcement or governance of the private ownership of elephants in many States.

Important Animal Rights Organisation

- Animal Welfare Board of India
- People for the Ethical Treatment of Animals (PETA)
- People for Animals
- Federation of Indian Animal Protection Organizations (FIAPO)

About Project Elephant

- It is a flagship programme of the Ministry of Environment and Forests (MoEF). It was launched in 1992 as a Centrally-sponsored scheme.
- The project aims-
  - To protect elephants, their habitat & corridors
  - To address issues of man-animal conflict
  - The welfare of captive elephants
- It addresses issues of man-animal conflict and welfare of domesticated elephants.

What do the rules say regarding Ownership of Elephants in India?

- Rules only allow for elephants to be exchanged or donated to temples or between private individuals.
- However, without an ownership certificate, the keeping of any elephant in captivity by a **private individual is illegal**, as per the new amendments to the **Wildlife Prevention Act.**

Impacts

- **Illegal Elephant trafficking & trade**: Elephants are also poached for meat, leather, and body parts with the illegal wildlife trade putting elephants increasingly in danger.
- **Threat to Elephant habitat:** The loss of habitat due to deforestation increases in mining and agricultural activities has become problematic, especially for Asian elephants.

Important Government Initiatives:

- Project RE-HAB
- Use of LiDAR technology

Practice Question:

Q. "Fewer than 50,000 Asian elephants live in the wild, with more than half of them in India. However, most of them are in private hands and put to work for entertainment, tourism and religious purposes". In the light of this statement, suggest effective measures to address this issue and ensure better protection for these majestic animals.

4. TIGER CENSUS 2022

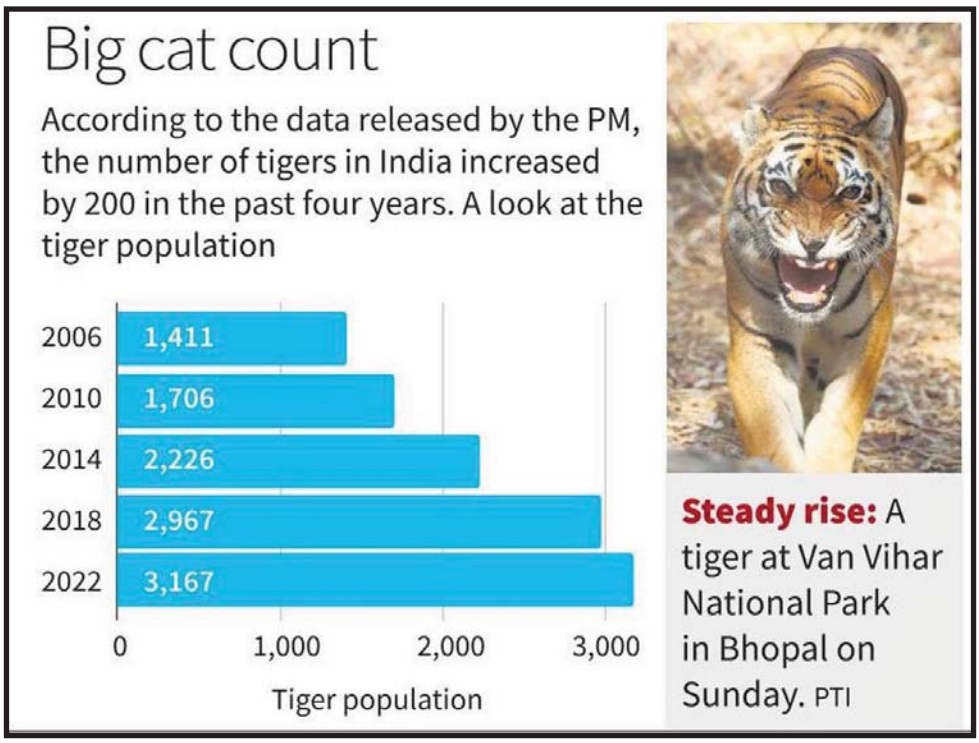
Context The tiger population numbers were made public by Prime Minister, at an event to mark the **International Big Cat Alliance conference** as well as the **50th anniversary of Project Tiger**.

Key Findings of Tiger Census, 2022:

- According to the recent findings, India has at least **3,167 tigers in total**.
- This is ostensibly an increase since the last census of 2018.
- There were **2,967 tigers recorded in 2018**, and 2,226 in 2014.
- **Regional upgradation**:
  - The tiger population has grown the most in the **Shivalik hills and Gangetic flood plains**, followed by central India, the north eastern hills, the Brahmaputra flood plains, and the Sundarbans.
  - There was a decline in the **Western Ghats numbers**.

Fourth Tiger Census 2018: (The last census)

- The 2018 tiger census uses more technology including a mobile app **named "MSTrIPES"** for the very first time to store information of the counting



- For the very first time three neighbouring countries **Bhutan, Nepal and Bangladesh** are helping in counting the number of tigers all across India, especially in the region with mutual borders.
- Madhya Pradesh saw the highest number of tigers, closely followed by **Karnataka and Uttarakhand.**
- **Chhattisgarh and Mizoram** saw a decline in tiger population and all other States saw a "positive" increase.
- Pench Tiger Reserve in Madhya Pradesh **recorded the highest number of tigers**; Sathyamangalam Tiger Reserve in Tamil Nadu registered the **maximum improvement**.

International Big Cat Alliance conference (IBCA):

- To commemorate 50 years of Project Tiger, the International Big Cat Alliance (IBCA) was launched for conservation of **seven big cats** namely **Tiger, Lion, Leopard, Snow Leopard, Cheetah, Jaguar and Puma** harbouring our planet.
- The alliance aims to reach out to 97 range countries covering the natural habitats of **Tiger, Lion, Snow Leopard, Puma, Jaguar, and Cheetah.**

Need for Tiger Conservation:

- **Barometers of Ecological health**: Tigers are indicators of the ecological wellness of planet earth. Being the dominant predators of the ecosystem, they ensure that the numbers of herbivore like deer are kept balanced
- **Umbrella species**: Tiger is an umbrella species whose conservation eventually leads to the conservation of many other species such as the ungulates, pollinators and other small animals.
- **Carbon storage value**: Poaching or killing of large bodied vertebrates such as tigers results in increase of herbivore population, which in turn results in forests getting decimated
- **Decline in the tiger population**: There is a tremendous decline in the tiger population as compared to the past 100 years and to prevent the deteriorating condition of tigers, it's important to conserve them.

Facts: ***29th July*** is observed as **International Tiger Day (ITD)** to promote the conservation of the striped cat as well as to advocate a global system for protecting its natural habitats.

About Project Tiger:

- Project Tiger is a **tiger conservation programme** launched in April **1973** by the Government of India during Prime Minister Indira Gandhi's tenure.
- **Aim**:
  - The project aims at ensuring a **viable population of Bengal tigers** in their natural habitats, protecting them from extinction, and preserving areas of biological importance as a natural heritage forever

represented as close as possible the diversity of ecosystems across the distribution of tigers in the country.

- It is a **Centrally Sponsored Scheme**of the **Ministry of Environment, Forest and climate change.**
- The project is administered by the **National Tiger Conservation Authority (NTCA)**.
- While it initially covered nine **Tiger Reserves** (**Manas, Palamau, Simlipal, Corbett, Ranthambhore, Kanha, Melghat, Bandipur and Sundarban**) spread over 18,278 sq. km, India now has 54 such reserves covering more than 75,000 sq. km (approximately 2.4% of the country's geographical area).

What has enabled this rise in the tiger population?

- Political commitment by the Indian Government during the 1970s wherein several national parks and wildlife sanctuaries were created across India.
- Tiger hunting was banned in the country in 1970.
- In 1973, a national tiger conservation program called Project Tiger was launched in the country.
- Objectives and plan:
  - Various tiger reserves were created in the country based on the 'core-buffer' strategy.
  - Voluntary relocation of local communities from core/critical tiger habitat was undertaken in order to provide safe space for tiger population to regenerate.
- The **Wildlife Protection Act of 1972** was amended in 2006.
- This constituted the **National Tiger Conservation Authority (NTCA)**, responsible for implementation of the Project Tiger plan to protect the endangered tigers.
- **M-STrIPES,** short for **Monitoring System for Tigers – Intensive Protection and Ecological Status,** a software-based monitoring system was launched across Indian tiger reserves in 2010. Its objective is to strengthen patrolling and surveillance of the endangered Bengal tiger.
- India's 2018 tiger census has made a world record of being the largest ever camera trap wildlife survey.
- Since 2010, it has been classified as an endangered species by the International Union for Conservation of Nature (IUCN).

What are the dangers confronting the tiger population in India?

- **Illegal poaching** – A large number of people across the world take pride in possessing skin, claws, nails, teeth and trophies of the tiger. Every part of the tiger has great market value leading thus promoting hunting by professional poachers, local hunters, trappers, pirates and villagers.
- **Man-animal conflict**– When tigers come in contact with human settlements local antagonism against tigers often erupts into a serious problem.
- **Encroachment**– human encroachment of tiger habitats for livestock grazing, infrastructure expansion and farming is a cause of concern.
- **Peak carrying capacity**– many reserves are approaching the peak of their capacity at sustaining their populations. Depletion of prey in tiger zones is a cause of concern.
- **Small core habitats**– The core habitats of the tigers in the country are very small. It is only with the addition of buffer zones that protection has become possible. Fragmentation of tiger habitats is a major cause of decreasing tiger population by reducing opportunities for these animals to inbreed. Few tiger reserves don't have any tigers left. In the northeast parts of the country their population has fallen significantly.
- **Infrastructural development**– Linear development such as railways and roadways are a serious threat to the tiger habitats.
- **Climate change**-Due to the global rise in temperatures the tigers along with other species are shifting their belts and migrating upwards towards colder regions.

Suggestive measures:

- Creating tiger corridors where the gene pool exchange would to take place is necessary.
- Corridors have to be built between the existing tiger reserves so that their population can freely move.
- Social upliftment of the communities living in and around the forests must be ensured so that their economic dependence on forest resources becomes lesser.
- Pench Kanha tiger reserve is a good example of development with conservation, where elevated national highway passes through the national park, without disturbing the wildlife.
- Involving the local communities into conservation efforts and sensitizing them about the importance of ecological conservation is the key.

- The tiger conservation approach has to be more dynamic and futuristic by mitigating the effects of climate change on wildlife.

Practice Question:
***Q.* Analyse the key challenges and successes in tiger conservation efforts in India. Discuss the significance of tigers in maintaining ecosystem balance and their cultural importance.**

5. FOREST FIRES, A THREAT TO UTTARAKHAND'S UNIQUE BIODIVERSITY

Context Forest fires are becoming more frequent and fierce in Uttarakhand.

What's at stake?

- Uttarakhand is home to at least 102 species of mammals, 70 reptiles, 19 amphibians, and 124 species of fish. The state also boasts of **600 species of birds.**
- The **International Union for Conservation of Nature (IUCN)** classifies 55 of the bird species as "threatened", of which six are critically endangered and four are endangered.
- Several mammalian fauna found in the state are also classified as endangered. The list includes the **Asian elephant, tiger, Alpine musk deer, Himalayan musk deer, leopard, snow leopard, blue sheep, Himalayan Thar, leopard cat, Himalayan black bear, sloth bear and pangolin.**
- With 7,000 species of plants, Uttarakhand contributes **31 per cent of the country's floral diversity.** As many as 119 flowering plants are endemic to the state.

How does it impact?

- **Loss and displacement of species:** The impact of recurrent forest fires in Uttarakhand is not limited to the direct loss of trees and wildlife, their displacement and subsequent colonisation of unwanted species.
- **Pushing towards extinction:** Forest fires can meddle with the life cycle of species and push many of the threatened and endemic species closer to extinction.
  - **Affecting growth:** By destroying the leaves and foliage, a forest fire can significantly reduce the photosynthetic activity of surviving trees and thereby affect their growth.
  - **Affected seedlings:** It can also damage the seed bank, both above and below the ground, and wipe out the seedlings and saplings growing on the forest floor.
- **Impact on recovery rate:** The loss of **keystone organisms** in forest ecosystems, such **as invertebrates, pollinators, and decomposers,** can significantly slow the recovery rate of the forest.
- **Serious impact of reproduction:** Forest fires can also interfere with the reproduction and propagation of certain plants and animals. Such recurrent events can be deadly to the species that are native or endemic to the region.

Suggestive measures

The below steps would not only minimise instances of forest fire but also protect biodiversity from such an event.

- **Collect fuel load in time:** Pine needle and dry leaf litter are the common fire materials that occur on the forest floor. These should be cleared by collecting them before January, when the fire season begins in Uttarakhand.
- **Fix fire line:** Creation of fire line is often delayed in Uttarakhand. This pattern needs to be changed and a timely (before February) excavation of the fire line should be ensured.
- **Install fire watch towers:** There is an urgent need for these towers in this hilly state with undulating topography, especially in areas that have a history of a forest fire.
- **Applying management techniques:** There is also an urgent need to understand management techniques such as
  - promoting habitat-specific research to limit burning especially in biodiversity-rich and water supply areas
  - establish a well-equipped centre for unbiased dissemination of information

Practice Questions:

Q. Discuss the causes, impacts, and mitigation strategies of forest fires in India. Analyze the socio-economic and ecological consequences of forest fires on local communities and biodiversity. Suggest measures to enhance fire management and prevent future occurrences, ensuring the sustainable management of forest ecosystems."

Q. Among the countries of the global south, India is one of the most vulnerable nations and is exposed to an increasing trend of forest fires. While discussing the ecological consequences of forest fires on biodiversity, suggest measures to enhance fire management and prevent future occurrences, ensuring the sustainable management of forest ecosystems.

6. A NEW GLOBAL BIODIVERSITY FRAMEWORK

Context: In Montreal, member governments have agreed on a new framework, ***"Kunming-Montreal Global Biodiversity Framework (GBF)"*** to halt the sharp and steady loss of biological species at the **Convention on Biological Diversity (CBD).**

Why to protect biodiversity?

- **Ecosystem Stability**: Different species play vital roles in maintaining the balance of ecosystems, such as pollinating plants, decomposing organic matter, and regulating populations of other organisms thus ensuring the stability of ecosystems.
- **Human Health**: Many medicines, including those used to treat cancer, malaria, and other diseases, are derived from natural compounds found in plants, animals, and microorganisms.
- **Food Security**: A diverse range of plant and animal species is needed to maintain resilient agricultural systems.
- **Economic Benefits**: Many industries rely on diverse ecosystems, such as tourism, forestry, fisheries, and agriculture. Biodiversity-rich areas attract visitors, create employment opportunities, and generate revenue.
- **Climate Regulation**: Forests, for instance, act as carbon sinks by absorbing carbon dioxide and reducing greenhouse gas emissions. Mangroves and coral reefs provide coastal protection against storms and flooding.

Threats to Biodiversity

- **Habitat Loss**: Activities such as deforestation, urbanization, agriculture, and infrastructure development result in the loss of ecosystems and the fragmentation of habitats. This reduces the available space for species to thrive and disrupts ecological processes.
- **Climate Change**: Rising temperatures, changing rainfall patterns, and extreme weather events can disrupt ecosystems, affect species distributions, and cause habitat loss.
- **Pollution**: Chemical pollutants, such as pesticides, herbicides, and industrial waste, can contaminate ecosystems and harm various organisms, including plants, animals, and microorganisms.
- **Overexploitation and Illegal Wildlife Trade**: Unsustainable hunting, fishing, and harvesting of wildlife, both legal and illegal, can severely deplete populations of various species. This disrupts ecosystems and undermines the integrity of ecosystems.
- **Invasive Species**: Non-native species introduced to new areas can outcompete and displace native species, disrupting ecosystem balance and reducing biodiversity.

What is Kunming-Montreal Global Biodiversity Framework (GBF)?

- The Global Biodiversity Framework is considered equivalent to the Paris Agreement on climate change in terms of its significance for protecting biodiversity.
- The **15th Conference of Parties (COP15)** to the UN Convention on Biological Diversity (CBD) adopted the Kunming-Montreal Global Biodiversity Framework (GBF).
- The **framework has 23 targets** that the world needs to achieve by 2030.
- **Objectives:** The new frameworks have four goals to achieve by 2050:
  - To halt the extinction and decline of biodiversity
  - To enhance and retain nature's services to humans by conserving

- To ensure fair and equitable benefits to all from the use of genetic resources
- To close the gap between available financial and other means of implementation and those necessary to achieve the 2050 Vision

Key Points about Kunming-Montreal Global Biodiversity Framework (GBF):

- Through Kunming-Montreal Global Biodiversity Framework (GBF), **countries agreed to protect 30 percent of the planet by 2030.**
- The countries **pledged to achieve 23 targets to reverse ecosystem degradation** under four overarching goals for the survival of the natural world.
- Under the GBF, **countries also agreed to reduce harmful government subsidies worth 500 billion dollars annually**, while vowing to identify subsidies that are harmful to biodiversity by 2025.
- Its other targets **include reducing the use of pesticides by half** and raising annual international financial flows from developed to developing countries to at least 20 billion dollars by 2025 and to at least 30 billion dollars by 2030.

What does the Kunming-Montreal pact aim to achieve?

- It sets out **targets for 2030** on protection for:
  - degraded areas
  - resource mobilization for conservation
  - compensation for countries that preserve biodiversity
  - halting human activity linked to species extinction
  - reducing by half the spread of invasive alien species (introduced plants and animals that affect endemic biodiversity)
  - cutting pollution to non-harmful levels and
  - Minimizing climate change impact and ocean acidification, among others

What funding arrangements are planned?

- **By 2030, the GBF hopes to see at least $200 billion raised per year from all sources** — domestic, international, public, and private — towards the implementation of the national action plans.
- In terms of international funding, **developing countries should get at least $20 billion a year by 2025** and at least $30 billion by 2030 through contributions from developed countries.
- The **Global Environment Facility (GEF),** a multilateral body that partners with countries and agencies, has been asked to establish in 2023, and until 2030, a Special Trust Fund to support the implementation of the GBF.
- The GBF is aligned with **UN Sustainable Development Goals**, three of which directly deal with the environment and thus with biodiversity i.e. **Goal 13** (climate action), **Goal 14** (life below water) and **Goal 15** (life on land). Thus the countries should implement the GBF in letter and spirit.

Practice Question

Q. Discuss the threats faced by the biodiversity in India. Discuss effectiveness of the global framework to tackle this threats.

7. AMENDMENT TO WILDLIFE (PROTECTION) ACT AND PROTECTION OF INDIA'S WILDLIFE

Context: The **Wildlife (Protection) Amendment Bill, 2022,** which seeks to strengthen the protection of endangered species and enhance punishment for illegal wildlife trade, has been passed in **Rajya Sabha by a voice vote**.

Background

- India is blessed with dense forests and thriving, healthy ecosystems within its borders.
- The flora and fauna of India, some of them only endemic to India, makes India a hotspot for tourists.

- The country is also home to well over 2000 tigers - most of which reside and roam within protected reserves.
- This makes a legislation like wild life protection act should be updated with the time to safeguard the fauna.

Facts on India's incredible Biodiversity

- India is the only country in the world with native populations of both tigers and lions.
- India is just 2% of the world's land mass, but is home to 8% of the world's biodiversity.
- Among plants, 33% of the world's species are endemic to India, which means they are found nowhere else in the world.
- India is one of the 17 megadiverse countries in the world. Out of 35 biodiversity hotspots in the world, India has 4 biodiversity hotspots.
- India is home to 12% of the world's bird species.

The original Act

- The original Wild Life (Protection) Act acts to:
  - prohibits people from hunting wildlife
  - provides legal safeguards for different species based on their threat status
  - regulates trade and commerce in wild species
  - imposes penalties for wildlife-related crimes
  - specifies the terms to declare protected areas
- The Act has been amended several times, in 1982, 1986, 1991, 1993, 2002, 2006 and 2013.
- The proposed amendment is likely the most expansive so far in scope: it covers more areas of legislation, from trade in wild species to permitting filmmaking in protected areas and controlling the spread of invasive species.

What is the need for Amendment?

- **Threat of blacklisting:** India has been blacklisted by CITES once before, and if a second blacklisting were to happen — then India will no longer be able to trade in important plant specimens.
- **Ambiguous listing:** The rationalization needed to be done because there were many discrepancies in the schedules and they were also ambiguous.
- **Non-uniform listing:** Some species were listed under English names, others under scientific names, some under families, and others under orders.
- **Issues in implementation:** Such a categorization was very confusing for wildlife and forest officials on the ground to implement.
- **Constant threats to wildlife:** There are constant threats to the wildlife like Illegal Wildlife Trade, Habitat Destruction, Human-animal conflict etc.

Significance of the amendments

- **Decentralization:** The Bill aims to decentralise wildlife protection, with the establishment of Standing Committees of State Boards of Wildlife, which can regulate permissions to various projects based on their impact on the wildlife, without having to refer to the **National Board for Wildlife.**
- **Streamlining the legislation**: The bill also aims to streamline the schedules mentioned in the original Act, shrinking them from six to four.
- **Greater protection**: Wildlife Management Plans crafted for wildlife sanctuaries and parks in the country will be brought under the jurisdiction of the Act, thereby increasing the scope for stricter protection for various species.
- **Increased penalty for wildlife crimes:** The Bill increases penalties for wildlife crimes which can act as a deterrence for such crimes. **For example**, offences that attracted a fine of Rs 25,000 now attract Rs 1 lakh.
- **CITES:** There's a new and separate chapter on regulating species involved in international trade according to the **Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)** Specifically, the Bill prohibits possessing, trading and breeding species without prior permissions from CITES authorities.
  - India became party to CITES in 1976.

- **Invasive alien species**: The Bill also recognises threats that invasive alien species pose. This will address the treats emerging from the alien species. An infamous example is the weed called **mesquite**.

Issues

- **Effect on elephant population:** The bill allows for commercial trade in elephants which is problematic because it effectively gives legal sanctity to commercial trade in live elephants.
  - Wild Asian elephants are taken from forests, often illegally, to maintain the high demand for captive elephants. This could affect wild populations of elephants.
- **More power to centre:** Another amendment in the bill has given excessive delegation and unrestricted power to the Central government to declare a species as Vermin
  - Once a wild animal is declared as vermin, it enjoys no legal protection and has the same status as a domestic animal. It can be killed, traded, and tamed.
- **Permission for film shoot: Section-28 (b)** has been amended to grant permission for film-making without causing any adverse impact to habitat/wildlife. Earlier, Film shooting was banned in **1978 to avoid accidents and tragedies.**
- **Research and habitats**: The bill also lacks to encourage the importance of including research and habitats in the Preamble and creating enabling provisions.

Conclusion

There is a dire need for joint effort of Government furthermore, Stakeholders with NGOs for various projects worry to protection of biodiversity and natural life government assistance. Government ought to endorse enactment for illicit exercises that drives biodiversity to the edge of termination. There ought to be open mindfulness about wildlife conservation significance through social, print and electronic media.

Practice Question
Q. To what extant Wildlife (Protection) Act is successful in protecting India's Wildlife. Discuss

2

CONSERVATION

1. GREEN HYDROGEN

Context: The Union Government has approved **Rs 19,744 crore for National Green Hydrogen mission** that aims to make India a 'global hub' for using, producing and exporting green hydrogen.

Introduction

- Green hydrogen is a type of hydrogen which is produced **using electrolysis** of water with electricity generated **by the renewable energy**.
- This has the potential to revolutionize the energy sector in India because of zero emissions potential.
- Seeing the tremendous opportunity, government has announced **National Green Hydrogen Mission**.

What is Green Hydrogen?

- **Green hydrogen** is a type of hydrogen that is produced through the **electrolysis of water. This electrolysis is done using renewable energy sources** such as solar or wind power.
- The **electrolysis process splits water into hydrogen and oxygen.** This hydrogen produced can be used as a clean and renewable fuel.

Significance of Green Hydrogen:

- **Meeting INDC targets**: Green hydrogen energy is crucial for India to meet its Nationally Determined Contribution (NDC) Targets and ensure regional and national energy security, access and availability.
- **Energy Storage: Green Hydrogen** can act as an **energy storage option,** which would be essential to meet intermittencies (of renewable energy) in the future.
- **Reducing Import Dependence:** Green hydrogen will reduce **India's import dependency on fossil fuels, which is largely imported from the foreign countries.**
- **Steel Industry**: It is also used in the **steel industry,** a sector which is under considerable pressure in **Europe because of its polluting effect.**

How will Green Hydrogen Mission help India's green hydrogen aspirations?

- **Push to domestic manufacturing of electrolysers:** The lack of domestic electrolysers capacity is the biggest challenge for the industry to take off. The prime goal of the mission is to solve this issue by developing domestic manufacturing of electrolysers through financial allocation.
- **Thrust to R&D activities for the sector:** The Mission focuses on the investments on the research and development in the green hydrogen. This will help in developing **globally competitive technologies** in the country.
- **Export potential: The Mission will help India in becoming** a **leading producer** of green hydrogen in the world and creation of **export opportunities** for it and its derivatives.

Challenges for the adoption of green hydrogen

- **High cost of producing green hydrogen:** Due to low economy of scale currently, there is very high cost associated with the manufacturing and adoption of green hydrogen.
- **Still a nascent technology:** Being relatively **new player in the energy basket,** there are still some apprehensions about the wider adoption of the technology**.**

- **Energy source challenge:** Green hydrogen requires renewable energy as a source of electricity. According to some reports, India will need **additional capacity of 125 GW** of renewable energy to meet its green hydrogen 2030 targets.
- **High demand of water in producing green hydrogen:** It has been estimated that the production of one kg of hydrogen by electrolysis requires around nine liters of water. As several parts of India are already facing severe water stress, uninterrupted supply of the resource will be a challenge.
- **Lack of an ecosystem around the green hydrogen:** Currently, most of the demand for hydrogen comes from the chemical industry to produce ammonia for fertilizers**. Transport industry** around the green hydrogen is yet to be developed.

Conclusion

Green hydrogen has the potential **to maximize de-carbonization** of the energy sector and use of energy in sectors such as **transport, buildings and industry**. It is also crucial to achieve **India's net zero emission** target by 2070. Currently, green hydrogen is where solar energy was 10-12 years ago. With the rise in capacity, investments, and demand, green hydrogen could also become one of the cheapest options globally.

Practice Question

Q. How will hydrogen mission of India facilitate demand creation and make India the global hub for the production of green hydrogen? Also, highlight challenges of implementing green hydrogen mission?

Q. The term 'net zero' is becoming a global rallying cry, frequently cited as a necessary step to successfully beat back climate change, and the devastation it is causing. Comment

2. INDIAN SOLAR POWER DREAM

Context: The Government of India has aimed to expand India's renewable energy installed capacity to 500 GW by 2030, from which 280 GW is expected to come from '**Solar PV'.** This makes the deployment of nearly **30 GW of solar capacity** necessary every year**.**

India's targets and achievements

- The government's aim is to achieve 500 GW of installed electricity capacity from non-fossil sources by 2030.
- India's total installed renewable energy capacity touched 168.96 GW mark by February 2023-end. Out of the total 168.96 GW-
  - 64.38 GW is solar power capacity
  - 51.79 GW hydro
  - 42.02 GW wind
  - 10.77 GW bio power

Significance of Solar Energy

- **Energy security**: India heavily relies on imported fossil fuels to meet its energy demands. By harnessing solar energy, the country can reduce its dependence on foreign oil and gas, enhancing its energy security and reducing vulnerability to fluctuations in global fuel prices.
- **Environment-friendly**: Solar energy is a clean and green source of power. It produces no greenhouse gas emissions or air pollutants during operation, thereby mitigating climate change and reducing environmental pollution.
- **Rural electrification**: A significant portion of India's population, particularly in rural areas, lacks access to reliable electricity. Solar power offers a decentralized solution to meet the electricity needs of remote and off-grid communities.
- **Job creation**: The solar energy sector has the potential to generate substantial employment opportunities in manufacturing, installation, operation, and maintenance of solar power plants.
- **Cost competitiveness**: Over the years, the cost of solar power generation has significantly declined, making it increasingly competitive with conventional sources of energy.

Challenges:

- **Dependence on Imports:** Indian solar companies **depend heavily on imports**, as India presently does not have enough module and cell manufacturing capacity. The demand-supply gap gets widened as we move up the value chain.
- **Limited manufacturing capacity:** India currently manufactures only 3**.5 GW of solar cells** and has a **limited solar module manufacturing capacity of 15 GW**.
  - **India has no manufacturing capacity for solar wafers and polysilicon ingots**, and currently **imports 100% of silicon wafers** and around **80% of cells** even at the current deployment levels.
- **Raw Material Supply:** Raw materials like **silver and aluminium metal pastes** which are crucial for making electrical contacts are **almost 100% imported.** Silicon wafer, the most expensive raw material, is not manufactured in India.
- **Poor investment in research**: India has not invested enough in creating centres to try and test solar technologies in a cost-effective manner. E.g., **IMEC Belgium or the Holst Centre in the Netherlands.**
- **Usage of Older Technology:** Indian manufacturers depend on older Al-BSF technology (Aluminium Back Surface Field Solar Cells), which has low efficiencies of 18-19% at the cell level and 16-17% at the module level.
  - Presently cell manufacturing worldwide has moved to **PERC (22-23%)**, **HJT (~24%), TOPCon (23-24%)** and other newer technologies, yielding module efficiency of >21%.
- **Land Issues:** Producing more solar power for the same module size means more solar power from the same land area. Land is scarce in India — and the Indian industry has no choice but to move towards newer and superior technologies as part of expansion plans.

Government Initiatives:

- **PLI scheme to Support Manufacturing:** The Scheme has provisions for supporting the setting up of integrated manufacturing units of high-efficiency solar PV modules by providing Production Linked Incentive (PLI) on sales of such solar PV modules.
- **Levying Custom Duties on Import of Solar Cells & Modules:** The Government has announced the imposition of **Basic Customs Duty (BCD)** on the import of solar PV cells and modules.It includes a 40% duty on the import of modules and a 25% duty on the import of cells.
- **Domestic Content Requirement (DCR): Central Public Sector Undertaking (CPSU) Scheme Phase-II**, **PM-KUSUM,** and **Grid-connected Rooftop Solar Programme Phase-II,** wherein government subsidies are given, it has been mandated to source solar PV cells and modules from domestic sources.
- **Modified Special Incentive Package Scheme (M-SIPS):** The scheme mainly provides a subsidy for capital expenditure on PV cells and modules 20% for investments in Special Economic Zones (SEZs) and 25% in non-SEZ.
- **Solar Parks Scheme:** The scheme facilitates and speeds up the installation of grid-connected solar power projects for electricity generation on a large scale. The capacity of the solar parks shall be 500 MW and above.
- **Central Public Sector Undertaking (CPSU) Scheme:** A scheme for setting up 12 GW Grid-Connected Solar PV Power Projects by Central Public Sector Undertakings with domestic cells and modules is under implementation.

Way forward

- **Strong industry-academia collaboration**: It will result in the development of home-grown technologies which could assist the industry and its participants in an innovative manner.
- **Boosting Local Manufacturing**: India should move up the value chain by making components locally that could drive the price and quality of both cells and modules.
- **Creation of PV manufacturing Parks**: India needs to set up industry-like centres to work on specific technology domains with clear roadmaps and deliverables for the short and long term.
- **Solution for land shortages: floating solar plants** offer a great deal of potential by utilizing the surface of water bodies, for example, Ramagundam Floating Solar PV Project at Ramagundam, Telangana.

UPSC PYQ

Q. Do you think India will meet 50 percent of its energy needs from renewable energy by 2030? Justify your answer. How will the shift of subsidies from fossil fuels to renewables help achieve the above objective? Explain. (2022)

Q. To what factors can the recent dramatic fall in equipment costs and tariff of solar energy be attributed? What implications does the trend have for the thermal power producers and the related industry? (2015)

Q. Describe the benefits of deriving electric energy from sunlight in contrast to the conventional energy generation. What are the initiatives offered by our Government for this purpose? 2020

Practice Question

Q. Solar Energy can act as a panacea to the growing energy needs of India. Discuss. What are challenges for India's solar energy growth?

3. AGROFORESTRY

Context: In order to aid carbon-neutral growth, India needs to stress working extensively toward agroforestry in the country.

Introduction

- Agroforestry is a low-cost integrated land management where trees are cultivated with cash crops. It is a process of interaction of agriculture and trees along with agricultural use of trees.

Significance of Agroforestry

- **Increased productivity**: Agroforestry systems often lead to increased productivity compared to monoculture agriculture. The presence of trees provides additional income through the production of timber, fruits, nuts, or non-timber forest products.
- **Climate change mitigation**: Agroforestry plays a crucial role in climate change mitigation by sequestering carbon dioxide from the atmosphere. Trees in agroforestry systems absorb and store carbon, helping to reduce greenhouse gas emissions.
- **Soil health and fertility**: Tree roots contribute to soil structure, preventing erosion and improving water infiltration. Tree leaves and litter provide organic matter and nutrient inputs, enhancing soil fertility and nutrient cycling.
- **Water management**: Agroforestry helps in efficient water management by reducing water runoff, enhancing water infiltration, and minimizing soil erosion. The presence of trees can regulate water availability by controlling evaporation and transpiration rates.
- **Livelihood diversification and resilience**: Agroforestry provides farmers with multiple sources of income and reduces their dependence on a single crop or livestock. It offers opportunities for value addition through timber, fruits, nuts, or non-timber forest products.
- **Sustainable land use**: Agroforestry promotes sustainable land use practices by integrating trees into agricultural landscapes. It allows for the productive use of land while conserving natural resources, reducing deforestation, and preserving biodiversity.

Limitations of Agroforestry:

- **Land and space requirements**: Agroforestry systems generally require more land compared to monoculture agriculture. The integration of trees with crops or livestock may reduce the available area for primary production.
- **Time and management requirements**: Agroforestry systems often require longer establishment periods and continuous management compared to conventional agriculture. Tree growth can be slower, and farmers need to invest time and effort for maintaining tree-crop or tree-livestock interactions.
- **Knowledge and technical expertise**: Implementing agroforestry effectively requires knowledge and technical expertise in tree management, crop-livestock integration, and ecological interactions. Farmers need to understand the suitable tree species for their region and the interactions between trees and other components of the system.
- **Site-specific limitations**: Agroforestry suitability can vary depending on local environmental conditions, such as soil type, topography, climate, and water availability. Some regions may face limitations due to factors like waterlogging, soil salinity, or extreme climate conditions.

- **Perceived risk and uncertainty**: Uncertainties related to tree establishment, market demand, and long-term returns may discourage farmers from transitioning to agroforestry.

Government steps

- **National Action Plan for Climate Change**: Under NAPCC government of India has launched a sub scheme of Green India Mission where the agro forestry has been a primary focus to increase the farmers' income and increase the forest cover of India.
- **Har Medh Par Ped**: Scheme introduced by government to promote agroforestry. The scheme is for planting trees on all farms' boundaries. The HMPP scheme aims to increase the income of farmers.

Way forward

- **Government support**: Government should support the agroforestry by Subsidizing or incentivizing the cost of inputs to the farmers.
- **Infrastructure**: Improving the quality of infrastructure growth for storage and transportation of forest products is necessary for promotion of agroforestry.
- **Banking penetration**: Efforts must be made in increasing the penetration of formal banking sector in the rural economy to protect the farmers and agro foresters from viscous cycle of debt.
- **Insurance schemes**: Introduction of insurance schemes for health income and crop yields will help the farmers in promoting agroforestry.

Practice Question

Q. What exactly do you mean by agroforestry? Explain its importance in context of climate change for India?

4. NEED OF LEGAL RIGHTS TO ANIMALS, TREES, AND RIVERS

Context The report titled as ***"Law in the Emerging Bio-Age"*** by the Law Society explores the scope of recalibrating the relationship between humans and mother earth in the future.

Key Questions raised in the report:

- Role of legal structure in improving human relations with living systems and our planet.
- Role of law in supporting the evolution of ethics in the capacity to manipulate living systems.
- Outcomes of granting rights to non-human life forms.
- Articulating legal frameworks to make them fit for the future.
- Legal Practitioner for the **bio age.**

Why it is necessary to grant nature rights?

- **Need to protect nature** — animals, plants, rivers, and beyond — because their existence is more than sustaining human lives. It is the holistic recognition that all life and all ecosystems on our planet are deeply intertwined.
- **Nature has an intrinsic right to exist** free of harm, regardless of the value, it provides humans.
- **Impact of anthropogenic activities:** Impacts from human activity on land and in the water, is influencing nature.
  - Climate change, ocean acidification, permafrost melting, habitat loss, eutrophication, stormwater runoff, air pollution, and contaminants are a few examples calling for attention.
- **Impact of climate change:** Warmer temperatures over time are changing weather patterns and disrupting the usual balance of nature. They are affecting non-human entities and their right as well.

Few Exemplary Regulations:

- **Ecuador was the first to recognize the rights of nature.** Article 71 begins: "Nature, where life is reproduced and occurs, has the right to integral respect for its existence.
- **Bolivia** adopted a biocentric/biocentric approach through the Law on the **Rights of Mother Earth (2010);** the enumerated rights are the rights to life, diversity of life, water, clean air, equilibrium, restoration, and pollution-free living.
- There is also a campaign to make **ecocide a prosecutable offense** at the international criminal court (ICJ), Hague.

Need to give non-human entities rights:

- **To tackle climate breakdown and biodiversity loss,** countries need to provide the 'rights' to the neglected elements of nature.
- **Something very different has to be done** to leave this planet more survivable to future generations.
- It means **granting legal rights and protections to non-human entities** such as animals, trees, and rivers is essential.
- Human makes up a fraction of this global ecosystem, and an **evolving legal framework** suited for the future requires **assigning rights to non-human entities**.

Existence of Nonhuman Rights:

- **Rights of Nature**: The concept of nature is not currently understood to include individual animals. But the provisions recognizing the **rights of nature** still implicitly acknowledge that a nonhuman can have rights.
  - It is also important to understand that, theoretically, the rights of nature may be violated even in the absence of any injury to humans.
- **Judicial Recognition:** Rivers have been treated as legal persons in some jurisdictions, notably in Bangladesh, Colombia, Ecuador, India, New Zealand, and the United States.
  - A **landmark judgment of the Uttarakhand High Court (UHC),** has extended the ***legal personhood*** to the Ganga, the Yamuna, their tributaries, and all other natural objects.
- In another case, the High court of Punjab and Haryana recognized all animals in the animal kingdom, including avian and aquatic species, as legal entities.
- **Banning Jallikattu Practice:** The Supreme Court order of 2014 bans jallikattu, because traditional sports involved the taming or overpowering of bulls.

Constitutional Provisions:

- **Article 51-A** of the Constitution of India states that it is the fundamental duty of all citizens to have compassion for living creatures.
- **Article 48-A** of the constitution of India requires the State to protect and improve the environment and to safeguard the forests and wildlife of the country.
- At **local and village level**, Panchayats have been empowered under the constitution to take measures such as soil conservation, water management, forestry and protection of the environment and promotion of ecological aspect.

New Legal Framework:

- **Inclusive Framework:** There is need for a framework that is more eco-centric than anthropocentric.
- **Ethical questions:**
  - Ethics of bringing back species from extinction or eradicating existing ones.
  - Wiping out mosquitoes, which carry malaria and other diseases.
  - Calves are taken away from their mothers and even pets

Practice Question:

Q. Granting legal rights and protections to non-human entities such as animals, trees and rivers is essential if countries are to tackle climate breakdown and biodiversity loss. Do you agree?

Q. The Ganga and Yamuna examples highlight the need for urgent laws — and a robust legal framework to back them — to protect nature from human damage and exploitation. Comment

5. E-WASTE

Context: The government is planning to revamp the electronic waste policy, focusing on complete lifecycle management of products. This revised policy could allow the industry to take into account the total volume of electronics products recycled instead of the amount of metals and rare earth minerals extracted from these products.

Impact of E-waste

- **Environmental impact**: E-waste contains hazardous substances such as lead, mercury, cadmium, and brominated flame retardants, which can leach into soil and water, contaminating the environment and posing risks to ecosystems.
- **Health risks**: E-waste recycling and dismantling processes often involve informal and unsafe practices like open burning, acid leaching. These activities expose workers to toxic substances, leading to health issues like respiratory problems, skin disorders etc.
- **Resource depletion**: Electronic devices contain valuable and finite resources, including precious metals like gold, silver, and platinum, as well as rare earth elements. Improper e-waste disposal results in the loss of these resources.
- **Global trade and dumping**: E-waste is sometimes exported illegally from developed countries to developing countries with lax regulations. This leads to the concentration of e-waste in these regions, where informal recycling processes are prevalent.
- **Data security and privacy risks**: Improper handling of e-waste can lead to the unauthorized access and misuse of personal and confidential data stored on discarded devices. If not properly wiped or destroyed, sensitive information can fall into the wrong hands, potentially leading to identity theft, fraud, and other security breaches.

About

- Electronic-Waste is the term used to describe old, end-of-life, or discarded electronic appliances. It includes their components, consumables, parts, and spares.
- According to the Central Pollution Control Board (CPCB), India generated more than 10 lakh tonnes of e-waste in 2019-20, an increase from 7 lakh tonnes in 2017-18.

Provisions of E-waste rules 2022:

Ministry has notified the **E-Waste (Management) Rules, 2022** in November, 2022. These rules replaced **E-waste (Management) Rules, 2016** and became effective from 1st April, 2023

- **Restrictions:** The government has restricted the use of hazardous substances in manufacturing electrical and electronic equipment (EEE) following deaths due to exposure to radioactive material.
- **Reuse and recycling:** Manufacturers shall use the technology or methods so as to make the end product recyclable and shall ensure that components or parts made by different manufacturers are compatible with each other so as to reduce the quantity of e-waste.
- **Strict monitoring:** The Central Pollution Control Board shall conduct random sampling of electrical and electronic equipment placed on the market to monitor and verify the compliance of reduction of hazardous substances provisions.
- **Extended Producer Responsibility Certificates:** Rules aim to incentivise registered electronic waste recyclers by **introducing EPR or Extended Producer Responsibility certificates** (which was not part of 2016 Rules).
- **E-waste exchange facilities:** The EPR requires producers to set up e-waste exchange facilities to facilitate collection and recycling, and assign specific responsibility to bulk consumers of electronic products for safe disposal.
- **Imports:** Imports or placement in the market for new electrical and electronic equipment shall be permitted only for those which are compliant with provisions laid down by the government.
- **Disposal:** It is the responsibility of the manufacturer to collect e-waste generated during manufacture and to ensure its recycling or disposal.

Way forward

Addressing these issues requires a comprehensive approach, including:

- **Enforcement of rules**: Implementation and enforcement of proper e-waste management regulations is necessary to solve the issues arising from the e-waste.
- **Recycling facilities**: Establishment of formal recycling facilities with environmentally sound practices should be encouraged by the government to properly treat the e-waste in India.
- **Awareness campaign**: Awareness campaigns and education about proper e-waste disposal among consumers and businesses should be carried by the local government and the non-governmental organisations. This will address the root cause of e-waste.
- **Sustainable practices**: Encouraging manufacturers to adopt sustainable practices, such as using eco-friendly materials and minimizing the use of hazardous substances to address the problems evolving from the e-waste.

Practice Question

Q. Examine the factors behind burgeoning problem of e-waste in India. Suggest some measures to tackle this crisis.

6. MIYAWAKI FORESTS, A SUSTAINABLE WAY FOR ECOLOGICAL RESTORATION

Context There are hundreds of thousands of **Miyawaki forest trees** in India. Also, this method is quickly finding favour in government corridors and corporate boardrooms to restore urban spaces.

About Miyawaki Forest:

- Miyawaki is a technique **pioneered by Japanese botanist Akira Miyawaki**, which helps build dense, native forests.
- It is effective because it is based on **natural reforestation principles**, i.e. using trees native to the area and replicating natural forest regeneration processes.
- The trees planted by this method **grow much faster, jump starting the forest creation process and capturing more carbon.**
- The approach is supposed to ensure that plant growth is 10 times faster and the resulting plantation is 30 times denser than usual.
- It **involves planting dozens of native species** in the same area, and becomes maintenance-free after the first three years.
- Higher biodiversity has been recorded in Miyawaki forests than in neighbouring woodland, so it's an ideal method for creating diverse forest ecosystems quickly.
- Within the context of the current climate change emergency and stark warnings about the global loss of biodiversity, being able to create diverse, **healthy forests quickly could prove vital to meeting international targets and tackling these issues**.

What are the benefits?

- **Effective in the urban environment**: It has some significant benefits over more traditional forestry methods when used in smaller afforestation projects and is **particularly effective in the urban environment**.
- **Faster Growth**: Trees in a Miyawaki forest **grow up to ten times faster** at around a metre per year, reaching a stable multi-layered forest community in **20 to 30 years instead of hundreds of years**
- **More Carbon Absorption**: The growing **trees absorb more carbon in a Miyawaki forest** than in a plantation or in standard afforestation projects because they grow more quickly and there are thirty times as many
- **Resilient to Environmental changes**: Native trees thrive in the conditions to which they are adapted and are **more resilient to environmental changes**
- **Biodiversity**: Miyawaki forests have been found to have **far higher biodiversity** than neighbouring woodland, on average 18 times higher.

Criticism of the Miyawaki Method:

- **Monotonous-looking forests**: Critics have accused him of shilling for corporations like Toyota, which have contributed to deforestation in places such as India, and of creating monotonous-looking forests that are expensive to boot.
- **Questions over efficiency**: Environmentalists have questioned the efficacy of the method that accelerates the growth of trees and claims to match a forest's complex ecosystem. They believe that it is not a good idea to force plants to photosynthesise fast.
- **Suitability for tropical region**: The technique was started by the Japanese considering the climate in Japan. Environmentalists have questioned the suitability of the method for a tropical country like India.
- **Restricted movement of Wildlife**: Miyawaki Forests are very dense, which restricts the movement of any possible wildlife the forest might attract. Experts are of the opinion that nothing can replace something that is very natural in its form, like natural forests.

It's important to note that while the Miyawaki method has its limitations and potential issues, it can still be a valuable tool for ecological restoration and urban greening when implemented with careful planning, appropriate species selection, and long-term management strategies.

Practice Question

Q. What is Miyawaki method of afforestation? Discuss the significance and issues associated with Miyawaki method.

7. UN DECLARES ACCESS TO A CLEAN, HEALTHY ENVIRONMENT AS A UNIVERSAL HUMAN RIGHT

Context: The United Nations declares that **every person on the planet has the right to live in a clean, healthy environment in a historic resolution**.

Why should clean, healthy environment be recognized as a universal human right?

- **Human Well-being**: A clean and healthy environment provides the necessary conditions for physical, mental, and social health. Access to clean air, water, and food is essential for human survival and quality of life.
- **Human Dignity**: Every individual deserves to live in an environment that respects their inherent worth and ensures their basic needs are met. Environmental degradation, pollution, and exposure to hazardous substances can undermine human dignity.
- **Sustainable Development**: Such right promotes a holistic approach that considers the long-term impacts of human actions on the environment and ensures the equitable distribution of resources for current and future generations.
- **Environmental Justice**: Recognizing this right empowers marginalized communities, gives them a voice in environmental decision-making processes, and helps address environmental inequalities and injustices.

About Resolution:

- This resolution is about the **right to a clean and healthy environment.**
- It has been passed by over 160 UN member nations including India.
- The resolution recognizes the right to a clean, healthy, and sustainable environment as a **human right** essential for the full enjoyment of all human rights and among others.
- It calls upon states and international organizations to **adopt policies and scale up efforts to ensure a clean,** healthy, and sustainable environment for all.
- It demonstrates that the member states can unite in the collective fight against the triple planetary crisis of climate change, biodiversity loss, and pollution.

Significance of this resolution

- About 50 years after the United Nations Conference on the Environment in Stockholm in 1972; a resolution is placing environmental issues at the global forefront.
- **Encourage countries:** It will **encourage countries to incorporate the right** to **a healthy environment in national constitutions** and regional treaties.
- **Empowering people**: The resolution will also empower people, especially those in vulnerable situations including environmental human rights defenders, children, youth, women, and indigenous people.
- **Environmental injustices**: It will help to **reduce environmental injustices** and plug the protection gaps.
- **Unity**: This landmark development demonstrates that the **member states can unite** in the **collective fight against the triple planetary crisis of climate change, biodiversity loss, and pollution.**
- **Empowering Vulnerable people:** People, particularly those who are vulnerable, such as indigenous people, children, youth, and environmental human rights advocates, can be empowered by it.

Issues with the resolution:

- **Vauge definitions**: The words 'clean', 'healthy', and 'sustainable' lack an internationally agreed definition.
- **No mention of Equity**: The resolution text also fails to refer to the foundational principle of equity in international environmental law.
- **No binding Obligations**: The General Assembly resolutions do not create binding obligations. Only through conventions and treaties do state parties undertake obligations for such rights.

Origins of Environmental Rights:

- The modern era of environmental law began in the late 1960s, when population growth, industrial expansion, and innovations in chemistry resulted in dramatic impacts on ecosystems, wildlife, and public health. Many industrialized nations adopted environmental national laws in the 1970s and 1980s.
- By the 1990s, many nations adopted constitutional provisions protecting the environment, which ushered in what is known as a **rights-based approach to environmental protection**. It is normatively based on rights and directed toward protecting those rights.

Stockholm Declaration:

- This was the **first global convergence on the planetary environment**. The theme was 'Only One Earth. 122 countries participated in the conference.
- It was the first declaration of international protection of the environment. It was held from 5th –16th June 1972.
- The Stockholm Declaration, contained 26 principles, placed environmental issues at the forefront of international concerns, and marked the start of a dialogue between industrialized and developing countries.

- As the right to a clean and healthy environment is not included in the **Universal Declaration of Human Rights, 1948**, this historic resolution will change the very nature of **international human rights law.**

Conclusion

The resolution will help to reduce environmental injustices and plug the loopholes. It is going to give more power in the hands of environmental activists to question environmentally destructive actions and policies.

Practice Question

Q. Why should clean, healthy environment be recognized as a universal human right? Discuss the statement in the light of the recent UN resolution.

8. THE ENERGY CONSERVATION (AMENDMENT) ACT, 2022

Context: The Energy Conservation Act, 2001, was amended with the Energy Conservation (Amendment) Act, 2022 ("Amendment Act"), recently. The amended Act received the President's assent on December 19, 2022.

About

- The Energy Conservation (Amendment) Bill seeks to increase India's demand for renewable energy, thereby reducing the nation's carbon emissions.
- The Bill proposes to amend the Electricity Conservation Act 2001, last amended in 2010, to introduce changes such as incentivising the use of clean energy by issuing carbon saving certificates.

The Current Energy Conservation Act:

- Currently, the **Energy Conservation Act, 2001 (amended in 2010) governs the domain in India.**
- The Act empowers the Centre to **specify norms and standards** of energy efficiency for appliances, industrial equipment and buildings with a connected **load over 100 kilo Watts (kW) or a contractual demand of more than 15 kilovolt-amperes (kVA).**

- The Act established the **Bureau of Energy Efficiency**.
- The 2010 amendment extended the tenure of the Director General of the Bureau of Energy Efficiency from three to five years.
- **Framework for energy trading:** According to the Act, the Centre can issue energy savings certificates to those industries which consume less than their maximum allotted energy.
  - However, this certificate can be sold to customers who consume higher than their maximum allowed energy threshold.
- **Penalty:** In case of any violations under this Act, each offence shall attract a penalty of Rs ten lakh with an additional penalty of Rs 10,000 for each day the offence continues.
- **Appeal:** Any appeals against any such order passed by the Central or state government will be heard by the appellate tribunal already established under the Electricity Act, 2003.

The proposed changes:

- **Minimum share of renewable energy**: Defining the **minimum share of renewable energy** to be consumed by industrial units or any establishment. This consumption may be done directly from a renewable energy source or indirectly via the power grid.
- **Carbon saving certificates**: Incentivising efforts to use clean energy by issuing carbon saving certificates
- **Strengthening institutions**: Strengthening institutions set up originally under the Act, such as the Bureau of Energy Efficiency
- **Green Hydrogen**: Facilitating the promotion of green Hydrogen as an alternative to the fossil fuels used by industries
- **Carbon credits**: Considering additional incentives like carbon credits for the use of clean energy to lure the private sector to climate action.
- **Sustainable habitats**: Including larger residential buildings under energy conservation standards to promote sustainable habitats. Currently, only large industries and their buildings come under the ambit of the Act.

Objective of proposed amendments:

- The main objective of these proposed amendments is to **reduce India's power consumption via fossil fuels** and thereby minimize the nation's carbon footprint.
- The Centre aims to **develop India's Carbon market** and boost the **adoption of clean technology.**
- India **aims to meet its Nationally Determined Contributions (NDCs**), as mentioned in the Paris Climate Agreement, before its 2030 target date.

Issues

- **Regulation**: The issue is whether the Ministry of Power is the appropriate Ministry to regulate this scheme. A further question is whether the market regulator for carbon credit trading should be specified in the Act.
- **Ambiguity**: Same activity may be eligible for renewable energy, energy savings, and carbon credit certificates. The Bill does not specify whether these certificates will be interchangeable.
- **Non-fossil energy use obligation**: Designated consumers must meet certain non-fossil energy use obligation. Given the limited competition among discoms in any area, consumers may not have a choice in the energy mix.

With the aim of facilitating the achievement of COP-26 goals, significant changes were made to the 2001 Act. The Amendment Act introduces new concepts such as carbon trading and mandates the use of non-fossil sources by designated consumers to ensure faster decarbonisation and achievement of sustainable development goals.

India's climate change commitments

- India has committed to reducing the carbon intensity of its economy by **33-35 per cent by 2030 from its 2005 levels** as part of its NDCs under the Paris Climate Agreement.
- The nation has also promised to **achieve over 40 per cent of its power generation from non-fossil-fuel energy resources by 2030.**

- In a bid to **reduce its CO2 emissions** to **550 metric tonnes (Mt) by 2030**, India has committed to creating an additional carbon sink for 2.5 -3 billion tonnes of CO2 by increasing its tree and forest cover.

India's five new climate targets are:

- To increase its **non-fossil energy capacity to 500 GW by 2030**
- To **meet 50 per cent of India's power demand via renewable energy sources**
- To reduce the **carbon intensity** of the Indian economy **by 45 per cent**
- To reduce **India's total projected carbon emissions** by one billion tonnes from 2021 to 2030
- To achieve a target **net zero (for carbon emissions) by 2070**

Practice Question

Q. Discuss the significance of the The Energy Conservation (Amendment) Bill, 2022. Also, discuss the issues associated with the bill.

9. BIOFUELS

Context: In line with the Ethanol Blending roadmap, Prime Minister launched **E20 fuel** at 84 Retail Outlets of Oil Marketing Companies in 11 States/UTs.

Introduction

- E20 is a blend of 20% ethanol with petrol.
- The Government aims to achieve a complete 20% blending of ethanol by 2025, and HPCL and other oil marketing companies are setting up 2G-3G ethanol plants that will facilitate the progress.
- Any hydrocarbon fuel that is **produced from an organic matter** (living or once living material) in a short period of time (days, weeks, or even months) is considered a biofuel. Biofuels may be solid, liquid or gaseous in nature.

Significance of biofuels

- **Energy Security**: India is heavily dependent on imported fossil fuels to meet its energy needs. By promoting biofuels, India aims to reduce its reliance on fossil fuel imports, enhance energy security, and reduce vulnerability to fluctuations in global oil prices.
- **Greenhouse Gas Emissions Reduction**: Biofuels offer a more sustainable alternative by emitting fewer carbon dioxide (CO2) and other harmful pollutants during combustion. By promoting biofuels, India aims to mitigate climate change and achieve its emission reduction targets.
- **Agricultural Sector Development**: The production of biofuels relies on feedstocks derived from agricultural crops, residues, and waste. Biofuel production can provide additional revenue streams for agricultural communities and contribute to rural economic growth.
- **Waste Management**: Biofuels offer a potential solution by converting agricutlrual waste materials into usable energy sources. This not only helps address waste management issues but also reduces environmental pollution and promotes circular economy principles.
- **Air Quality Improvement**: The use of biofuels, such as biodiesel or bioethanol, in transportation can help reduce emissions of particulate matter, nitrogen oxides, and other pollutants. This can lead to improved air quality, resulting in better public health outcomes.
- **Renewable Energy Diversification**: Biofuels contribute to the diversification of India's energy mix, reducing dependence on fossil fuels and promoting renewable energy sources. By integrating biofuels into the energy sector, India can enhance the share of renewables.

What is ethanol blending?

- **Naturally Produced**- Ethanol is a biofuel, naturally produced by the fermentation of sugars by yeasts or by petrochemical processes like ethylene hydration.
- **Derived from agricultural products**- In ethanol blending, a blended motor fuel containing ethyl alcohol derived from agricultural products is blended with petrol specifically.
- **High in oxygen content**- Ethanol is high in oxygen content, allowing an engine to more thoroughly combust fuel.

About E20 fuel:

- The **number "20" in "E20"** refers to the **percentage of ethanol** in the gasoline blend.
- To simply put, the higher the number, the higher the percentage of Ethanol in the gasoline.
- India's current **ethanol-to-petroleum mix is 10%,** the highest it has ever been.
- Because it is made from biomass, ethanol does not require crude oil.
- Ethanol is primarily produced from crops such as **corn and sugarcane**.
- India already produces significant quantities of grain and sugarcane. It may allow automobiles to use a higher proportion of Ethanol.

Ethanol Blended with Petrol (EBP) programme:

- EBP programme was launched by the government in 2003 to promote the **use of alternative and environmental friendly fuels**.
- This intervention also aimed to **reduce import dependency** for energy requirements, and give boost to the agriculture sector (supply of straw, additional income to farmers).
- Oil marketing companies (OMCs) were **mandated to sell ethanol blended petrol** with percentage of ethanol up to 10 per cent. The government allowed procurement of ethanol produced from non-food feed stocks, like cellulosic and ligno-cellulosic materials, including petrochemical route.

Issues with biofuels

- **Land Use Change**: Large-scale cultivation of crops for biofuels can lead to land use change, including deforestation and conversion of natural habitats, which can have adverse environmental impacts and threaten biodiversity.
- **Food Security**: The use of food crops, such as corn, sugarcane, and vegetable oils, for biofuel production can affect food availability and prices.
- **Limited Feedstock Availability:** Relying heavily on traditional food crops for biofuel production can strain agricultural resources and may not be sustainable in the long term.
- **Water Resources**: The cultivation of water-intensive crops for biofuels can lead to increased water stress, depletion of water resources, and competition with other sectors, such as agriculture and domestic water supply.

Addressing these issues requires a holistic approach to biofuel development and implementation. It involves promoting sustainable feedstock, such as non-food biomass and waste materials, implementing robust land use regulations, ensuring water resource management, conducting life-cycle assessments to evaluate environmental impacts, and considering the social and economic implications of biofuel production.

Practice Question

Q. Biofuels contribute to the diversification of India's energy mix and reduce dependence on fossil fuels. Comment

3

ENVIRONMENTAL POLLUTION & DEGRADATION

1. AIR POLLUTION IN DELHI:

Context: India's national capital New Delhi is known for being one of the world's most polluted cities, with the problem getting particularly severe in the winter months.

Causes of sever air pollution in Delhi

- **Growing population of the city** -The pressure and haphazard growth of the population is deteriorating the environment.
- There has been **highly haphazard and unplanned development of industries and factor** Studies have revealed that only about 20% of the industrial units are set up in the approved industrial areas whereas the rest of them are in residential and commercial areas.
- There has been **a huge rise in the vehicular population,** despite the metro railways, aggravating traffic congestion and increasing air and noise pollution. It has also been reported that the number of vehicles plying on the roads of Delhi is more than that of the three metropolitan cities of Mumbai, Kolkata and Chennai taken together.
- There has also been an **ever-increasing number of diesel vehicles** plying on the roads, which are largely responsible for the air pollution.
- It has been reported by the National Environmental Engineering Research Institute (NEERI) that everyday almost **8,000 m tonnes of solid waste is be**ing generated in Delhi. Plus, we also have the **industrial hazardous and non-hazardous waste**. On an average, every day, the MCDs and the NDMC manage to clear about 5,000-5,500 m tonnes of garbage. This results in the accumulation of more and more garbage in the city.
- There has **been no proper technology or methods to treat solid**, liquid, waste water, industrial and hospital wastes in the city.
- There has been **too much dependence on fossil fuels** like coal-fired power plants, improper use of energy in buildings and the excessive use of biomass for cooking and heating, etc.

Major reasons for extremely poor Delhi air in winters

- **Burning of Crop Stubble** – Burning of crop residue by farmers in Northern states of Punjab, Haryana and Uttar Pradesh is considered as the prime reason for a spike in air pollution during the winter months in Delhi and NCR. This is a traditional practice followed by farmers in these states to prepare their fields for sowing crops after harvesting their fields.
- **Winter season** - As the winter season sets in, dust particles and pollutants in the air become unable to move. Due to stagnant winds, these pollutants get locked in the air and affect weather conditions, resulting in smog.
- **Burning crackers** - Despite the ban on cracker sales, firecrackers are usually a common sight every Diwali. It may not be the top reason for this smog, but it contributes to its build up.

Challenges due to Air Pollution

- Air pollution leads to **low birth-weight, tuberculosis, ischemic heart disease, cataracts, asthma and nasopharyngeal a**nd laryngeal cancers

- It might also affect c**ognitive development**.
- Air pollution is linked to diseases and **infections that kill around 600,000 children** under five years of age per year.
- The number of **premature deaths** due to outdoor air pollution is projected to increase from three million people globally in 2010 to a global total of six to nine million people in 2060.

Practice Question:

Q. Urban air contamination is a serious problem in many of the India's big cities.

Q. Examine the causes and consequences of increasing pollution in big cities and suggest effective measures and policy interventions to combat pollution and promoting sustainable urban development.

2. BLACK CARBON DEPOSITS ON HIMALAYAN GLACIERS

Context According to a research by scientists from NASA and Chinese Academy of Sciences, soot deposited on Tibetan glaciers has contributed significantly to retreat of the world's largest non-polar ice masses – the Himalayan glaciers.

About

- According to research, **black carbon deposits** on Himalayan ice **threaten earth's "third pole".** Tibet's glaciers are retreating at an alarming rate.
- **The study:** To better understand the role that black soot has on glaciers, researchers trekked high into the Himalayas to collect ice cores that contain a **record of soot deposition that spans back to the 1950s.**

Warming of Tibetan Plateau

- **Temperature increase:** Temperatures on the Tibetan Plateau – sometimes called Earth's "third pole" – have warmed by 0.3°C (0.5°F) per decade over the past 30 years, about **twice the rate of observed global temperature increases.**
- **The retreat of glaciers:** Fifty percent of the glaciers were retreating from 1950 to 1980 in the Tibetan region; that rose to **95 percent in the early 21st century.**

Black soot/Black carbon – details

- Black soot is generated from **industrial pollution, traffic, outdoor fires, and household burning of coal and biomass fuels.**
- Soot **absorbs incoming solar radiation** and can **speed glacial melting** when deposited on snow in sufficient quantities.
- Soot includes **black carbon**, as well as **organic carbon.**
- Black carbon results from **incomplete combustion of fossil fuels and biomass.**
- It is said to be the **second-largest contributor to climate change after CO2.**
- **Black carbon is short-lived** and remains in the atmosphere only for days to weeks before it descends as rain or snow.
- **India is the second-largest emitter of black carbon** in the world.

- **Black soot is the cause:** Black soot is responsible for as much as **half of the glacial melt**, and **greenhouse gases** are responsible for the rest.
  - During the last 20 years, the black soot **concentration increased two- to three-fold** relative to its concentration in 1975.

Reason for black carbon increase:

- **Black carbon,** which is **caused by incomplete combustion**, is especially prevalent in **India and China.** The main reason for the increase in black carbon in the region is **accelerated economic activity** in India and China over the last 20 years

Mechanism of black soot related warming:

- **Atmospheric aerosols** are tiny particles containing **nitrates, sulfates, carbon and other matter,** and can influence the climate. Unlike other aerosols, **black carbon absorbs sunlight, similar to greenhouse gases**.
- **It warms only the atmosphere.**
- **Deposition of the black carbon on a white surface**, which produces an **albedo effect that accelerates melting**. Dirty snow absorbs far more sunlight—and gets warmer faster—than pure white snow.

Other issues caused by black carbon increase:

- It contributes to the **decrease in rainfall over central India**.
- Because black carbon heats the atmosphere, it **changes the local heating profile**, which **increases convection**, one of the primary causes of precipitation
- While this results in more intense rainfall in some regions, it leads to less in other regions.

Practice Question:

Q. How are black soot and ash deposited on distant glaciers? What are the effects of soot & ash deposits on glaciers?

3. METHANE EMISSIONS

Context: The leaking of the Nord Stream natural gas pipeline under the Baltic Sea is the biggest single event that led to the massive release of climate-damaging methane.

Anthropogenic causes of methane emissions

- **Agricultural Emission:** Methane is emitted from **Paddy rice cultivation** – in **which flooded fields prevent oxyge**n from penetrating the soil, **creating ideal conditions for methane-emitting bacteria**. It accounts for another 8 per cent of human-linked emissions**.**
- **Livestock emissions: Methane is emitted from manure and gastro enteric releases, which accounts for roughly 32 per cent** of human-caused methane emissions. With growth in population, economic development and urban migration there is stimulated unprecedented demand for animal protein. This results into higher methane emissions.
- **Industrial sources of pollution and waste/Landfills:** Methane enters the atmosphere due to **leaks in oil and gas industries and the decomposition of waste in landfills** which emits the harmful methane gas.
- **Thawing of permafrost region-** Arctic methane release is the release of methane from seas and soils in permafrost regions of the Arctic. While it is a long-term natural process, methane release is exacerbated by global warming.

Natural causes

- **Wetlands, termites and the oceans**: With breakdown or decay of organic material it can be introduced into the atmosphere by either natural processes – such as the decay of plant material in wetlands, the **seepage of gas from underground deposits** or the digestion of food by cattle. Thus globally, approx. over 60% of total methane emissions come from human activities and 40% from human activities.
- **Arctic region:** The Arctic region is one of the many natural sources of the greenhouse gas methane. Large quantities of methane are stored in the Arctic in natural gas deposits and as undersea catharses.
- **Biomass burning:** Biomass burning, which includes forest fires, charcoal combustion, and firewood burning releases methane naturally.

The "Big deal" about methane emissions and its impact on climate change

- **Erratic weather phenomenon: Methane is naturally present in atmosphere to** keep global temperature balanced, however any further increase results in excessive warming of climate and **resultant erratic weather phenomenon**. The same applies to methane emissions as it has huge warming potential it contributes towards Climate change.
- **Human and environment health: The above tolerance limit concentration of methane in atmosphere wreaks havoc on human and environment health** by causing disturbance in production, food security, and environmental sustainability.
- **Ground level ozone: Methane is the primary contributor to the formation of ground-level ozone,** a hazardous air pollutant and greenhouse gas, exposure to which causes approximately 1 million premature death globally.
- **Affect the GHG**: The **presence of methane in the atmosphere can also affect** the abundance of other **greenhouse gases, such as tropospheric ozone, water vapor and carbon dioxide.**

Global/International and national efforts/policies to control and curb methane emissions

- **Global Methane Initiative (GMI):** It has aim of reducing barriers to the recovery and use of methane as a valuable energy source and givingcost-effective, near-term **methane abatement** and recovery and use of methane as a valuable energy source.
- **Global Methane Pledge**: **the Global Methane Pledge**, which was launched at COP26, aimed to catalyze action to reduce methane emissions.
- **India's reduction and control strategies: India's Ministry of New and Renewable Energy (MNRE) is investing heavily in a national strategy** to increase biogas production and reduce methane emissions. Further ICAR developed bovine feeds that both reduce methane belching and increase milk output.

Way forward

- **Rethink: The world needs to begin by "rethinking our approaches** to agricultural cultivation and livestock production." That includes leveraging new technology, shifting towards plant-rich diets and embracing alternative sources of protein.
- **Reduction:** New agricultural practices should be adopted to curb increasing methane concentration. **For example**, **Rather than continuous flooding of fields**, paddies could **be irrigated and drained two to three times throughout the growing season,** limiting methane production without impacting yield.
- **Livestock management:** Further Improved manure management and animal feed quality, Promoting farm-scale anaerobic digestion to control methane emissions from livestock.
- **Fossils and fuel based control measures:** Carrying out **pre-mining degasification** and recovery and oxidation of methane from ventilation air from coal mines. Further reducing the leakage **from long-distance gas transmission and distribution pipelines and Extending recovery and utilization from gas and oil production.**
- **Waste management:** Up-gradation of wastewater treatment with gas recovery and overflow, **control Improve anaerobic digestion of solid and liquid waste by food industry** bringing up gradation in primary waste water treatment would lessen the emissions.

Recognizing the importance of need to limit global warming and thus halving resultant changes in climate, dedicated efforts and awareness is **required in reduction and control of methane emissions in current agricultural and livestock managemen**t along with apt and targeted policy measures at global and national level.

Practice Question:

Q. Bringing out the natural and anthropogenic factors responsible for the Methane emissions, highlight the national and global initiatives to tackle the methane emissions.

4. CLIMATE INDUCED MIGRATION

Context: Recently, **International Institute for Environment and Development (IIED)** and **Anti-Slavery International** released a report named **Climate-Induced Migration and Modern Slavery.**

Increased Migration (major reasons):

- **Economic reasons:** People are being driven to migrate within and across borders in search of resources and income.
- **Climate change:** As many as 55 million people were internally displaced within their countries due to extreme weather events in 2020.

The **World Bank** estimates that, by 2050, the impact of the climate crisis, such as poor crop yields, a lack of water and rising sea levels, will force more than 216 million people across six region s, including sub-Saharan Africa, south Asia and Latin America, from their homes (Groundswell Report).

Impact (Modern Slavery):

- Climate change-induced extreme weather events put women, children and minorities at risk of modern slavery and human trafficking. The phenomenon is on the rise in India, among other countries.

- 40.3 million People are living under slavery in the world.
- Drivers of vulnerability to modern slavery are complex and impacted by many layers of risk. While several socio-economic, political, cultural and institutional risks shape vulnerability, they are increasingly considered to be made worse by climate change impacts and environmental degradation.
- **Increasing Inequality:** Climate change is devastating the planet, leading to intensifying global inequality as well as disputes over land, water and scarce resources.

Plight of Sundarban:

- The Sundarban region is characterised by intense, recurrent and sudden onset disasters, therefore millions of people across the Sundarbans are unable to work for most of the year. Severe cyclones and flooding in Sundarbans delta had also reduced the land for agriculture, which is the major source of livelihood.
- While restrictions were imposed by bordering countries, smugglers and traffickers operating in the affected region targeted widows and men desperate to cross the border to India to find employment.
- Women were trafficked and often forced into hard labour and prostitution, with some working in sweatshops along the border.
- People displaced and migrating from rural to urban areas with no resources, skills or social networks at their destination, are targeted by agents and / or traffickers.

SUGGESTIONS:

- **Recognise the Impact of Climate Change:** Climate and development policy-makers urgently need to recognise that millions of people displaced by climate change are being, and will be, exposed to slavery in the coming decades.
- **Committed Funding:** G 20 should commit to providing long-term funding to address anti-slavery efforts in the context of recurring displacement due to climate impacts.
- **Coordination of Ongoing Initiatives:** Several ongoing initiatives — including the **Warsaw International Mechanism Task Force on Displacement (WIM TFD), the Sendai Framework**, etc. — should be coordinated to increase understanding of, and response to, growing risks of climate-induced migration / displacement and exposure to modern slavery.

Practice Question:

Q. Human migration and mobility are age-old phenomena, but their triggers are fast changing due to deteriorating environment and ecosystems. Discuss.

5. DESERTIFICATION: 'DROUGHTS REDUCED INDIA'S GDP BY UP TO 5% IN 20 YEARS'

Context According to the **Drought in Numbers, 2022 report** released at the **15th Conference of Parties (CoP15) to the United Nations Convention to Combat Desertification (UNCCD),** the frequency and duration of drought is increasing at an alarming rate across the world since the onset of the 21st century.

Background

- According to **Desertification and Land Degradation Atlas of India**, released by the **Space Applications Centre of the Indian Space Research Organisation**, some 97.85 million hectares (mha) — nearly 30 per cent of India's total geographical area (TGA) — underwent land degradation during 2018-19.
- In 2003-05, 94.53 mha (28.76% of the TGA) underwent land degradation. This number increased to 96.40 mha (29.32% of the TGA) in 2011-13.
- The level of desertification increased in 28 of 31 states and Union territories between 2011-13 and 2018-19.
- In eight states—**Rajasthan, Delhi, Goa, Maharashtra, Jharkhand, Nagaland, Tripura, and Himachal Pradesh**—around 40 to 70 per cent of land has undergone desertification.
- Around 23.79% of the area undergoing desertification/land degradation in the country was contributed by **Rajasthan, Maharashtra, Gujarat, Karnataka, Ladakh, Jharkhand, Odisha, Madhya Pradesh and Telangana.**

What is Land degradation/Desertification?

- UNCCD defines desertification as "land degradation in arid, semi-arid and dry sub-humid areas resulting from various factors, including climatic variations and human activities"
- C**auses of Land degradation/Desertification:** Factors like deforestation, wetland drainage, overgrazing, unsustainable land-use practices, and the expansion of agricultural, industrial, and urban areas are the other significant causes of land degradation.

Impacts of land degradation	Measures to combat desertification
• Loss of soil fertility • Erosion • Impacting vegetation, soil quality & water table • Destructing the ecosystems • Economic loss • Leading to climate crisis • Impact on human health	• Terracing on hill slopes • Drip Irrigation • Contour binding • Dune stabilization • Cover crops • Climate-smart agriculture • Windbreaks

Practice Question:
Q. The cost of land degradation can be substantial in the case of India where agriculture is a large contributor to the country's Gross Domestic Product. Examine.

6. NUTRIENT DEFICIENCY IN SOIL

Context According to a report released by the **Centre for Science and Environment (CSE),** most Indian soils are deficient in organic carbon and macronutrients.

Key highlights of report:

- About 85 per cent of the samples were found to be deficient in **organic carbon**; 97 per cent samples were deficient in available **nitrogen**; 83 per cent were deficient **in phosphorus**; and 71 per cent in **potassium**.
- Soils were deficient in **micronutrients** as well: About 47 per cent, 39 per cent, 37 per cent and 36 per cent soil samples were deficient in **boron, zinc, iron and sulphur**
- At least **half of the soil samples** in 24 states and Union territories were **deficient in organic carbon.**
  - Of them, seven states have more than 90 per cent deficient samples.
  - Haryana's soils are the most deficient in organic carbon, followed by those of Punjab, Uttar Pradesh, Rajasthan, Tamil Nadu, Mizoram and Andaman and Nicobar Islands, in that order.
- As many as 27 states and UTs recorded nitrogen deficiency in over 90 per cent samples.
  - **15 states had nitrogen deficiency in almost all (99-100 per cent) of their samples.**
- In 2019, India was the second highest producer and consumer of chemical fertilizers in the world.
- **Chemical fertilizer consumption**: In 2020–21, the chemical fertilizer consumption in India, excluding single super phosphate (SSP), was 62.98 million tonne, with a growth of more than 82.5 per cent since 2000–01.
- **Carrier-based solid bio-fertilizers:** In 2020–21, India produced about 1,34,323 tonne of carrier-based solid bio-fertilizers.
- **Liquid bio-fertilizers**: In 2020–21, the total production of liquid bio-fertilizers in India was about 26,442 kilolitre (kl). This marked a growth of about 552 per cent over the 2014–15 figures.

Importance of fertilization for nutrient replenishment in soil:

- Crops extract nutrients from soil. Replenishment of nutrients is crucial if crop production is to continue in the long run.
- Soil replenishment can be done through several ways, for example, by recycling organic matter or biomass in soil or through practices that help regain and rejuvenate soil nutrients or by application of external fertilizers.

- Recycling of organic matter or biomass can be done through application of organic fertilizers and practices like growing green manure crops or mulching.
- Some other practices that help regain nutrients include crop rotation, inter-cropping and mixed cropping.
- Biofertilizers can enable nutrient mobilization and solubilization in soil. Chemical-based fertilizers directly provide nutrients to the soil.

Practice Question:
Q. The adverse impact of nutrient depletion in soils resulting from nutrient removal and fertilizer practices poses a significant threat to global food security, as it compromises soil quality and hampers the stability of crop yields. Discuss.

7. EMERGING HAZARDS OF RADIOACTIVE CONTAMINATION

Context: As per the latest data, **radioactive materials or contaminated devices** are entering into the booming scraps recycling chain, posing a grave health hazard.

About the data:

- **Released by**: The annual data on ***illicit trafficking of nuclear and other radioactive material*** released by the **International Atomic Energy Agency (IAEA).**
- For this database, participating members report **three groups of incidents**.
- **According to IAEA,**
  - **Group I** includes incidents that are, or are likely to be, connected with trafficking or malicious use
  - **Group II** covers incidents of undetermined intent
  - **Group III** accounts for incidents that are not, or are unlikely to be, connected with **trafficking or malicious use**
- The most common source of such contamination is the **feed material (in most cases, metal)** from which the product had been manufactured.

Radioactive waste and Pollution:

- Water and air contamination caused by radioactive elements is known as **radioactive pollution**. It can produce dangerous pollution if radioactive waste is not disposed of properly.
- Radioactive elements are naturally found in the earth's crust.
- **Uranium, thorium and actinium** are three NORM (Naturally Occurring Radioactive Materials) series that contaminate water resources.
- A small amount of radiation is found in all types of water but the extended amount of radiation is harmful to human health.

Note: Radioactivity in drinking water can be determined by **a gross alpha test.**

- Radioactivity is measured in **Becquerel (SI unit) or in Curie**. The unit Sievert measures the quantity of radiation absorbed by human tissues.

Sources of Radioactive waste generation:

- **Atmospheric Deposition of Cosmogenic Radionuclides:** Atmospheric deposition (both dry and wet) of **cosmogenic radionuclides** adds radioactive nuclei in the surface water.
  - Cosmogenic radionuclides are radioactive isotopes which are produced by natural processes and distributed within the Earth system.
- **Nuclear Reactors and Warheads: Nuclear reactors and nuclear warhead** experiments are the key sources of human-induced radionuclides discharge.
  - Nuclear reactors produce **radioisotopes (Cobalt-60, Iridium-192, etc.)** that hand out as sources of gamma radiation in radiotherapy and numerous industrial appliances.
  - Nuclear power plants placed at the coastal regions add to the radiological contaminants in the marine water by releasing atomic wastes.

- **Dumping of Radioactive Waste:** The application of radioactive elements in **nuclear weapons, X-rays, MRI and other medical equipment causes their exposure to human beings.** Dumping of these radioactive **wastes in surface water bodies causes water pollution.**
- **Mining:** Mining activities of radioactive elements like uranium and thorium also pollute surface and groundwater.

Health Impacts and concerns:

- **Radiation Syndrome:** Human tissues absorb radiation through polluted water and foodstuff, which can cause serious health risks. High doses of radiation can cause acute radiation syndrome or dermal radiation injury.
- **Disorders in Human Physiology:** Exposure to radiation causes various disorders in human physiology, including cancer, leukaemia, genetic mutations, cataracts, etc.
- **Mutation and Structural Alteration:** Genetic effects ionizing **radiation induces mutations in germ cells** (male sperm cells and female egg cells), resulting in **structural alteration in germ cell DNA** that are passed on to off springs. Hereditary disorders can lead to **premature death and severe mental illness.**

The Atomic Energy Act, 1962:

- The Act articulates India's resolve to pursue the development, control and use of atomic energy1 for the welfare of the people of India and for other peaceful purposes and for matters connected therewith.
- This Act confers on the Government of India, the powers and responsibilities for **framing of Rules and issuance of notifications for implementing the provisions of the Act.**
- **The powers and responsibilities include those for:**
  - Production, development, use and disposal of atomic energy / radioactive substances;
  - Control over radioactive substances or radiation generating plants in order to prevent radiation hazards, secure public safety and safety of persons handling radioactive substances or radiation generating plant and ensure safe disposal of radioactive wastes.

In accordance with these mandates, the **Central Government has promulgated** the;

- Atomic Energy (Radiation Protection) Rules, 2004
- the Atomic Energy (Working of the Mines Minerals and Handling of the Prescribed Substances) Rules, 1984
- the Atomic Energy (Safe Disposal of Radioactive Wastes) Rules, 1987
- the Atomic Energy (Factories) Rules, 1996
- the Atomic Energy (Radiation Processing of Food and Allied Products) Rules, 2012
- These laws formulate the policy and regulatory framework for **control of activities and for ensuring safety** in the activities relating to use of atomic energy.

Practice Question:

Q. What is Hazards of Radioactive Pollution? Evaluate the measures and regulations in place to mitigate radioactive pollution and suggest strategies for better management of radioactive waste to ensure long-term environmental sustainability.

8. STUBBLE BURNING

Context: Stubble burning in Punjab and Haryana is old but an important issue for the safety of the 'public health'.

Introduction:

- Stubble burning is a post-harvest practice used to clear fields of paddy crop residue by burning them.
- This practice mostly carried out in Punjab, Haryana and UP contributes solely to the grave winter pollution in the national capital.
- During milling of paddy about 78% of weight is received as rice, broken rice and bran. Rest 22%of the weight of the paddy is husk.
- For farmers, burning the residue becomes the easiest way of disposing it owing to lack of time, equipments and awareness.

Factors for Stubble burning

- **Paucity of time with farmers**: Paucity of time forces farmers to burn residue to clear the farms early for preparing them for sowing of wheat in the Rabi season.
- **Shortage of labour**: Mechanization and employment guarantee schemes like MGNREGA have led to shortage of farm labourers to carry on seasonal migration from UP and Bihar to Punjab and Haryana, as was prevalent earlier.
- **Inadequate technological support**: Availability, affordability and awareness regarding crop residue management machines like 'Happy seeder' and 'Super SMS attachment' is inadequate.
- **Lack of awareness**: Farmers in this region have a traditional belief that burning crop residue will restore nutrients back to the soil.
- **Changes in cropping pattern**: **Due to a slight shift in the cropping pattern in these** states, there is now very little time between the harvesting of one crop and the planting of the next crop.

Alternatives to Stubble Burning:

- **In-Situ Treatment of Stubble**: For example, crop residue management by zero-tiller machine and Use of bio-decomposers.
- **Ex-Situ (off-site) Treatment**: For example, Use of rice straw as cattle fodder.
- **Use of Technology**:
  - **Turbo Happy Seeder (THS) machine**, which can uproot the stubble and also sow seeds in the area cleared. The stubble can then be used as mulch for the field.
  - **Bio-Decomposer:** It accelerates the decomposition process of stubble by turning it into manure over a period of 15-20 days, thereby reducing the need to clear the fields of stubble by burning.

Impact of stubble burning:

- **Health**: Crop Residue Burning (CRB) has been identified as a major health hazard and a reason for breathing illness, irritation of eyes and respiratory tract diseases.
- **Air pollution**: Stubble burning releases toxic pollutants like **Methane, Carbon Monoxide (CO), Volatile organic compound (VOC)** in air. Also, it leads to spike in Particulate Matter levels, contributing between 12 and 60 per cent of PM concentrations.
- **Smog**: Clouds of ash and smoke from stubble burning can travel more than thousand kilometers aided by the Westerly winds coming from the Mediterranean region and create an obstinate and non-clearing clouds.
- **Soil nutrition**: Burning husk on ground destroys the nutrients like nitrogen, phosphorus, sulphur and potassium from the topsoil, making it less fertile. Heat generated by stubble burning penetrates into the soil, leading to the loss of the moisture and useful microbes.
- **Economic loss**: Crop residue holds high productive value in biofuel and fibre industry. Burning it deprives the farmers of higher economic returns.

Government steps

- **Penalty**: Crop residue burning was notified as an offence under the Air Act of 1981, the Code of Criminal Procedure, 1973 and various appropriate Acts. In addition, a penalty is being imposed on any offending farmer.
- **GRAP**: EPCA has rolled out the Graded Response Action Plan which includes efforts like banning construction activities, diesel generators, etc.
- **Technology**: Remote sensing technology, use of satellite imagery and a team comprising local officials has been deployed to monitor incidences of crop burning in the states of Punjab and Haryana.
- **Procurement**: Marketing and procurement of crop residue like husk is also being carried out in these states. Government should collaborate with cement, packaging, textiles, etc industries for husk/hull or stubble collection to use it proficiently.
- **Awareness**: Youth clubs, Kisan camps, radio and television campaigns have been started to spread awareness on scientific crop residue management. Trained cadres of agriculture scientists, assistants and workers can be deployed to create awareness clarify doubts about machines and disseminate information on residue procurement.
- **Subsidising machines**: Government has been providing subsidies ranging from 50-80% to farmers to buy crop residue disposal machines like happy seeders.

Thus, stubble burning is not a new and surprising phenomenon and has been occurring since decades now. Considering the predictability of occurrence of problem and available initiatives in place, tackling the issue is the urgent need of the day given its severe consequences and associated problems.

Practice Question

Q. Discuss the factors behind continuance of stubble burning in northern part of India. Also, suggest some measures to solve the issue of stubble burning.

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4

ENVIRONMENTAL GOVERNANCE

1. CARBON CAPTURE, UTILIZATION AND STORAGE (CCUS)

Context India's decisive march towards a sustainable future can be shaped by the adoption of **Carbon Capture, Utilization and Storage (CCUS) technology.**

Carbon Capture, Utilization and Storage (CCUS)

- Carbon capture and storage, also known as **CCS or carbon sequestration**, describes the technologies designed to tackle global warming by capturing CO2 at power stations, industrial sites or even directly from the air and permanently storing it underground.
- Carbon sequestration describes long-term storage of carbon dioxide or other forms of carbon to either mitigate or defer global warming.
- It has been proposed as a way to slow the atmospheric and marine accumulation of greenhouse gases, which are released by burning fossil fuels.

There are number of technologies under investigation for sequestering carbon from the atmosphere. Some of these are:

- **Ocean Sequestration***:* Carbon stored in oceans through direct injection or fertilization.
- **Geologic Sequestration***:* Natural pore spaces in geologic formations serve as reservoirs for long-term carbon dioxide storage.
- **Terrestrial Sequestration***:* A large amount of carbon is stored in soils and vegetation, which are our natural carbon sinks. Increasing carbon fixation through photosynthesis, slowing down or reducing decomposition of organic matter, and changing land use practices can enhance carbon uptake in these natural sinks.
- **Geologic Sequestration trapping mechanisms**
- Geologic Sequestration is thought to have the largest potential for near-term application.

Geologic Sequestration trapping mechanisms include:

- **Hydrodynamic Trapping**: Carbon dioxide can be trapped as a gas under low-permeability cap rock (much like natural gas is stored in gas reservoirs).
- **Solubility Trapping***:* Carbon dioxide can be dissolved into a liquid, such as water or oil.
- **Mineral Carbonation***:* Carbon dioxide can react with the minerals, fluids, and organic matter in a geologic formation to form stable compounds/minerals; largely calcium, iron, and magnesium carbonates.

Practice Question:

Q. What is carbon capture, utilization, and storage? Discuss the significance of Carbon Capture, Utilisation, and Storage as an emission reduction strategy to achieve deep decarbonization from the hard-to-abate sectors.

2. WIND PROJECT ADDITION TO PEAK BY 2024

Context: According to a report released by the **Global Wind Energy Council (GWEC) and MEC+** (a consulting firm that specialises in renewable energy), annual installation of new wind power projects in India will peak by 2024 and likely decline thereafter.

Introduction:

- As part of its transition away from fossil fuels, India has committed to sourcing half its electricity in 2030 from non-fossil fuel sources and installing 60 gigawatt (GW, or 1000 MW) of wind power by 2022. This showcases importance of the Wind power in the Indian energy scenario.

Wind energy and India

- India currently has 13.4 GW of prospective projects in wind energy, which are expected to drive installations until 2024 in the market.
- India is expected to add 3.2 GW in 2022, 4.1 GW in 2023 peaking to 4.6 GW in 2024, thereafter declining to 4 GW and 3.5 GW in the next two years, respectively.
- After 2024, fresh projects are likely to be wind-solar hybrid projects (where both systems are installed on a piece of land to generate power through the day).

Significance of wind power

- **Renewable energy transition:** Wind power is a crucial component of India's renewable energy transition. As the country aims to reduce its dependence on fossil fuels and mitigate the impacts of climate change, wind power offers a clean and sustainable source of electricity generation.
- **Securing Energy independence:** It offers a domestic and indigenous source of energy, promoting energy independence and reducing vulnerability to price fluctuations and supply disruptions in fossil fuel markets.
- **Mitigation of air pollution:** The use of coal for electricity generation and other fossil fuel-based activities contributes to high levels of air pollution and associated health hazards. Wind power, as a clean and emissions-free source of electricity, helps mitigate air pollution, improve air quality, and protect public health.
- **Potential for large-scale power generation**: India has a vast wind energy potential, particularly along its coastline, in hilly regions, and in some inland areas. Expanding wind power capacity can help harness this potential and contribute significantly to the country's overall electricity generation.
- **Economic growth**: The development, installation, operation, and maintenance of wind farms create jobs across various skill levels. The growth of the wind power industry also attracts investments, boosts local economies.
- **Decentralized energy:** Wind power projects, especially small-scale and decentralized installations, have played a crucial role in electrifying remote and rural areas of India. They provide access to electricity in areas where grid connectivity is limited or non-existent.

Limitations of wind energy

- **Intermittency and variability**: Wind energy production is intermittent and dependent on wind availability, which can vary over time and across locations.
- **Land and visual impacts**: Wind turbines require significant land area, and large-scale wind farms may result in land use conflicts, especially in densely populated areas
- **Noise**: Wind turbines can generate noise, especially at close proximity, which may cause disturbance to nearby residents.
- **Impacts on Environment**: the construction and operation of wind farms can have environmental impacts, such as bird and bat collisions, habitat disruption, and potential effects on local ecosystems.
- **Infrastructure and transmission challenges**: Building wind power infrastructure, including transmission lines, can face challenges related to land acquisition, permitting, and grid connection.
- **Technological limitations**: Technological limitations, such as the height and size of turbines, may pose challenges in areas with low wind resources or limited space for installation.

Way forward

To address these limitations and pave the way forward for wind energy, several strategies can be pursued:

- **Energy storage**: Investing in energy storage technologies, such as batteries or pumped hydro storage, can help mitigate the intermittent nature of wind energy and ensure a more stable power supply
- **Site selection and planning**: Careful site selection, considering wind resources, environmental impacts, and social acceptance, can minimize conflicts and optimize the performance of wind energy projects.

- **Technological advancements**: Continued research and development in wind turbine design, materials, and control systems can improve efficiency, increase power output, and reduce costs.
- **Policy support and market mechanisms**: Governments can provide long-term policy support, incentives, and stable regulatory frameworks to encourage investment in wind energy

Practice Question

Q. Discuss the role of the wind energy in achieving the energy security in India. Why India's wind potential still remains largely untapped?

3. GREEN INVESTMENTS AND SUSTAINABILITY

Context As the world aims to bring the **Greenhouse gas emissions** to sustainable levels by 2050 to prevent irreversible damage to the environment, the Companies have to work for **Environment, Social and Governance (ESG) factors** for making its impacts more sustainable in all aspects.

What are ESG Goals?

- **Environmental, Social, and Governance (ESG) goals** are a set of standards for a company's operations that force companies to follow better governance, ethical practices, environment-friendly measures and social responsibility. These includes:

Environmental	Social	Governance
Environmental is all about an enterprise focus and action leadership around energy usage, waste management, and natural resources conservation.	Social deals with an enterprise relationship and reputation with its employees, customers, stakeholders, institutions and the larger community.	Governance is all about how an enterprise manages with the proper management structure, executive compensation and ensuring stakeholder rights, especially employees, shareholders and customers.

ENVIRONMENTAL

Focuses on a company's environmental disclosure, envirionmental impact, and any efforts to reduce pollution or carbon emissions.

SOCIAL

Refers to the workplace mentality (e.g. diversity, management, human rights) as well as any relationships surrounding the community (e.g. corporate citizenship and philantrophy).

GOVERANANCE

Accounts for compensation, shareholder rights, and the relationship between shareholders and management.

- It focuses on **non-financial factors** as a metric for guiding investment decisions wherein increased financial returns is no longer the sole objective of investors.
- Ever since the introduction of the **United Nations Principles for Responsible Investing** (UNPRI) in 2006, the ESG framework has been recognised as an inextricable link of modern day businesses.

Europe has been a pioneer in ESG norms with some countries initiating ESG investment mandates.

India and ESG norms:

- ESG as a concept is not new to India.
- SEBI requires top **1,000 listed companies** to issue Business Responsibility and Sustainability Report that includes ESG concepts in its disclosures.
- India also has a **green bond market**, proceeds of which are used to fund renewable energy projects.

What Initiatives have been taken to Ensure ESG Compliance?

- **National Voluntary Guidelines:** One of the initial milestones towards identifying ESG disclosure requirements for companies was the release of **the National Voluntary Guidelines on Social, Environmental and Economic Responsibilities of Business (NVGs)** in 2011 by the **Ministry of Corporate Affairs (MCA).**
- **Business Responsibility Reports**: In 2012, the SEBI formulated the Business Responsibility Reports (BRR) which mandated top 100 listed entities (which was extended to top 500 listed entities in 2015) by market capitalization to file BRR as part of their annual report.
- **Business Responsibility and Sustainability Report:** In 2021, SEBI replaced the existing BRR reporting requirement with a more comprehensive integrated mechanism, the Business Responsibility and Sustainability Report (BRSR).
  - It will be mandatorily applicable to the top 1,000 listed entities (by market capitalization) from FY 2022-23 onwards.
  - The BRSR seeks disclosures from listed entities on their performance against the nine principles of the '**National Guidelines on Responsible Business Conduct'** (NGBRCs).

Persistent Challenges:

- **Lack of standardisation** of reporting requirements across borders pose difficulties in harmonising ESG principles, frameworks and considerations.
- **Lack of transparency**, consistency, and materiality of ESG standards pose roadblocks in the seamless implementation of ESG reporting framework ahead.
- **Requirement of high capital costs** and/or lack of expertise in implementing ESG measures.

Practice Question:

Q. As the world grapples with climate change and its consequences, it is important to recognise the need for climate change resilience with fiscal stability. Discuss

4. FLY ASH:

Context: **Spheroidal carbonaceous particles (SCP),** a component of fly ash, have been identified for the first time in an Antarctic ice core, according to a new study.

What is fly ash?

- Fly ash is a residue generated in combustion and comprises the fine particles that rise with the flue gases.
- Fly ash is a heterogeneous material. The main chemical components present in fly ash are:
  - Silicon dioxide
  - Aluminum oxide
  - Ferric oxide
  - Calcium oxide (occasionally)
- **Source:** Coal-fired power plants are the biggest sources of fly ash, which contains toxic chemicals such as **arsenic, barium, cadmium, nickel and lead**, among others.
- **Impact:** Without proper management, fly ash can pollute the waterways, ground water, drinking water, and air, posing a risk to humans, wildlife, and the environment.

What are the applications?

- In the commercial and industrial sectors, fly ash has a wide variety of applications and uses, though it is primarily known for improving the durability and workability of concrete mixes.

- Fly ash is also a filler in paints, adhesives, and metal and plastic composites.
- It's commonly used as structural fill for road construction and fly ash can be used to make bricks, ceramic tiles, plaster, Portland cement, and ready-mix cement.

India has over 200 coal power plants that generate an enormous amount of fly ash. According to the Central Electricity Authority, India's coal plants generated 232.56 million tonnes of fly ash in 2020-2021. Although 93 per cent of it was utilised, millions of tonnes accumulated over the years lie unused.

Amendments and Notification of Fly Ash Utilisation	
1999	Stipulated target for utilisation of fly ash produced at thermal plants
2003	Mandated the use of 100% fly ash by construction agencies in phased manner in five years until August 2007
2009	Revised and extended the timelines and period of implementaiton of achieving 100% utilisation in phased manner by 2014
2014	Mandated all thermal plants located more than 500 km away from a coal mine to use coal with ash content not exceeding 34%
2016	Extended the area within which fly ash can be ustilised from 100 km to 300 km. The time periiod to comply with 100% utilisation was again extended to 2017.
2019	Certain fly ash uses like mine filling, reclamation of low-lying areas and as soil conditioner in agriculture were prohibited under the environmental clearance (EC) condition for thermal powers plants. The 2019 amendment reserves such EC conditions in order to enhance utilisation.
2020	Did away with mandatory 34% ash content cap stipulated in 2014 notification
2021	Mandated 100% utilisation of ash in 'eco-friendly purposes" in a three-year cycle

Practice Question:

Q. Despite several policy and regulatory interventions, coal ash management in India remains a challenge. Critically examine.

5. HYDROPOWER IN INDIA: BALANCING GLOBAL CARBON BENEFITS WITH LOCAL ENVIRONMENTAL COSTS

Context The crisis in **Joshimath** has led to conversations on the relevance of hydropower in the Himalayan region. Two years ago, a glacier burst led to question marks over the Rishiganga hydroelectric project in Uttarakhand.

Background

- In 1947, hydropower capacity in India was about 37 percent of the total power generating capacity.
- In the late 1960s, growth in coal-based power generation initiated the decline in hydropower's share in both capacity and generation.
- In 2022, hydropower capacity accounted for roughly 7 percent of total capacity.

What is Hydropower?

Hydro electricity is the conversion of the mechanical energy in flowing water into electricity. Hydro electricity is generated when the force of falling water from dams, rivers or waterfalls is used to turn turbines, which then drives generators that produce electricity. The energy produced is directed to a substation, where transformers "step up" the voltage before its transmission to the electricity grid.

Increasing development of hydropower projects

- The Himalaya are a major water source for much of South Asia. Most countries in the region, including **India, China, Nepal, Bhutan, and Pakistan**, have built or are planning to build hydropower projects in the Himalaya.
- **India:** In India, the government has identified hydropower as a key renewable energy source.
  - Many hydropower projects are under construction or in the planning stages in the Indian Himalaya, including the **Subansiri Lower Hydroelectric Project** in Arunachal Pradesh and the **Teesta Low Dam Hydroelectric Project** in Sikkim.
- **Nepal** has also identified hydropower as a major source of energy. It has many hydropower projects in the planning and development stages, including the **Arun III Hydroelectric Project** and the **West Seti Hydroelectric Project.**
- **Bhutan:** In Bhutan, hydropower is the main source of revenue, and the government has set a target to export surplus electricity to India. The country has built several hydropower projects, including the **Chukha Hydropower Project and the Tala Hydropower Project**.

Declining Growth in Power generation from Hydro Station in past:

- **1947-1967:** Power generation from hydro stations grew by 11.8%
- **1967-1987:** Power generation from hydro stations grew by 5.6%
- **1987-2007**: Power generation from hydro stations grew by around 3%
- **2007-2019:** Power generation from hydro stations grew by under 1%

Impacts

- The Himalaya is a fragile ecosystem and home to a diverse range of flora and fauna. It is already threatened by deforestation, overgrazing, and construction activities that harm the environment and local communities that depend on it.
- The construction of dams can disrupt the flow of rivers, leading to changes in water temperature and chemistry.
- It can also cause erosion, landslides, and sedimentation which can have a negative impact on the local environment.
- Dams also disrupt the migration patterns of fish and other aquatic species and impact the local wildlife, particularly if the dam's construction leads to habitat loss.
- Large-scale hydroelectric dams displace local communities, affecting their livelihoods and cultural heritage and impacting the overall well-being of the local population.

The Alternative

Micro hydro is a small-scale hydroelectric power generation system that typically generates up to 100 kilowatts (kW) of electricity. These systems use the energy of falling water to turn a turbine, which, in turn, generates electricity. They can be used for various applications, including powering homes, businesses, and small communities.

Practice Question:

Q. With its steep topography and abundant water resources the Himalayas offer sustainable, low-carbon hydropower for energy-hungry South Asia. However, the mountain range falls in one of the world's most seismically active regions. Analyze the environmental implications and challenges associated with developing hydropower projects in this seismically active region.

6. GOVERNMENT PLANS TO DEVELOP INDIAN CARBON MARKET (ICM)

Context The **Union Ministry for Power** is going to develop a **Carbon Credit Trading Scheme (CCTS)** for decarbonisation in partnership with the **Ministry of Environment, Forests and Climate Change.**

What is the need?

Decarbonisation is the process of reducing or eliminating carbon dioxide (CO2) emissions from human activities.

- The government plans to develop the **Indian Carbon Market (ICM)** where a national framework will be established with the objective to decarbonise the Indian economy by pricing the **Green House Gas (GHG) emission** through trading of the carbon credit certificates.
- Even as an **Indian Carbon Market (ICM)** is being developed to decarbonize the economy and greenhouse gas (GHG) emissions are being priced through **trading of carbon credit certificates**, the CCTS will aim at enhancing India's energy transition efforts by **covering potential energy sectors.**
- The **Bureau of Energy Efficiency** under the **Ministry of Power** along with the **Ministry of Environment, Forest & Climate Change** are developing the **Carbon Credit Trading Scheme.**

What is the current system?

- Currently, India has an **energy savings-based market mechanism**.

What Indian Carbon Market (ICM) will do?

India's Climate Goals

As per the updated NDC, India now stands committed to reduce Emissions Intensity of its GDP by **45 percent by 2030**, from 2005 level and achieve about 50 percent cumulative electric power installed capacity from non-fossil fuel-based energy resources by 2030.

- The new avatar scheme will enhance the **energy transition efforts** with an increased scope that will cover the **potential energy sectors.**
- For these sectors, the GHG emissions intensity benchmark and targets will be developed, which will be aligned with **India's emissions trajectory** as per **climate goals.**
- The trading of carbon credits will take place based on the performance against these **sectoral trajectories.**
- **Voluntary mechanism:** Further, it is envisaged that there will be a development of a **voluntary mechanism** concurrently, to encourage GHG reduction from non-obligated sectors.
- The ICM will develop **methodologies** for the estimation of **carbon emissions reductions** and removals from various registered projects, and stipulate the required validation, registration, verification, and issuance processes to operationalise the scheme.
- **Monitoring, Reporting, Verification (MRV) guidelines** for the emissions scheme will also be developed after consultations.
- **Structure:** A comprehensive institutional and governance structure will be set up with specific roles of each party involved in the execution of the ICM.
- The ICM will mobilise new mitigation opportunities through demand for **emission credits** by private and public entities.
- **Significance:** A well-designed, competitive carbon market mechanism would enable the reduction of GHG emissions at the least cost, both at the level of entity, as well as the overall sector and drive faster adoption of clean technologies, in a growing economy like India.

Practice Question:

Q. Given India's current energy savings-based market mechanism, do you think the proposal to create the Indian Carbon Market (ICM) to decarbonise the Indian economy by pricing the Green House Gas (GHG) emission is an effective solution? Give reason in support of your answer.

7. G7 VOWS TO ZERO CARBON

Context Energy and environment ministers of the **Group of Seven** wealthy nations vowed to work to hasten the shift toward cleaner, renewable energy, but set no timetable for phasing out coal-fired power plants.

Key excerpts

- The **Group of Seven** industrialised nations, which also includes **Germany, Italy, Canada and the EU**, all target net-zero emissions by 2050 or sooner after signing the Paris Agreement to cap warming at well under 2 degrees Celsius, and ideally 1.5C.
- **Reducing carbon emission:** The leaders reiterated the need to urgently reduce carbon emissions and achieve a "predominantly decarbonized power sector" by 2035.
- **Phasing out fossil fuel:** The group is committed to accelerate the phase-out of unabated fossil fuels so as to achieve net zero in energy systems by 2050 at the latest.
  - But they offered no new deadlines beyond last year's G7 pledge.
- **Hydrogen and Ammonia:** The group recognised low-carbon and renewable hydrogen and its derivatives such as ammonia should be developed and used where they are impactful as effective emission reduction tools to advance decarbonisation.
- **Critical mineral:** The group is committed to maintain products containing critical minerals and raw materials in the economy as long as possible
- **Plastic pollution:** The group is committed to end plastic pollution, with the ambition to reduce additional plastic pollution to zero by 2040.

What Does Carbon Free Mean?

- In contrast to carbon-neutral, becoming carbon-free means directly reducing emissions to zero.
- **For Critical mineral**: example, if a country or company is carbon-free, all the energy and electricity comes from renewable sources, like wind or solar.

What is this move significant?

- The G-7 nations account for 40% of the world's economic activity and a quarter of global carbon emissions.
- Their actions are critical.

Practice Questions:

Q. In the light of the latest findings in a report by the Intergovernmental Panel on Climate Change (IPCC), highlight the need of "increased urgency" to reduce emissions.

8. GUIDING PERI-URBAN TRANSFORMATION

Context: The rural characteristics of many **peri-urban areas (PUAs)** adjoining large cities are undergoing a transformation with in-migration of population. The rapid urbanization of peri-urban areas across India requires targeted and planned intervention to allow cities to grow in a sustainable manner.

What are peri-urban areas (PUAs)?

- As the name indicates, peri-urban areas (PUAs) are areas at the periphery of cities.
- In India's PUAs, different forms of settlement structures can be found, such as hamlets, villages, urban villages, slums, unauthorized colonies, and census towns.
- In addition, numerous planned housing colonies and townships have come up in PUAs due to availability of vacant land.
- People who are unable to live in cities due to high living costs or non-availability of houses reside here.
- PUAs are inhabited by the native population that is engaged in agro-based activities, as well as migrants, who pursue non-farm interests.

How PUAs are transforming the region?

The transformation occurring in PUAs is seen in the form of:

- Increasing population densities
- Changes in land use and occupational patterns

- Reduced farmlands
- Growth of built structures (residential, commercial, institutional, and industrial)
- Many people living in PUAs benefit from this transformation
- There is exchange of knowledge and ideas
- New income generating activities come up

Fundamental problems observed in peri-urban areas:

When an **ecosystem's carrying capacity** is pushed to the limits, it is bound to be affected. This is exactly what is happening in several peri-urban areas of India. These areas are under tremendous stress due to pressures created by urbanization.

- **Indiscriminate conversion of land use:** Open spaces, green areas, and farmlands are reducing, with the coming up of built structures and non-farm economic activities.
- **Occurrence of unregulated development:** There is haphazard growth of built structures due to high demand. Many buildings do not meet safety norms.
- **Emergence of informal/unplanned slums in PUAs:**
- **Inferior quality of life:** In view of their illegal status, slums and unauthorized colonies remain uncovered by formal service delivery systems, such as water and sanitation.
- **Issue of drainage and Waste disposal:** While there is uncontrolled construction of built structures, no provision is made for drainage.
- **Women safety:** Frequent incidents of harassment reduce their ability to contribute to city life and limits opportunities available to them.
- **Population displacement:** At times, the so called 'unauthorized occupants' living in slums and unauthorized colonies are evicted due to implementation of government infrastructure projects, such as regional road/rail corridors.
- **Lack of access to good and reliable public transport:** Due to their peripheral location, many PUAs are not served properly by public transport.

Government Initiatives at state levels:

- In **Delhi**, the Development Authority's land pooling policy aims to ensure planned development in PUAs. At the regional level, some metropolitan regions have formulated spatial plans for PUAs.
- Amongst the states, the government of **Uttarakhand**, with support from the World Bank, has launched a water supply programme to improve access for peri-urban residents.
- Projects have been initiated in PUAs of **Dehradun, Roorkee, Haridwar, Haldwani**, etc.
- In **Haryana**, the government aims to introduce the concept of peri-urban agriculture for supplying essential commodities, such as fresh vegetables, fruits, milk, and fish, to residents in neighbouring cities. For this purpose, the Russian government has sought cooperation from Haryana.

At the national level:

- **Metropolitan Planning Committees** (MPCs) proposed under the Constitution (74thAmendment Act) are required to look into matters of common interest between municipalities and panchayats, including coordinated spatial plans of the metropolitan area, which includes PUAs.
- **The Ministry of Housing and Urban Affairs** (MoHUA) has requested state governments to take steps towards constituting municipalities in census towns, which are presently governed by rural governments to ensure better governance.
- **The Union Ministry of Agriculture and Farmers Welfare** (MoAFW) has taken steps to promote food production and diversification in PUAs to improve supply of food to cities.
- Under the **National Rurban Mission**, in the PUAs of Chhattisgarh, women have been empowered by way of training in activities such as handloom, bee keeping, poultry/pig rearing, amongst others. This has helped in employment generation.

Practice Question:

Q. Over the years, the influence of the city has spread to the peri-urban zones putting immense pressure on the agricultural land. Examine.

9. RIVER INTERLINKING PROJECTS: BOON OR BANE FOR INDIA

Context Environmental groups in Karnataka have criticised the project to link the **Bedti and Varada rivers** in Karnataka, calling it **'unscientific'** and a '**waste of public money'**.

This issue has aroused questions on several river interlinking projects across the country, and brought them under scrutiny.

What is Inter-linking of rivers?

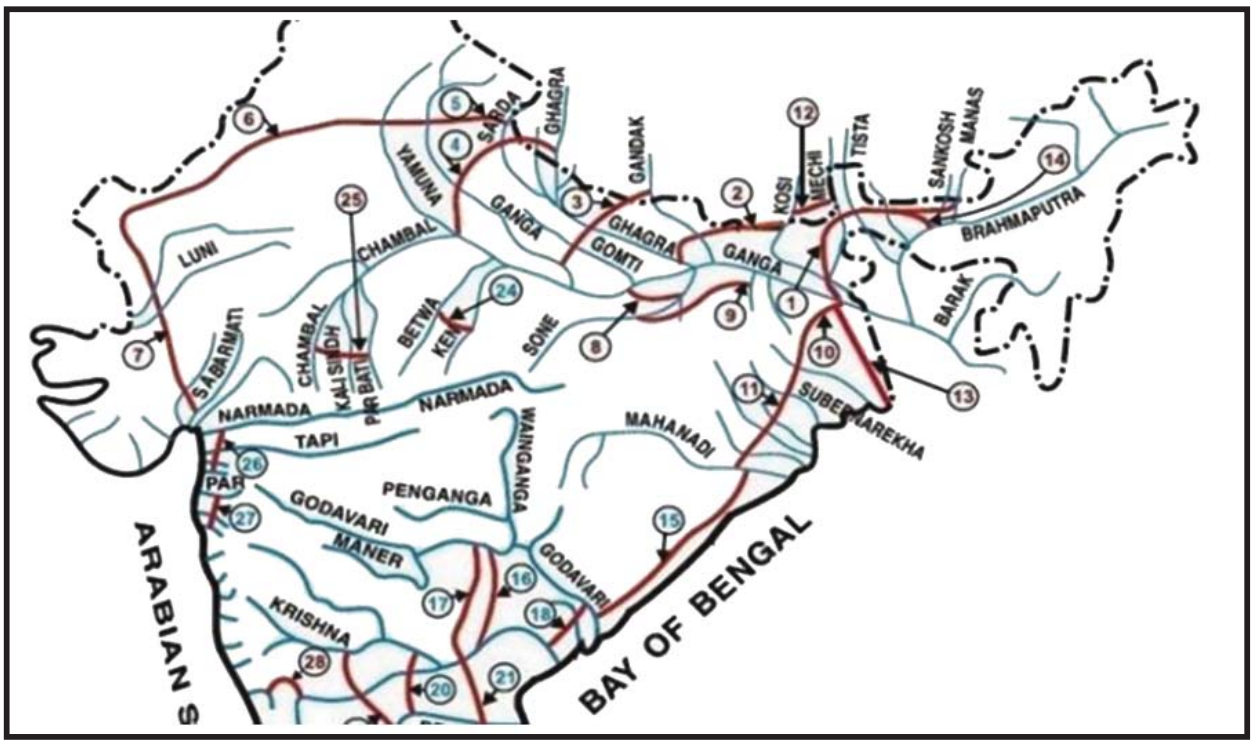
- **River Linking** is a project of linking two or more rivers by creating a network of manually created reservoirs and canals, and providing land areas that otherwise does not have river water access and reducing the flow of water to sea using this means.
- It is based on the assumptions that surplus water in some rivers can be diverted to deficit-river by creating a network of canals to interconnect the rivers.
- **Uses:**
  - For Irrigation purposes
  - flood control in the region
  - for Livelihood needs of locals
  - Building Dams for water conservation

What was the issue raised under 'Bedti- Varada river project'?

- The issue highlighted the government's planning of interlinking two opposite directional flowing rivers with each other that lack sufficient source of water in them.
- The investigating group has made allegation on government for using river interlinking project for their benefit and corruption, making profit to contractors, builders and wasting valuable resources in the region.

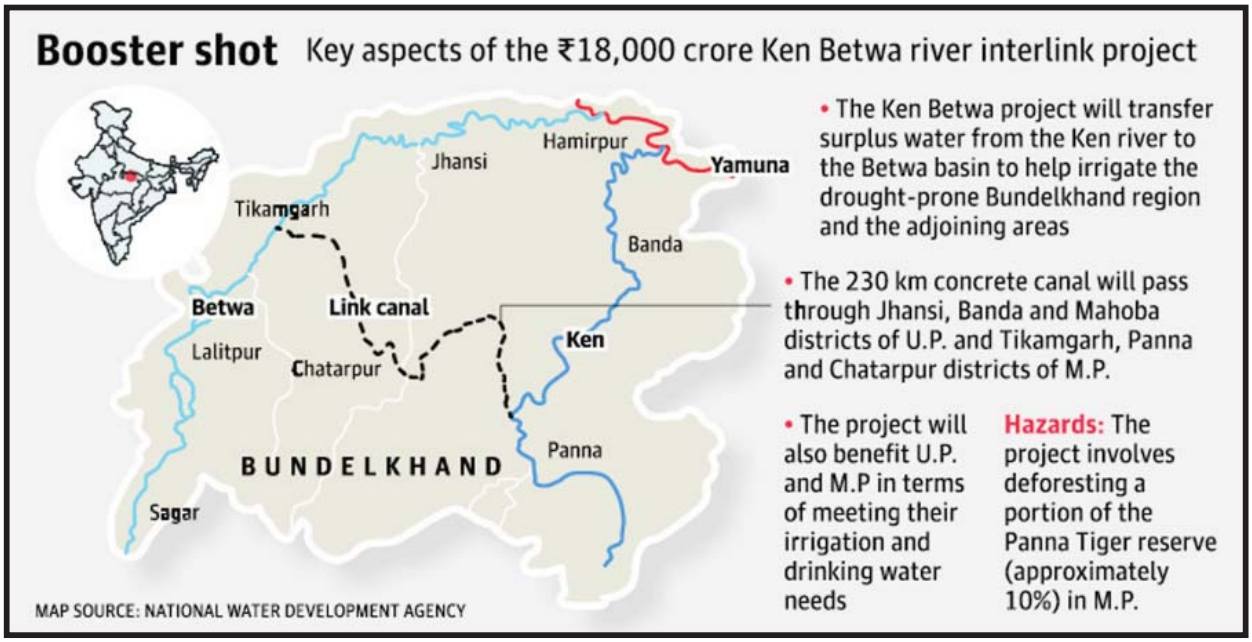
National River Linking Project (NRLP)

- NRLP, formerly known as the **National Perspective Plan**, proposes to connect **14 Himalayan** and **16 peninsular rivers** with 30 canals and 3,000 reservoirs to form a gigantic **South Asian Water Grid**.
- NRLP includes two components:
- **Himalayan component:** This component aims to construct storage reservoirs on the Ganga and Brahmaputra rivers, as well as their tributaries in India and Nepal. It will connect-
  - The Ganga and Brahmaputra basins to the Mahanadi basin
  - The Eastern tributaries of the Ganga with the Sabarmati and Chambal river systems.
- **Peninsular component**: It includes 16 links that propose to connect the rivers of South India. It envisages linking
  - The Mahanadi and Godavari to feed the **Krishna, Pennar, Cauvery, and Vaigai rivers**
  - The Ken river to the **Betwa, Parbati, Kalisindh, and Chambal rivers**
  - West-flowing rivers to the south of Tapi to the north of Bombay
  - Linking some west-flowing rivers to east-flowing rivers
- The NRLP is managed by **National Water Development Agency (NWDA)** under the **Ministry of Jal Shakti.**
- Recently, it has been reported that the Centre is deliberating on creation of a **National River Interlinking Authority (NIRA).**
- It will have powers to set up SPV for individual link projects.



What is the vision for interlinking river projects in India?

- As per the government, the project is needed to meet increasing water requirement in the country.
- **Core idea**: Overall, the NRLP envisions the **transfer of water** from **water 'surplus' basins** (perennial Himalayan rivers) where there is flooding to **water 'deficit' basins** (rain-fed peninsular rivers) where there is drought/scarcity, through inter-basin water transfer projects. **For example- The Ken-Betwa Linking Project.**



Are there previous examples of river-linking in India?

- In the past, several river linking projects have been taken up.
- Under the **Periyar Project**, transfer of water from Periyar basin to Vaigai basin was envisaged. It was commissioned in 1895.
- Similarly, other projects such as **Parambikulam Aliyar, Kurnool Cudappah Canal, Telugu Ganga Project**, and **Ravi-Beas-Sutlej** were undertaken.
- **Godavari River** has also been formally interlinked with the **Krishna River** at Ibrahimpatnam (near Vijayawada) in Andhra Pradesh in September 2015.

What are the advantages of interlinking Rivers?

- **Reduce dependence on Rainfall**
- **Used for Navigation**
- **For Agriculture purposes**
- **Power Generation**
- **Other benefits:**
  - **Water supply:** The project envisages a supply of clean drinking water amounting to 90 billion cubic meters. It can resolve the issue of drinking water scarcity in India.
  - Similarly, interlinking of rivers has the potential to provide 64.8 billion cubic meter of **water for industrial use**.
  - Apart from that, interlinking can help the survival of **fisheries**; **protect wildlife in the summer months** due to water scarcity. It can also reduce forest fires occurring in India due to climatic conditions.
  - India can also **explore an additional line of defence** in the form of waterline defence.

What are the challenges associated with River-Interlinking?

Despite the many benefits that are associated with the river interlinking project, the project is yet to take off because of the many hurdles it is facing. Some of the challenges in this regard are as follows:

- **Project feasibility**: There is a requirement of huge structures which requires a great engineering capacity. So, the cost and manpower requirement is immense.
- **Environmental impact**: The huge project will alter entire ecosystems. The wildlife, flora and fauna of the river systems will suffer because of such displacements and modifications.
- Many national parks and sanctuaries fall within the river systems.
- **Can lead to displacement**: Building dams and reservoirs will cause the displacement of a lot of people. This will cause a lot of agony for a lot of people.
- They will have to be rehabilitated and adequately compensated.
- **Myth of controlling floods**: There have been instances where big dams like Hirakud Dam, Damodar Dam, etc. have brought flooding to Odisha, West Bengal, etc.
- **Inter-state disputes:** River water has no boundary and flows across different states. Hence River water remains a matter of dispute between the states normally.
- Interlinking of those already disputed rivers can further worsen the situation between the states.
- **International disputes**: In the Himalayan component of the project, the effect of building dams and interlinking rivers will have an effect on the neighbouring countries. This will have to be factored in while implementing the project.
- Bangladesh has opposed the transfer of water from the **Brahmaputra to the Ganga.**

Practice Question

Q. River linking projects for the country are a great opportunity to address the water issues arising out of climate change.

Q. Do you think river interlinking is the most suitable way forward for water management in India? Critically examine.

10. RECYCLING HEAT GENERATED BY DATACENTRES

Context Global cybersecurity firm Kaspersky estimated that in winter, a datacentre can provide heating up to 85 degrees Fahrenheit, similar to a gas boiler, with better energy efficiency than a heat pump in a new house.

Background

- Microsoft has partnered with Fortum, a Finnish energy company to heat homes, services and businesses in Finland with sustainable waste heat from a new datacentre region that Microsoft has planned to build.

- The software giant claims the waste heat recycling concept from the datacentre region to be the world's largest scheme to recycle waste heat from data centres.
- The joint project takes place at the intersection of two megatrends: digitalisation and energy transition.

What is a datacentre?

- A datacentre is a physical facility that organizations use to
  - Store their critical applications and data
  - Process data
  - Disseminate them to users
- It is designed based on a network of computing and storage resources that enables delivery of shared applications and data.
- The key components of a datacentre are routers, switches, firewalls, storage systems, servers, and application-delivery controllers.
- Many large datacentres are located in dedicated buildings. Smaller datacentres may be situated in specially designed rooms within buildings constructed to serve multiple functions.
- Since datacentres consume large amounts of energy, it's important to ensure the physical structures that house them are well-designed and insulated to optimize temperature controls and energy efficiency.

How much heat datacentres generate?

- The temperatures recorded in the hot aisles of a datacentre hover between 80 and 115 degrees Fahrenheit.
- Global cybersecurity firm Kaspersky estimates over 75% of a datacentre's electricity becomes waste heat.
- It noted that in winter, a datacentre can provide heating up to 85 degrees Fahrenheit, similar to a gas boiler, with better energy efficiency than a heat pump in a new house.

Practice Question:

Q. Data centers account for about 1% of global electricity use annually, and emit enormous amounts of heat that generally goes unused. In the light of this statement, discuss the significance of recycling of waste heat as a sustainable tool for civilization.

11. ORGANIC AND NATURAL FARMING

Context: The Centre is planning to enhance the subsidy on "natural farming" by 50 per cent by re-launching the scheme on a mission mode in select blocks without hampering the food security.

Background

- **Bhartiya Prakritik Krishi Padhati (BPKP)** was introduced as a sub-scheme of Paramparagat Krishi Vikas Yojana (PKVY) in 2020-21 under which the Centre releases about ₹12,200/hectare for a period of three years for cluster formation, capacity building and continuous handholding.
- In the 2022-23 Budget both the BPKP and PKVY have been subsumed under Rashtriya Krishi Vikas Yojana (RKVY).

About

Organic Farming	Natural Farming
In organic farming, organic fertilizers and manures like compost, vermicompost, cow dung manure, etc. are used and added to farmlands from external sources.	In natural farming, neither chemical nor organic fertilizers are added to the soil. In fact, no external fertilizers are added to soil or given to plants whatsoever.

Organic farming still requires basic agro practices like ploughing, tilling, mixing of manures, weeding, etc. to be performed.	In natural farming, decomposition of organic matter by microbes and earthworms is encouraged right on the soil surface itself, which gradually adds nutrition in the soil, over the period.
Organic farming is still expensive due to the requirement of bulk manures, and it has an ecological impact on surrounding environments; whereas, natural agriculture is an extremely low-cost farming method, completely moulding with local biodiversity.	In natural farming there is no ploughing, no tilting of soil and no fertilizers, and no wedding is done just the way it would be in natural ecosystems.

Though the plan is to cover 6,672 blocks in the country in phases over a period of time with at least one cluster each, initially the focus will be on those areas which have been practising natural farming and there is potential to achieve the target at the earliest, sources said.

Significance:

- **Minimized Cost of Production:** It is considered as a **cost- effective farming practice** with scope for raising employment and rural development.
- **Ensures Better Health:** As Natural Farming **does not use any synthetic chemicals, health risks and hazards are eliminated.** The food has higher nutrition density and therefore offers better health benefits.
- **Employment Generation:** It generates employment **on account of natural farming input enterprises, value addition, marketing in local areas,** etc. The surplus from natural farming is invested in the village itself.
- **Environment Conservation:** It ensures **better soil biology, improved agro biodiversity** and a more judicious usage of water with much smaller carbon and nitrogen footprints.
- **Reduced Water Consumption:** By working with diverse crops that help each other and cover the soil to prevent unnecessary water loss through evaporation, **Natural Farming optimizes the amount of 'crop per drop'.**
- **Rejuvenates Soil Health:** The most immediate impact of Natural Farming is on the biology of soil—on microbes and other living organisms such as earthworms. Soil health depends entirely on the living organisms in it.

Practice Question:

Q. **Discuss the potential benefits and challenges of implementing organic and natural farming methods to ensure ecological balance and long-term agricultural sustainability.**

12. SUSTAINABLE FARMING

Context: A sustainable natural farming system adopted in **southern Rajasthan's Banswara district,** which has created new livelihood sources and brought food security to indigenous tribal communities, has impressed the **Chief Minister's Economic Transformation Advisory Council.**

What is Sustainable farming?

- **Sustainable farming** is farming in sustainable ways meeting society's **present food needs, without compromising the ability for current or future generations** to meet their needs.
- The basic goals of sustainable agriculture are **environmental health, economic profitability, and social and economic equity.**

Benefits of Sustainable Farming:

- **Contributes to Environmental Conservation:** Sustainable agriculture helps to **replenish the land as well as other natural resources such as water and air.**
- **Public Health Safety:** Sustainable agriculture **avoids hazardous pesticides and fertilizers**. As

a result, farmers are able to produce fruits, vegetables and other crops that are safer for consumers, workers, and surrounding communities.

- **Prevents Pollution:** Sustainable agriculture means that any waste a farm produces remains inside the farm's ecosystem. In this way, the waste cannot cause pollution.
- **Prevents Soil Erosion:** Our continued ability to produce adequate food has been a serious threat to soil erosion. Therefore, numerous practices have been developed to keep soil in place, which includes **reducing or eliminating tillage, managing irrigation to reduce runoff, and keeping the soil covered with plants or mulch.**
- **Reduction in Cost:** Sustainable agriculture lessens the overall costs involved in farming. **Smarter farming and moving food from farm-to-fork in a more efficient manner have helped everyone involved with the agriculture industry.**
- **Biodiversity:** Sustainable farms produce a wide variety of plants and animals, resulting in biodiversity. During **crop rotation, plants are seasonally rotated, and this results in soil enrichment, prevention of diseases, and pest outbreaks**.

Sustainable Farming Methods or Practices:

- **Make use of Renewable Energy Sources:** The use of **solar, hydro-power or wind-farms is ecology friendly.** Farmers can use solar panels to store solar energy and use it for electrical fencing and running of pumps and heaters.
- **Integrated pest management:** Integrated pest management is a combination of pest **control techniques for identifying and observing pests in the initial stages**. One also needs to realize that not all pests are harmful, and therefore it makes more sense to let them co-exist with the crop than spend money eliminating them.
- **Hydroponics and Aquaponics:** In these innovative farming techniques, **plants grow without soil and get nourished through specialized nutrients that are added to water**. In hydroponic systems, crops are grown with the roots directly in a mineral solution or with the roots in an inert medium like gravel or perlite. **Aquaponics combines the raising of aquatic animals (such as fish) with the growing of hydroponic crops.**
- **Crop Rotation:** Crop rotation is a tried and tested method used since ancient farming practices proven to keep the soil healthy and nutritious. Crop rotation has a logical explanation to it – the crops are picked in a pattern so that the crops planted this season **replenish the nutrients and salts from the soil** that were absorbed by the previous crop cycle. For example, row crops are planted after grains to balance the used nutrients.
- **Polyculture Farming:** It involves **growing multiple crop species in one area.** These species often complement each other, and greater diversity of products can be produced at one plot while fully utilizing available resources. High biodiversity makes the system more resilient to weather fluctuations, promotes a balanced diet and applies natural mechanisms for preservation of soil fertility.
- **Permaculture:** Permaculture is a food production system with intention, design, and **smart farming to reduce waste of resources and create increased production efficiency.** The focus is on the use of perennial crops such as fruit trees, nut trees, and shrubs that all function together in a designed system that mimics how plants in a natural ecosystem would function.
- **Avoid Soil Erosion:** Healthy soil is key to a good crop. Age-old techniques l**ike tilling the land, plowing etc. still work wonders. Manure, fertilizers, cover crops etc.** also help improve soil quality. Crop rotations prevent the occurrence of diseases in crops, as per studies conducted.
- **Agroforestry:** Agroforestry has become one of the **powerful tools of farmers in dry regions with soils susceptible to desertification.** It involves the growth of trees and shrubs amongst crops or grazing land, combining both agriculture and forestry practices for **long-lasting, productive, and diverse land** use when approached sustainably.
- **Natural Pest Eliminators: Bats, birds, insects etc. work as natural pest eliminators.** Farmers build a shelter to keep these eliminators close. Ladybugs, beetles, green lacewing larvae, and fly parasites all feed on pests, including aphids, mites and pest flies.

Practice Question:

Q. Given the current scenario, it is imperative to prioritize sustainable agriculture while ensuring a harmonious balance between economic gains and environmental sustainability. Discuss

13. GLOBAL CARBON BUDGET

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

Carbon budget framework

- India has neither historically emitted nor currently emits carbon anywhere close to what the global North has, or does, in per capita terms.
- If anything, the argument goes, it should ask for a higher and fairer share in the global carbon budget.
- There is no doubt that this carbon budget framework is an excellent tool to understand global injustice but to move from there to our 'right to burn' is a big leap.
- However, the question is do the countries in the global South necessarily need to increase their share in the global carbon budget?

Justification for continuing the dependence on coal

- The crux of the theoretical argument is that India needs to develop, and **development requires energy.**
- However, since India has neither historically emitted nor currently emits carbon anywhere close to what the global North has, it has no reason to commit to reduce dependence on coal at least in future.
- The argument is that it should ask for a **higher and fairer share in the global carbon budget.**

Why India doesn't/shouldn't need to depend on coal for its future energy requirements?

- **Alternative forms of energy**: Normally the argument in favor of coal is on account of its **cost**, **reliability,** and **domestic availability**. But a deeper analysis reveals the truth.
  - **Cost**: The recent data shows that the levelised cost of electricity from renewable energy sources like the solar (photovoltaic), hydro and onshore wind **has been declining sharply** over the last decade. It is already less than fossil fuel-based electricity generation.
  - **Reliability:** With technological progress, the reliability issues are being addressed by the frontier renewable tech.
  - **Domestic availability**: As for the easy domestic availability of coal, it is a myth. According to the Ministry of Coal, India's net coal import went up from ₽782.6 billion in 2011-12 to ₽1,155.0 billion in 2020-21. India is among the largest importers of coal in the world.
- **The abundance of renewable natural resources** in the tropical climate can give India a head start in this competitive world of technology.
- **South-South collaboration:** This type of collaboration can help India avoid the usual patterns of trade between the North and the South, where the former controls technology and the latter merely provides inputs.
- **Benefits of a greener development path**: The high-employment trajectory that the green path entails vis-à-vis the fossil fuel sector may help address the issue of surplus labor, even if partially. Such a path could provide decentralised access to clean energy to the poor and the marginalised, including in remote regions of India. So, it simultaneously addresses the issues of employment, technology, energy poverty, and self-reliance.
- **Arguing for burning more coal will make the situation worse** for developing countries like India. Due to its tropical climate and high population density along the coastal lines, India remains vulnerable to climate change. Hence, burning more coal is not the solution.
- **Moral high ground**: If the global south including India takes an independent and greener approach to development, then it affords it a moral high ground. This will allow developing countries to push for a more inclusive carbon budget framework, like **South Africa at Glasgow**. It'll force the global north to come to the table for negotiations on climate finance.

14. THE UN HIGH SEAS TREATY DRAFTED

Context: Recently a draft international agreement referred to as the '**UN High Seas Treaty'** was finalised to govern the conduct of governments in '**open seas'.**

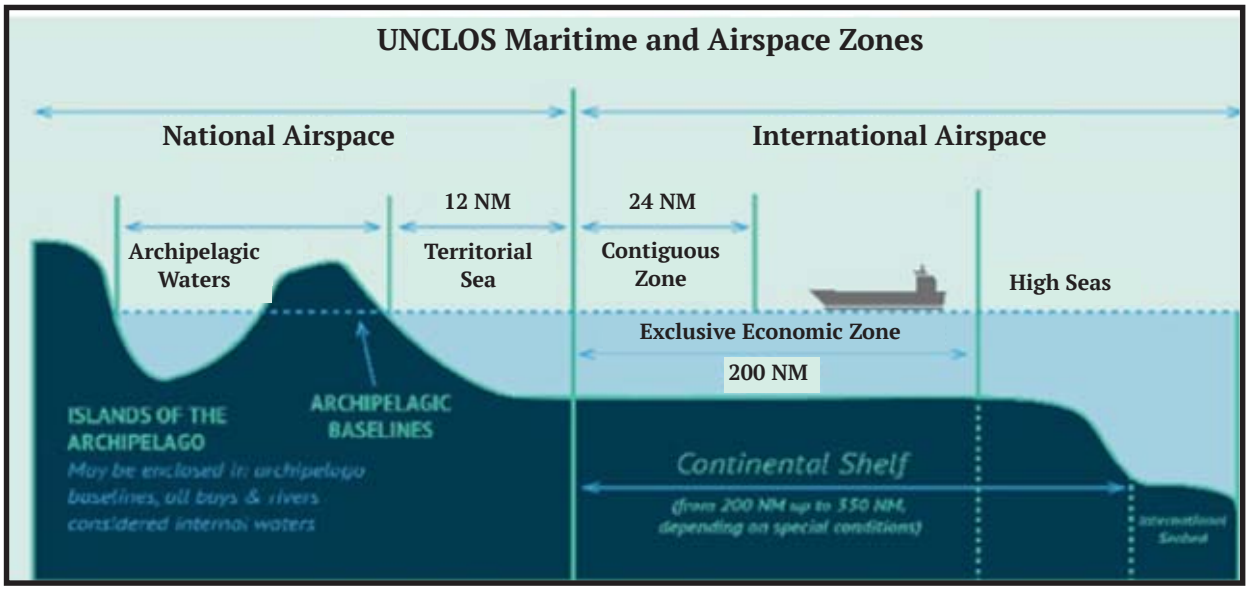
Background:

- The **UN general assembly** had decided to convene an **Intergovernmental Conference (IGC)** in December 2017 to elaborate on the text of the **legal instrument** for protecting biodiversity in areas **beyond national jurisdiction (BBNJ).**
- The IGC held **four formal sessions** in September 2018, March 2019, August 2019 and March 2022.
- The ambition of the treaty is to reverse the current downward trend in biodiversity and protect marine life, while also guaranteeing safe access to international waters.
- The treaty will help conserve biodiversity in areas beyond national jurisdiction (BBNJ) that lie outside countries' 322-kilometre exclusive economic zones.

Need of a universal Law:

The draft treaty was negotiated under the **United Nations Convention on Laws of the Sea (UNCLOS)** of 1982 which governs the **rights of countries regarding marine resources**. Till now, there was **no treaty** for conserving the open earth's oceans.

- **Biodiversity conservation**: The high seas are home to a rich array of marine biodiversity, including vulnerable ecosystems, unique species, and genetic resources. However, current regulations and mechanisms for protecting these areas are fragmented and insufficient.
- **Overfishing and depletion of fish stocks**: The high seas are subject to extensive fishing activities, often characterized by weak regulation and insufficient enforcement. This has led to overfishing, depletion of fish stocks, and ecosystem disruption.



- **Marine pollution and plastic waste**: The high seas are also subjected to pollution from various sources, including plastic waste, chemical runoff, and oil spills. Current efforts to combat marine pollution have primarily focused on national jurisdictions, leaving a regulatory gap in international waters.
- **Climate change and ocean acidification**: The high seas play a crucial role in regulating the Earth's climate and absorbing carbon dioxide. However, they are also highly vulnerable to the impacts of climate change, including rising temperatures, ocean acidification, and loss of biodiversity.
- **Technology and benefit-sharing**: The high seas hold potential for the development of new technologies, such as deep-sea mining and bioprospecting for genetic resources.

About the draft treaty:

- **Objective:** To ensure the **conservation and sustainable use** of marine biological diversity of areas beyond national jurisdiction through the Convention and to further **international cooperation**.
- The draft often mentions a **clearing-house mechanism** that will be a centralised platform to **enable parties to access, provide and give information on** activities taking place in relation to the agreement.

30 by 30 goals:

- This round of treaty negotiations comes on the heels of the adoption, by the U.N. Convention on Biological Diversity, of a target to protect 30% of Earth's land and coastal and marine areas by 2030.
- This agreement, known as 30 by 30, is intended to halt and reverse biodiversity loss to help put nature on a path to recovery.
- The new high seas treaty would enable protections that would contribute greatly to the 30 by 30 goal.

Key highlights of the Treaty:

- **The polluter-pays principle**: It means those causing pollution in a particular region are responsible for its reduction, such as a factory owner having to compensate for air pollution.
- **Building ecosystems' resilience** against adverse effects of climate change and ocean acidification, and also maintaining and restoring ecosystem integrity.
- **Parties should take legislative**, **administrative or policy measures** with the aim of ensuring that traditional knowledge associated with marine genetic resources in areas beyond national jurisdiction held by Indigenous Peoples and local communities shall only be accessed with their free, prior and informed consent.
- **Full recognition of the special circumstances of Small Island** developing States and of least developed countries; Acknowledgement of the special interests and needs of landlocked developing countries.
- Parties are to promote **international cooperation in marine scientific research** and in the development and transfer of marine technology.

Other Conventions related to Seas

- **Convention on Continental Shelf 1964**: It defines and delimits the rights of States to explore and exploit the natural resources of the continental shelf.
- **London convention 1972**: Its objective is to promote the effective control of all sources of marine pollution.
- **MARPOL Convention (1973)**: It covers pollution of the marine environment by ships from operational or accidental causes.

The treaty is significant in achieving the 30x30 target set at UN CBD (Convention on Biological Diversity) COP15 under which the countries agreed to protect 30% of oceans by 2030.

15. CIRCULAR PLASTIC ECONOMY

Context: Plastic waste is one of the most rapid-growing waste streams in municipal solid waste all over the world and India as well. The **unchecked flow** of the plastic waste into the environment has threatened the terrestrial and marine life adversely affecting humans, wildlife and their habitat. To restrict the ever increasing threat of plastic, the idea of **circular plastic economy** has come into prominence.

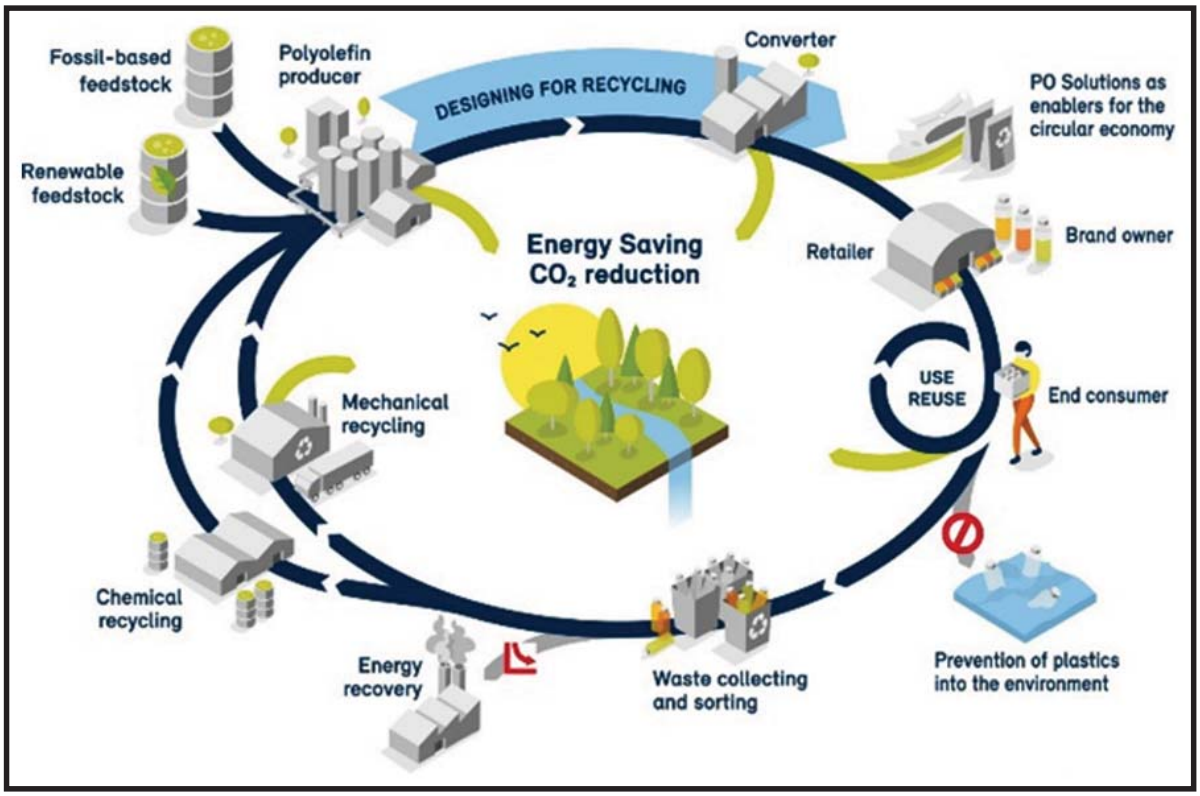
Circular plastic economy

In a circular plastic economy, plastics cycle through **a perpetual 'closed loop'**, rather than being used once and discarded. Thus, **extending the life cycle of plastic** and mitigating its harmful impacts on environment.

Significance of the circular plastic economy:

- **Economic benefits:** Research shows that the circular plastic economy offers huge economic opportunities by reducing waste, stimulating innovation and creating employment. **New business models** focused on reuse, remanufacturing and sharing models offer significant innovation opportunities.
- **Prevention of soil degradation:** The traditional practice of dumping plastics in the landfill sites results in **leaching of toxic chemicals** into the soils. Circular plastic economy reduces the waste generation and thus protecting the soils.
- **Protection of marine environment:** Plastic waste has accumulated in the oceans over the years creating gyres of marine debris ex. Great Pacific garbage patch, affecting the marine life in numerous ways. The flow of plastic into the ocean can be checked through a circular economy.

- **Limiting the air pollution:** Due to a lack of processing facilities, especially in the middle and low income economies, the plastic is disposed through burning in open releasing the toxic gas in the air. This can be checked through a circular plastic economy.
- **Creation of additional employment:** Additional jobs can be created by participation in the plastic value chain.



Challenges in plastic recycling in India:

- **Very high production of single use plastic:** The plastic consumption in India has grown at a significant pace over the past few years, and so has its waste output. This makes it difficult to keep track of the ever growing waste.
- **Low waste segregation at the source:** This is caused by poor implementation of rules and low awareness among the citizen. Lack of segregated waste makes recycling even more difficult. Some of the urban regions have taken lead to check the menace but majority of the tier 2 and tier 3 cities is yet to follow.
- **Capacity deficit and high informalization of the sector:** Collection of plastic waste at the local level is mostly **fragmented and informal** in India. Manual sorting of the waste makes the process inefficient. This coupled with **lack of capacity** is the reason for low levels of recycling of plastic in India.
- **Lack of proper expertise:** India lacks proper expertise because of developing status and low financial resources.

Measures taken by the government:

- **Plastic Waste Management Rules:** It mandates the generators of plastic waste to take steps to minimize plastic waste, prevent littering, and ensure waste segregation at source. The rules were amended in 2022 to include Extended Producer Responsibility (EPR) which puts responsibility on the producer for the environmentally sound management of the product.
- **Solid Waste Management Rules:** The Rules also focus on efficient disposal of municipal solid waste in sustainable manner.
- **Ban on single use plastic:** The government imposed **a ban on 'single-use plastics'** items ranging from straws to cigarette packets to combat worsening pollution in the country.

Conclusion

It is clear that the circular plastic economy is **indispensable** for fighting the challenge of plastic waste. The most efficient way to achieve that is by focusing primarily on the overarching **principle of the 3Rs**, "**reduce**," followed by "**reuse**" and then "**recycle**." Creating additional capacity, awareness generation

etc. are the ways to complement the efforts and to achieve the **SDGs** related to the environment protection like **climate action, life below water and lie on land**.

PYQ

Q. What are the impediments in disposing the huge quantities of discarded solid wastes which are continuously being generated? How do we remove safely the toxic wastes that have been accumulating in our habitable environment? (2018)

Practice Quesion

Q. What is the significance of the circular plastic economy for India? Also, highlight the challenges in plastic recycling in India.

16. ENVIRONMENTAL GOVERNANCE & THE CASE OF INDIA

Context: The Environmental crisis faced by India compels us to have relook at the Environmental governance in India.

Introduction:

- **Environmental governance** is a concept in political ecology and environmental policy that advocates **sustainability** (sustainable development) as the supreme consideration for managing all human activities— political, social and economic.
- It **views natural resources and the environment as global public goods**, belonging to the category of goods that are not diminished when they are shared. This means that everyone benefits from, for example, a breathable atmosphere, stable climate and stable biodiversity.

History of Environmental Governance in India:

- In the 1950s, the dominant view in the global environmental discourse was that ecological imbalances were caused by the **population explosion** in developing countries.
- The **National Planning Commission of India**: Its first task was to prepare **"Five-Year Plans" (FYP)** for fulfilling this intended aim. **In its nascent stage, the FYPs focused more on development rather than environmental management.**
- However, the **fourth FYP (1969-1974)** made special mention of the need for environmental protection, and it **stressed the importance of both environmental and economic concerns.**
- Incidentally, the history of environmental governance in post-independent India took a humble when the then Prime Minister, Indira Gandhi, returned from the United Nations (UN) Conference on Human, Environment and Development in Stockholm in 1972.
- A **National Environmental Planning and Co-Ordination Committee** was formed by the Prime Minister with **BP Pal (FRS).** In 1972, the **Central Pollution Control Board** was set up followed by the state boards. The **department of environment** came into existence on November 1, 1980, followed by state departments.
- She pushed through two laws **Wildlife (Protection) Act, 1972,** and **Forest Conservation Act, 1980**. The laws for dealing with water and air pollution — **The Water (Prevention and Control of Pollution) Act, 1974** and **Air (Prevention and Control of Pollution) Act, 1981** — were also enacted as the umbrella act of Environment protection (1986).

Case study: Inadequacy of Environmental Governance:

- In the aftermath of the **Bhopal Gas Tragedy in 1984**, environmental activism in India increased drastically. **This was a landmark event in the environmental history of India**.
- **This was one of the major factors contributing to the formation of The Environmental Protection Act of 1986** in tandem with the formation of a central authority: the Ministry of Environment and Forests (MoEF), now the Ministry of Environment, Forests and Climate Change (MoEFCC).
- This was followed by numerous legislations and acts to further strengthen environmental policy and law in India. Along with the previous policies, the MoEF also launched the **National Environmental Policy (NEP) in 2006.**

- In 1996, India became a nation to follow the environmental governance system with a series of further controlling notifications on coastal zone management, hill development, and disposal of wastes

(biomedical, plastic, hazardous). **Public Interest Litigation provided justice through the Supreme Court and high courts.**

Policy Principles for Environmental Protection:

- **The Polluter Pays Principle (PPP):** The Polluter Pays Principle, as interpreted by the Supreme Court of India, means that the absolute liability for harm to the environment extends not only to compensate the victims of pollution but also to the cost of restoring the environmental degradation.
- **The User Pays Principle—(UPP):** It is considered a part of the PPP. The principle states that all resource users should pay for the full long-run marginal cost of the use of a resource and related services, including any associated treatment costs.
- **The Precautionary Principle (PP):** Its objective is to ensure that a substance or activity posing a threat to the environment is prevented from adversely affecting the environment, even if there is no conclusive scientific proof of linking that particular substance or activity to environmental damage.

Key Environmental Issues and Challenges:

- The biennial global **Environmental Performance Index** report has consistently put India at the bottom of its rankings. We were an alarming **168th out of 180 countries in 2020**, faring badly on virtually all indicators of environmental health policy, biodiversity and habitat, air and water pollution and climate change.
- **Compliance**: It is hard to find an answer to a question on the extent of compliance with environmental laws. Measuring environmental compliance requires proper **recordkeeping and monitoring system**
- **Enforcement**: There is ample evidence to show that enforcement of environmental laws tends to act weak if the enforcement is not right. The lack of proper enforcement by the regulatory agencies further aggravates the problem.
- **Judiciary ignored:** More than two-thirds of the states/union territories in the country have neither bothered to comply with the orders passed by the Supreme Court nor complied with the directions given by the MoEF&CC.
- **Coal based power plants**: I**ndia has several rules and guidelines to control air pollution, but they aren't put to good use.** Coal-based power plants continue to be the major source of air pollution in the country as more than 300 coal thermal power plants still violate emission standards.
- **Co-ordinations issues**: SC pointed out that there was no effective coordination amongst various Ministries/institutions regarding the integration of environmental concerns.
- **Other problems**: Poor coordination across government agencies, weak institutional capacity, lack of access to information, corruption and stifled civic engagement are the key factors behind the poor effectiveness and implementation of environmental regulations.
- **Debilitating smog** : The **North Indian plains** and the National Capital Region are **engulfed in a debilitating smog** year after year. Yet, there has been a lack of concerted action to address this public health emergency.

Constitutional Provisions in India:

- **Article 48A** casts an obligation on the Indian State not only to protect but, more importantly, to improve the environment and to safeguard the forests and wildlife of the country.
- **Article 51A (g)** imposes a fundamental duty on the Indian citizen to protect and improve the natural environment, including forests, lakes, rivers and wildlife, and to have compassion for living creatures. Therefore, the duty to protect and enhance the quality of the environment in India is the duty of the Union, States and the citizens.
- **Article 253** empowers Parliament to make laws for implementing any treaty, agreement or convention with any other country/countries or for implementing any decision made at any international conference, association or other body.
- **Article 51(c)** mandates that the State shall endeavour to foster respect for international law and treaty obligations.

Two major and vital Indian environmental laws, namely, The **Air [Prevention and Control of Pollution] Act of 1981** and The **Environmental [Protection] Act of 1986,** have been enacted under these Constitutional provisions.

Environmental Governance in India

- **National Action Plan on Climate Change (NAPCC):** It presents a national policy aimed at enabling the country to adapt to climate change and improve India's ecological sustainability.
- **Nagar Van Yojana:** Ministry is implementing Nagar Van Yojana and revised its guidelines in October 2021 with an aim of developing 400 Nagar Vans and 200 Nagar Vatikas with the objective to significantly enhance the tree outside forests and green cover in cities.
- **Compensatory Afforestation Fund Management and Planning Authority (CAMPA):** CAMPA are meant to promote afforestation and regeneration activities as a way of compensating for forest land diverted to non-forest uses.
- **Combating the Land Degradation, Desertification and Drought**: India committed to achieving Land Degradation Neutrality and restoration of 26 million hectares of degraded land by 2030.
- **Extended Producer Responsibility (EPR) Portal for Plastic Packaging (CPCB)** for improving accountability, traceability, transparency and facilitating ease of reporting compliance to EPR Obligations by Producers, Importers and Brand-owners.

Conclusion:

Unless **implementation and enforcement are strengthened**, even rules that appear to be rigorous are destined to fail and the fundamental human right to a healthy environment will go unfulfilled. **We need to shift its focus from the development of policies and institutions to implementation and enforcement.**

Practice Question

Q. Various Environmental report have consistently kept India at the bottom of their rankings. In this context, discuss the issues faced by Environmental governance in India.

17. BIOTRANSFORMATION TECHNOLOGY

Context A UK-based start-up claims to have developed **Biotransformation technology** that can alter the state of plastics and make them **biodegradable** without leaving behind any **microplastics.**

Biotransformation:

Biotransformation is the process by which substances that enter the body are changed from hydrophobic to hydrophilic molecules to facilitate elimination from the body. This process usually generates products with few or no toxicological effects.

What is biotransformation technology?

- Biotransformation technology is a novel approach to ensure plastics that escape refuse streams are processed efficiently and broken down.
- The tech was co-developed by the Imperial College in London, UK, and a Britain-based startup, Polymateria.
- Plastics made using this technology are given a pre-programmed time during which the manufactured material looks and feels like conventional plastics without compromising on quality.
- Once the product expires and is exposed to the external environment, it self-destructs and biotransforms into bioavailable wax.
- This wax is then consumed by microorganisms, converting waste into water, CO2, and biomass.
- This biotransformation technology is the world's first that ensures polyolefins fully biodegrade in an open environment causing no microplastics.

Why do we need it?

- **Huge plastic waste**: the country is generating 3.5 billion kgs of plastic waste annually and that the per capita plastic waste generation has also doubled in the past five years. Of this, a third comes from packaging waste.
  - According to Statists, in 2019, plastic packaging waste from e-commerce firms was estimated at over a billion kilograms worldwide.

- **Freshwater and marine ecosystems as pollution**: Amazon generated nearly 210 million kgs of plastic from packaging waste in 2019. They also estimated that up to 10 million kgs of Amazon's plastic packaging ended up in the world's **freshwater and marine ecosystems as pollution** in the same year.

Applications:

- Food packaging and health care industries are the two prime sectors that could use this technology to reduce waste.
- "The increase in cost is relatively small compared to conventional plastic that does not contain" this technology.

Alternatives to reducing plastic waste:

- A switch to **jute or paper-based packaging** could potentially cut down plastic waste. This could also build sustainability within the paper industry, and save on the import bill on ethylene solutions.
- The **wooden packaging** is yet another alternative, but that will make the packaging bulkier and increase cost.
- Some other alternatives can be like coir, bagasse, rice and wheat bran, plant and agricultural residue, banana and areca leaves, jute and cloth.

18. LAB GROWN DIAMONDS AND ENVIRONMENTAL IMPACTS

Context: Traditionally, diamonds have been assessed based on the **four Cs: cut, color, clarity, and carat.** However, a fifth C, **Climate Neutrality,** is now emerging as a factor for judging diamonds

What are Lab-grown diamonds?

- Naturally-formed diamonds are **pure carbon, crystalised** in the isometric cubic form beneath the earth's crust.
- **Method:** Lab-grown diamonds (LGDs), on the other hand, are **manufactured in laboratories** with either of the two methods — **chemical vapour deposition (CVD) or high pressure, high temperature (HPHT)** using a **chemical composition**.
- **Duration:** It takes less than a month to make a distinctively-shaped crystal.

Status

- In India, the **share of lab-grown diamonds** in overall diamond business is presently just 2-3 per cent.
- In India, lab-grown diamonds are mostly used for jewelleries and exports.
- About 80 per cent of the cut and polished LGDs are exported, while only 20 per cent are consumed locally.

How environment-friendly are Lab-grown diamonds?

	Natural Diamonds	Lab-grown diamonds
Carbon Footprint	The process of mining natural diamonds involves significant energy consumption and carbon emissions	Lab-grown diamonds, on the other hand, require less energy and have a considerably lower carbon footprint. This is because they are produced in controlled laboratory environments using advanced technologies.
Ecological Disruption	Diamond mining often involves extracting large quantities of earth, leading to habitat destruction and ecosystem disruption.	Lab-grown diamonds eliminate the need for such environmentally harmful mining practices, minimizing ecological damage and preserving natural habitats.
Water Conservation	Mining diamonds typically requires extensive water usage for various purposes, including extraction, processing, and washing.	Studies and reports claim that 1 carat of a lab grown diamond can save upto 250 tonnes of land and gallons of water.
Pollution	Diamond mining can lead to pollution through the release of hazardous chemicals, sediment runoff, and soil erosion.	Lab-grown diamonds eliminate the associated pollution risks, as they are produced without the use of harmful mining practices, thereby reducing environmental contamination.

19. ENVIRONMENTAL IMPACT ASSESSMENT(EIA)

Context: With the **rise in developmental projects and emergent trend** of utilization of available resources and landscape for large projects, tourism etc. the need for **efficient EIA and adherence to its tenets** in project clearance has become more critical.

What is Environmental Impact Assessment (EIA)

- **Environmental Impact Assessment or EIA** is the process or study which predicts the effect of a proposed industrial/infrastructural project on the environment.
- It prevents the **proposed activity/project** from being approved without proper oversight or taking adverse consequences into account.
- **Under the Environment (Protection) Act, 1986**, India notified **its first EIA norms in 1994,** setting in place a legal framework for regulating activities that access, utilise, and affect (pollute) natural resources.
- The **1994 EIA notification was replaced with a modified draft in 2006.** Earlier this year, the government redrafted it again to incorporate the amendments and relevant court orders issued since 2006, and to make the EIA "**process more transparent and expedient."**

EIA: Core philosophy and precautionary principle

- **Estimation of impact: EIA** is basically about gauging or estimation of the '**Impact' any project, program, or policy may have** on the surrounding 'Environment,' during or after its implementation.
- **Balancing economic and environment goals: EIA** has evolved and become part of major developmental project requirements. It was first introduced as regulatory requirement to balance economic development and environment protection to minimize the impact.
- **The methodology adopted: Self-assessment by the project proponent** followed by review and project **approval by the regulators** created by law like state government, expert committees and Central government.
- **Evolution as precautionary principle of environmental jurisprudence:** It is a method to assess pro-cons on the environment and ecology prior to clearance is given to a project. **As precautionary principle it also advances the environmental justice**.
- **Foresee possible impacts: It aims to foresee the environmental impacts** in the preliminary phase of planning, discover strategies and provide the decision-makers with predictions and options.

How much Important EIA is?

- **Cost-effective method**: EIA provides a cost-effective method to eliminate or minimize the adverse impact of developmental projects.
- **Effect of developmental activities**: EIA enables the decision makers to analyse the effect of developmental activities on the environment well before the developmental project is implemented.
- **Mitigation strategies**: EIA encourages the adaptation of mitigation strategies in the developmental plan.
- **Sustainable development**: It is considered an effective tool to ensure sustainable developmental planning and minimize any irreversible or prolonged damage to the environment.
- **Environmentally sound policies**: EIA makes sure that the developmental plan is environmentally sound and within the limits of the capacity of assimilation and regeneration of the ecosystem.

Application of precautionary principle through EIA:

- **The SC in 2020 set aside the National Green Tribunal order issued by MoEFCC in 2002,** stating that **"Ex post facto" Environmental Clearance is not in compliance** with the primary principles of environmental jurisprudence. It said that the environmental law cannot approve/support the concept of ex post facto clearance.
- The **Supreme Court in the Vellore Citizen Welfare Forum's case** had laid the principle of the **"Polluter Pays"** principle which means the polluter has to pay substantial amount in accordance with damages it caused and amount required to mitigate those damages.
- In the case of **Common Cause v. Union of India (2017) SC held** the **granting of EC cannot be considered as a mechanical exercise**. It can only be permitted **after due diligence and care**, as damage to the environment can have long-lasting effects.

- **In Sterlite Industries ltd v UOI, The SC** discussed the **grounds on which grant of environmental approval can be challenged.** They are illegality, irrationality and procedural impropriety.
- In **another case SC held that the decision making shall not only be transparent but also must be arising out of a reasoned conclusion** which is reflective of due application of mind to the diverse conditions arising out of a project.

Case Study: Sethusamudram Ship Channel

All the ships from west to east and from Tuticorin Port to the east have to go round Sri Lanka entailing an additional distance of more than 254-424 nautical miles and 21-36 hours of additional sailing time.

The Ministry of Shipping in 1997, identified the Tuticorin Port Trust (TPT) as the nodal agency for the implementation of the Sethusamudram Ship Channel Project (SSCP).

The Tuticorin Port Trust retained National Environmental Engineering Research Institute (NEERI), Nagpur, India to conduct the EIA study for the project.

Public Concerns regarding the project:

- The Bombay Natural History Society (BNHS), the largest NGO working in the field of bio-diversity and environmental conservation in India, has said the EIA report prepared by the NEERI is insufficient and a detailed study should be conducted in all seasons for at least a year.
- The India Meteorological Department has assigned the Palk Bay area as a "high risk area" for volcanic and cyclonic activity, this fact has not been addressed at all.

Environmental impact assessment (EIA) has evolved and become part of major developmental project requirements in many countries including India. The significance and relevance of EIA are often **subjected to** congenialities of **economic development and ecological values.**

The adherence shall be on **main objective** of protecting the **environment and also to achieve an alternative objective** that focuses on the convenience of carrying out a business with ease and serving developmental needs.

Practice Question

Q. Critically evaluate the Environmental Impact Assessment (EIA) as Precautionary Principle of Environmental jurisprudence in India.

5

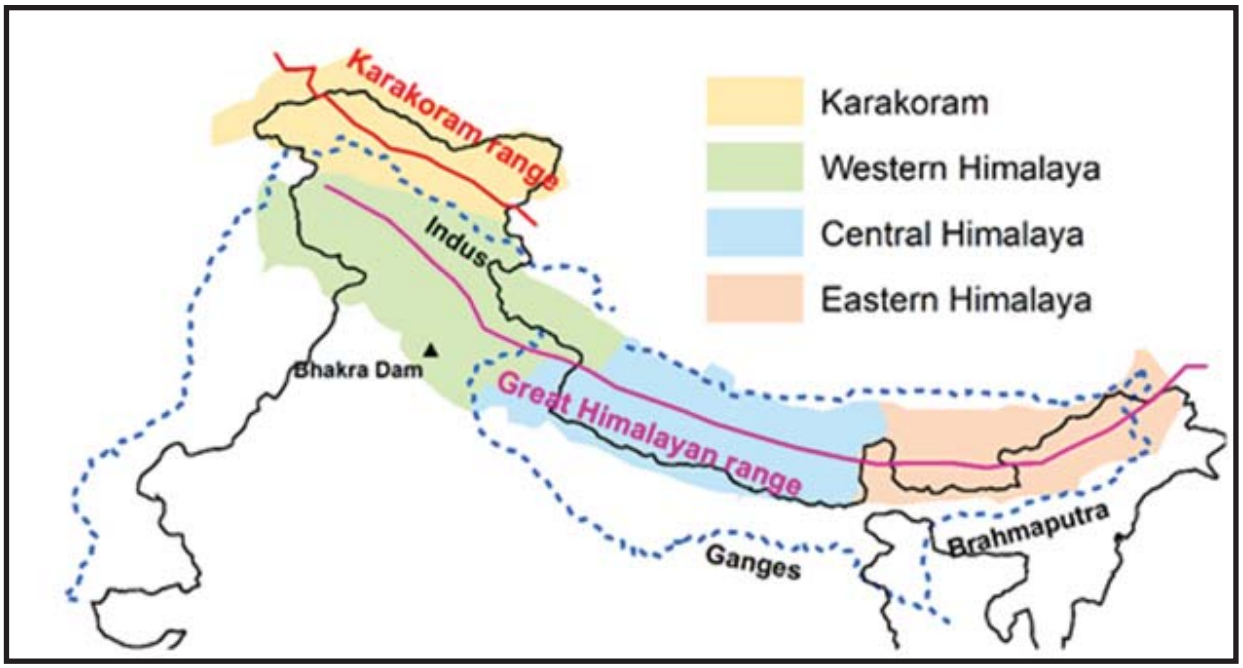
CLIMATE CHANGE

1. JOSHIMATH: THE SINKING LAND

Context Joshimath, the ancient Uttarakhand town has become a cause of concern. The sinking has against highlighted the vulnerability of the Himalayan ecosystem

The Himalayan ecosystem:

- The Himalayas are ecologically **fragile and economically** underdeveloped, with geo-environmental constraints imposing severe limitations on the level of resource productivity.
- Consequently, subsistence agriculture constitutes the main source of livelihood in the region.
- The rapid growth of tourists in the region has brought about extensive land-use changes in the region, mainly through the extension of cultivation and large-scale deforestation.
- This irrational land transformation process has not only disrupted the ecological balance of the Himalayan watersheds through reduced groundwater recharge, increased run-off and soil erosion, but has also adversely affected the ecology and economy of the adjoining Indo-Gangetic plains by recurrent floods and decreased irrigation potential.



Recent disasters in the region:

- In last ten years, two major earthquakes have occurred in Uttaranchal namely the Uttarkashi earthquake (1991) and the **Chamoli earthquake (1999).**
- 380 people were killed when massive landslides washed away the whole village Malpa, Uttaranchal (then Uttar Pradesh) in 1998.

- In 1999, forest-fires in the hills of Uttaranchal destroyed more than 3, 75,000 hectares of forest. The same year, more than 450 cases of forest fire were reported in Himachal Pradesh and by May 1999, more than 80,000 hectares of forests were turned to ashes.
- The Kedarnath floods in 2013, had took lives of several innocent people and disaster in the region

Why Himalayan region is susceptible to disasters?

The Hindu Kush Himalayan region is prone to numerous types of disasters because of its

- Steep terrain
- fragile geology
- intense and variable precipitation
- Common incidents of floods and landslides
- neo-tectonic mountain-building process, like earthquakes, landslides, floods, etc
- **Other factors:**
  - **Overexploitation of the ecosystem**(tourism, increased consumerism)
  - **Exploitative development projects:** The indiscriminate exploitation of the fragile Himalayan region in the name of development projects has extracted a heavy price in terms of environmental damage.
  - **Fragmentation of natural resources:** String of hydroelectric and road projects in the Himalayan States have already resulted in the fragmentation of natural systems.

Sustainable tourism in Himalayas: Recommendations

- **Regulated tourism practice**: There is need to establish regulated tourism practices with promotion of sustainable agendas for the Indian Himalayan region (IHR).
- Also, there is need of maintenance of proper tourist capacity in every tourist place.
- **Vigilance and patrolling**: Protected areas require vigilance and regular patrolling to reduce unwanted wildlife-tourist interaction as well as habitat destruction due to off-road driving and encroachment.
- **Early Warning System:** It is important to have early warning and better weather forecast systems in order to forecast the disaster and alert the local population and tourists.
- **Regional Cooperation**: There is a need for a trans-boundary coalition of Himalayan countries to share and disseminate knowledge about the mountains and preservation of the ecology there.
- **Area Specific Sustainable Plan**: What is most critical is to review the area's present status and draw up a sustainable plan that respects the specific requirements of this fragile region and the impact of the climate crisis.
- **Promote Ecotourism**: Initiating a dialogue on adverse impacts of commercial tourism and promoting ecotourism.

Practice Question:

Q. The combination of climate change and poorly executed human activities in the Himalayas has amplified the susceptibility of the hilly regions to disasters, leading to a significant rise in the destruction of both property and human lives.

2. WORLD LIKELY TO BREACH 1.5C CLIMATE THRESHOLD BY 2027: WMO

Context The world is almost certain to experience new record temperatures in the next five years, and temperatures are likely to rise by more than 1.5C above pre-industrial levels, scientists have warned.

Key-highlights of the Report

- The report found there was a 66% likelihood of exceeding the 1.5C threshold in at least one year between 2023 and 2027.
  - For each year from 2023 to 2027, the global near-surface temperature is predicted to be between 1.1C and 1.8C above the pre-industrial average, taken from the years 1850 to 1900.

Previous breaches: Global average surface temperatures have never before breached the 1.5C threshold. The highest average in previous years was 1.28C above pre-industrial levels.

- **Heat waves:** New record temperatures have been set in many areas around the world in the heatwaves of the past year, but those highs may only be the beginning, as climate breakdown and the impact of a developing El Niño weather system combine to create heatwaves across the globe.
- **El Niño and La Niña:** El Niño is part of an oscillating weather system that develops in the Pacific. For the past three years, the world has been in the opposing phase, known as La Niña, which has had a dampening effect on temperature increases around the world.
- As La Niña ends and a new El Niño develops, there is a 98% likelihood that at least one of the next five years will be the hottest on record, the scientists found.

How would it impact?

- This will have far-reaching repercussions for **health, food security, water management and the environment.**
- There is likely to be less rainfall this year in the **Amazon, Central America, Australia and Indonesia.**
  - That could have calamitous consequences for the planet, which relies on rainforests as **massive carbon sinks.**

2015 Paris Climate Agreement

Countries have pledged, under the 2015 Paris climate agreement, to try to hold global temperatures to no higher than 1.5C above pre-industrial levels, after scientific advice that heating beyond that level would unleash a cascade of increasingly catastrophic and potentially irreversible impacts.

Way Forward

This November, governments will meet for the Cop28 UN climate summit, where they will assess progress towards meeting the goals of the Paris agreement. Known as the "global stocktake", this assessment is likely to show that the world is far off track to reduce greenhouse gas emissions by the 43% this decade that is required to have a good chance of limiting temperature rises to 1.5C.

Practice Question:
Q. How does climate change affect the strength and frequency of extreme weather events?

3. THREATS TO CORAL REEFS:

Context: Recently, coral reefs are facing new threats due to rising marine heat waves.

Coral bleaching

- When corals are stressed by changes in conditions such as temperature, light, or nutrients, they expel the symbiotic algae living in their tissues, causing them to turn completely white.
- Warmer water temperatures can result in coral bleaching. When water is too warm, corals will expel the algae (zooxanthellae) living in their tissues causing the coral to turn completely white. This is called **coral bleaching.**
- When a coral bleaches, it is not dead. Corals can survive a bleaching event, but they get under more stress and are subject to mortality.
- There have been instances when cold water conditions have caused coral bleaching-like in 2010, cold water temperatures in the Florida Keys caused a coral bleaching event that resulted in some coral death. Water temperatures dropped -6.7 degrees Celsius lower than the typical temperatures observed at this time of year.

About

- Corals are **invertebrate animals** belonging to a large group of colourful and fascinating animals called **Cnidaria.**
- **Polyp:** Each coral animal is called a **polyp**, and most live in groups of hundreds to thousands of genetically identical polyps that form a 'colony'.

- **Colony:** The colony is formed by a process called budding, which is where the original polyp grows copies of itself.
  - These polyps have microscopic algae called **zooxanthellae** living within their tissues. The corals and algae have a **mutualistic relationship.**
    - The coral provides the zooxanthellae with the compounds necessary for photosynthesis.
    - In return, the zooxanthellae supply the coral with organic products of photosynthesis, like carbohydrates, which are utilized by the coral polyps for the synthesis of their calcium carbonate skeletons. Zooxanthellae are responsible for the unique and beautiful colours of corals.

Causes of coral bleaching

- **Warm Sea Temperature:** Coral species prefer to live in waters close to the warm temperatures which they can tolerate but a slight increase in ocean temperature can harm corals. Events like El Nino and marine heatwaves increase the sea temperature and destroy coral reefs.
- **Extreme low tides:** Extreme events of low tides exposes the corals to solar and ultraviolet radiations which can induce coral bleaching.
- **Ocean Acidification:** Oceans are the carbon sinks, but more carbon dioxide increases the acidity of the ocean. This increase in the acidity of ocean water inhibits the coral's ability to create calcareous skeletons, which is essential for their survival.
- **Diseases:** Species of bacteria like *vibrio shiloi* inhibits the photosynthesis of zooxanthellae. These bacteria become more potent at higher sea temperatures.
- **Ocean Pollution:** The increasing nutrient concentrations leads to excessive phytoplankton growth, and attracts more and more marine life, which may cause strain on the reefs.
- **Sedimentation:** High rates of land erosion causes silt and other sediments to leach into ocean waters which causes sedimentation and water turbidity. The siltation tends to smother corals and turbidity reduces light availability potentially reducing coral photosynthesis and growth.
- **Anthropogenic threat:** Over-fishing, pollution from agricultural and industrial runoff, coral mining, development of industrial areas near coral ecosystems have adverse impacts on coral reefs.
- **Predators:** Acanthaster planci, also known as Crown-of-Thorns Starfish, eats corals during the night. They may destroy the entire coral reefs if found in huge numbers.
- **Plastic pollution:** 8 million tonnes of plastic rubbish enters the world's oceans every single year. Such plastic is now found in all corners of the ocean, from the deepest – the Marianas Trench – to sea ice and coral reefs. Many discarded plastic is broken down into what is known as micro plastics, tiny pieces that are mistaken by coral polyps as food and ingested.

Practice Question:

Q. As global efforts to mitigate greenhouse gas emissions continue, there arises a pressing imperative to enhance the resilience of coral reefs and facilitate their adaptation to the escalating temperatures resulting from climate change. Discuss.

4. HEAT STRESS MORE DANGEROUS TO CORALS THAN OCEAN ACIDIFICATION

Context Global warming poses a more significant threat to coral growth and reef accretion than ocean acidification (OA), according to a new study.

How heat stress affects corals more than ocean acidification?

- Ocean acidification slows the rate at which coral reefs generate calcium carbonate, thus slowing the growth of coral skeletons.
- Heat stress directly affects coral performance in hospite exacerbation of light stress in the symbionts, whereas ocean acidification induces moderate effects on coral metabolism, some of them even positive.
- As temperatures rise, mass coral bleaching events and infectious disease outbreaks are becoming more frequent.

Role of corals:

- Corals are animals. Coral reefs boost biodiversity, buffer storms and support the livelihoods of over one billion people.
- Coral reefs do not absorb carbon and do not play a direct role in climate change mitigation. However, they are important for climate adaptation.
- In the last decade, the world lost about 14 per cent of its coral reefs.

What is Coral Bleaching?

- It occurs when abnormal environmental conditions, such as warmer sea temperatures, cause coral polyps to expel algae (zooxanthellae) living in their tissues, causing the coral to turn completely white.
- Normally, coral polyps live in an endosymbiotic relationship with this algae crucial for the health of the coral and the reef as the algae provides up to 90% of the coral's energy.
- When a coral bleaches, it is not dead. Corals can survive a bleaching event, but they are under more stress and are subject to mortality.
- Corals can recover if the water temperature drops and the algae are able to recolonise the coral reefs.

Factors responsible for Coral Bleaching:

- Increased water temperature (most commonly due to global warming), or reduced water temperatures
- Oxygen starvation caused by an increase in zooplankton levels
- Increased solar irradiance (photosynthetic active radiation and ultraviolet light)
- Increased sedimentation (due to silt runoff)
- Bacterial infections
- Changes in salinity
- Herbicides
- Extreme low tide and exposure
- Cyanide fishing
- Pollutants such as oxybenzone, butylparaben, octyl methoxycinnamate, or enzacamene: four common sunscreen ingredients that are nonbiodegradable and can wash off of skin
- Ocean acidification due to elevated levels of CO2 caused by air pollution
- Being exposed to Oil or other chemical spills

Required measures:

- A better understanding of the underlying mechanisms that enable corals to tolerate heat can significantly improve coral reef conservation and restoration efforts.

Understanding the terms:

- **Heat Stress:** Thermal stress is a term to describe a temperature change that is severe enough to cause unfavourable and even lethal conditions to aquatic organisms, their populations, community structure, or the ecosystem.
- **Ocean acidification:** Ocean acidification describes the lowering of seawater pH and carbonate saturation that results from increasing atmospheric CO2 concentrations.

Practice Question:

Q. What is heat stress? Discuss how heat stress poses a significant threat to coral growth and reef accretion.

5. CARBON FOOTPRINT FOR MARINE INDUSTRY

Context According to a research by the Indian Council of Agricultural Research's (ICAR) **Central Marine Fisheries Research Institute (CMFRI),** the carbon footprint of the **marine fisheries sector in India** is much lower than the global figure.

Central Marine Fisheries Research Institute (CMFRI):

- CMFRI is the **largest marine fisheries research institute** in India.
- **Established in:** 1947
- **Headquarter:** Kochi, Kerala.
- **Parent Body**: Indian Council of Agricultural Research (ICAR).
- CMFRI has developed a unique method for estimation of fishery catch called the "Stratified Multistage Random Sampling Method". With this methodology the Institute is maintaining the National Marine Fisheries Data Centre (NMFDC).

About the study:

- **Objective**: This is the assessment of the **greenhouse gas (GHG) emissions** from total activities in the sector, from pre-harvesting to marketing, by converting it into CO2 equivalent.
- The study was presented at a review meeting of the fisheries component of the network research project **National Innovations in Climate Resilient Agriculture (NICRA)** of the ICAR held in Kochi.
- **Key features:**
- The study was conducted at **selected fishing centres** at all maritime states of the country, dividing the fishing-related activities into three phases — **pre-harvesting, harvesting and post-harvesting.**
- The **NICRA research project** was aimed at studying the impact of climate change on agriculture including crops, livestock, horticulture and fisheries and to develop and promote climate resilient technologies, thereby addressing vulnerable areas of the country.
- **Findings**:
  - At **1.32 tonnes of CO2** (carbon dioxide) produced **per tonne of fish** in India.
- India's carbon footprint is much lower than the global figure of more than **2 tonnes of carbon emission per tonne of fish**.
- The CMFRI identified **cyclone proneness, flood proneness, shoreline changes, heat waves and sea level rise** as **major hazards** that could affect coastal lives.
  - Works on a **Coastal Climate Risk Atlas** that marks **areas of risk**, including **hazards and vulnerabilities** in all coastal districts in India, are in progress.

India's Marine sector:

- The importance and the role of the fisheries sector were officially recognized in India, through the enactment of the '**Indian Fisheries Act' in 1897.**
- The **first Five-year plan** (1951—56) of the Government of India, drew the canvas of the Fisheries sector (both Marine and Inland Fisheries sector).
- It was followed by the creation of an independent Ministry of Fisheries, Animal Husbandry & Dairying in 2019.

Highlights of the Fisheries Sector:

- The **culture of Pangassius and mono-sex Tilapia**, native catfishes, and freshwater prawns are picking up due to culture-based production being adopted at a faster pace.
- **Three Major Carp (IMC) species**- Catla, Rohu, and Mrigal together contribute a lion's share in production.
- In the **shrimp segment**, most of the production comes from vannamei.
- Rainbow trout culture and rehabilitation of **native Mahaseer** in cold waters of the Himalayan corridor are promising ventures.

Government Policies:

- **Pradhan Mantri Matsya Sampada Yojana (PMMSY):** PMMSY is a flagship scheme for focused and sustainable development of the fisheries sector in the country as a part of the Aatmanirbhar Bharat Abhiyan.
- **Livelihood and nutritional support:**
- It has been provided for 13.99 lakh (FY 2020 to date) **socio-economically backward active traditional fishers' families** during the seasonal fishing ban/lean period.

- For safety net, 31.89 lakh fishers have been insured under the Group Accidental Insurance Scheme (GAIS).
- The insurance premium under GAIS is 100 percent borne by central and state governments.

Practice Question:

Q. The maritime industry is highly dependent on fossil fuels contributing to almost 3% of global greenhouse gas emissions annually. In the light of this statement, discuss the challenges and strategies for decarbonizing the maritime sector, and highlight the role of international cooperation in achieving sustainable shipping.

6. INDIA'S COST OF ADAPTING TO CLIMATE CHANGE NEEDS SEEN AT $1 TRILLION: RBI

Context India needs to spend an estimated 85.6 trillion rupees ($1.05 trillion) by 2030 to adapt its various industries to be compliant with climate change norms, a report by the Reserve Bank of India.

The Report

- **Title:** Reserve Bank of India's (RBI) Report on Currency and Finance
- **Report theme:** Towards a Greener Cleaner India
- The report is written by contributors from the **Department of Economic and Policy Research**.

Key-highlights of the Report

- India's goal of achieving the **net zero target** by 2070 would require-
  - an **accelerated reduction** in the **energy intensity of GDP** by about 5% annually
  - a significant improvement in its **energy-mix in favour of renewables** to about 80% by 2070-71
- **Financing requirement:** The green financing requirements in India could be at least **5% of GDP** annually to address the infrastructure gap caused by climate events.
- **Vulnerability of financial institutions:** Results of a climate stress-test reveal that public sector banks (PSBs) may be more **vulnerable** than private sector banks. Globally, however, measurement of climate-related financial risks remains a work in progress.
- **Requirement of sector-centric approach:** Different sectors of the economy have different emission intensities, it is advisable to not have a uniform climate mitigation strategy across sectors.
- Without any policy action, India's carbon dioxide emission levels may rise to 3.9 gigatonnes by 2030, from 2.7 gigatonnes in 2021.

India's Climate Finance Strategy

- **Long-Term Low Emission Development Strategy (LT-LEDS):** In November 2022, at COP27, India submitted its Long-Term Low Emission Development Strategy (LT-LEDS) to the United Nations Framework Convention on Climate Change.
  - **Issue:** This requires trillions of dollars of investment. Yet India currently lacks a comprehensive climate finance strategy for mobilizing the capital required to execute on the LT-LEDS.
- **Green Bonds:** India's maiden issue of green bonds, within the broader green bonds framework outlined by the government is commendable.
  - **Issue:** India may issue $3 billion of green bonds in financial year 2023–2024, but still this will amount to only 1.6 percent of its overall annual borrowing.

Practice Question

Q. There has been a significant increase in climate action, both multilaterally and in individual countries. Alongside fiscal policies, recent years have seen a growing experimentation with regulatory instruments. Discuss.

7. CLIMATE SMART AGRICULTURE

Context: Climate change, one of the most pressing issues, is already having a significant impact on agriculture, and this impact is only going to get worse in the years to come. However, climate-smart farming can help farmers adapt to climate change and mitigate its effects.

What is Climate-Smart Farming?

- Climate-smart agriculture (CSA) is the name given to an approach to agricultural systems that supports development while ensuring food security in the context of a changing climate.
- CSA aims to tackle three main objectives:
  - increasing agricultural productivity and incomes in a sustainable manner
  - building resilience to climate change
  - reducing and/or removing greenhouse gas emissions, where possible

Need for Climate smart Agriculture

- **Enhanced resilience:** Indian agriculture is prone to drought and other climate related shocks heavily dependent on Monsoon. Climate change will further reduce farm productivity. CSA will **reduce vulnerability to drought, pests, diseases and other climate-related risks and shocks**.
- **Nutrition security and Farm income:** India, whose population is increasing, need higher agricultural productivity to address the issues of malnutrition. CSA will help produce more and better food to **improve nutrition security and boost incomes**.
- **Reduce emissions:** As per the national GHG inventory, the **agriculture sector emits 408 MMT of carbon-dioxide equivalen**t. CSA will help pursue lower emissions for each kilo of food produced, avoid deforestation from agriculture and identify ways to absorb carbon out of the atmosphere.
- **Improving sustainability:** Agriculture practices have become unsustainable in many parts of India due to over-use of fertilizers, over-exploitation of water etc. This has reduced fertility of soils and groundwater level. CSA will make agriculture sustainable.

Climate smart strategies

- Many agricultural technologies and practices such as minimum tillage, different methods of crop establishment, nutrient and irrigation management and residue management can improve crop yields: nutrient and water use efficiency and reduced greenhouse gas (GHG) emissions from agricultural activities.
- Similarly, the use of improved seeds, rainwater harvesting (RH), Information and Communication Technologies (ICTs)-based agro-advisories and crop/livestock insurances can also help farmers to reduce the impact of climate change and variability.
- In general, the CSA options integrate innovative and traditional technologies, practices and services that are relevant for particular location and reduce the effect of climate change and provide the opportunities to stand such changing scenario.
- Adaptation and mitigation are complementary strategies for reducing and managing the risks of climate change.
- Substantial reduction in GHG emission over the next few decades can reduce the occurrence of climatic variability in the twenty-first century and beyond, increase prospects for effective adaptation, reduce the costs and challenges of mitigation in the longer term and contribute to climate-resilient pathways for sustainable agriculture.

Government steps

- **National Innovation on Climate Resilient Agriculture (NICRA)**: the project intends to increase the resilience of Indian agriculture, including crops, animals, and fisheries, with the help of risk management technologies.
- **National Action Plan on Climate Change (NAPCC)**: It presents a national policy aimed at enabling the country to adapt to climate change and improve India's ecological sustainability.
- **The National Mission on Sustainable Agriculture (NMSA)**: The NMSA promotes sustainable agriculture through the adoption of eco-friendly technologies, energy efficiency, natural resource conservation, and integrated farming.

- **The National Adaptation Fund for Climate Change (NAFCC)**: It was formed to cover the costs of climate change adaptation for Indian states and union territories that are particularly vulnerable to the effects of climate change.
- **Climate-smart villages (CSV)** : An institutional strategy for testing, implementing, modifying, and promoting CSA at the local level, as well as improving farmers' ability to adapt to climate change.
- **PMSKY (Pradhan Mantri Krishi Sinchayee Yojna)**: This Scheme was designed and developed with the goal of prioritising water conservation and management in agriculture, to expand the area under irrigation.

Climate smart strategies like choice of suitable crop and cultivars, residue management, intercropping with legume, agro-forestry and crop diversification can help minimize negative impacts and strengthen farmers by sustainably increasing productivity and income.

Practice Question

Q. What is climate smart agriculture? Discuss the necessity of climate smart agriculture in the 21st century.

8. HEAT WAVE

Context: Heatwaves have fuelled devastating wildfires and affected millions of people around Europe. From India and Pakistan to Tunisia and Europe, numerous countries have suffered heat waves

What is a Heat wave?

- **A Heat Wave** is a **period of abnormally high temperatures** (**hot and humid** weather) more than the normal maximum temperature that **occurs during the summer season** in the **North-Western parts of India.** Heat Waves typically occur between March and June, and in some rare cases even extend till July. **According to The Indian Meteorological** Department, **Heat Wave** occur **40°C for Plains and at least 30°C for Hilly regions.**

The reasons behind increase in frequency and intensity of heat wave:

- **Global rise in temperature:** Concurrent heat waves are becoming more common as global temperatures rise. World must cut greenhouse-gas emissions that are causing temperatures to rise.
- **Lock-in effect:** Heat waves occur due to the **high pressure in the atmosphere that forces hot air downward** and traps it near the ground. This **high-pressure system acts like a lock** that **prevents the hot air from rising.** Consequently, rain cannot form and the hot air gets hotter.
- **Loss in natural balance:** Owing to the **higher temperature, the rate of evaporation gets intensified and results in less forming of clouds and resultant rains to keep weather cool**. Further the **shrink in water levels** and **disturbance in natural cycle of heat and pressure** transfer results in both intensity and frequency of heat waves.
- **Compounding impact:** Climate change **exacerbates the factors causing more extreme** and frequent heat waves.

Impact on Health

- The **scale and nature of the health impacts** of heat **depend on the timing, intensity** and duration of a temperature event, the level of acclimatization, and the adaptability of the local population.
- **Disability: Exposure to excessive heat has wide ranging physiological impacts** for all humans, often amplifying existing conditions and resulting in **premature death and disability**.
- **Diseases:** It Compromises the body's ability to regulate temperature and can result in a cascade of illnesses, including heat cramps, heat exhaustion, heatstroke, and hyperthermia.

Impact of Heat waves on Environment

- Heat waves poses huge **risk to agriculture, energy, and infrastructure** due to the imbalances it caused. There would be adverse impact on irrigation **potential, agricultural productivity and a threat to food security too.**

- **Increasing energy demands**: With rise in heat waves, **demand for cooling systems would also magnified** resulting in huge **energy demand**. Air conditioning is constantly used where accessible, **leading to power shortages in many place**s during extreme heat events.
- **Increased GHGs: Coal and fuel consumption**, the main resources for electricity generation in South Asia, has been ramped up due to heightened energy demands. The **increased greenhouse gas emissions** exacerbate climate change impacts in the long term, triggering more heat waves.
- **Impact on Flora and Fauna**: With increase in frequency it **impacts the flora and fauna in their adaptation** and cause disturbance in their ecosystem and habitat.
- **Natural disasters**: Heat waves can also **trigger other natural disasters such as drought, bushfires, and forest fires** which consequently damage crops and livestock.

Government Initiative Regarding Heat Waves

- **National action Plan for Climate Change (NAPCC):** There are 8 national missions forming the core of the NAPCC which represent comprehensive strategies for achieving key goals in climate change.
- **India Cooling Action Plan (ICAP)**: Goals of ICAP is to reduce cooling demand by 20-25% and refrigeration demand by 25-30% by the year 2037.

Way forward

- **Afforestation**: More and more plantation of plants can help address the problem of heat waves across the space.
- **Infrastructure**: Increasing use of permeable materials in civic infrastructure can diminish the negative impact of heat waves.
- **Clean fuels**: Encouraging cleaner cooking fuels such as Biogas, Compressed Natural Gas, liquified Petroleum Gas will help in diminishing indoor air pollution. .
- **Green Buildings**: Promoting the use of **green roofs and cool roofs** in residential or commercial buildings, can help the increasing temperatures.
- **Agricultural adaptation**: Agroforestry, crop rotation, cover cropping, drip irrigation and sprinkler systems can be help in reducing the negative impacts of heat waves.

Practice Question

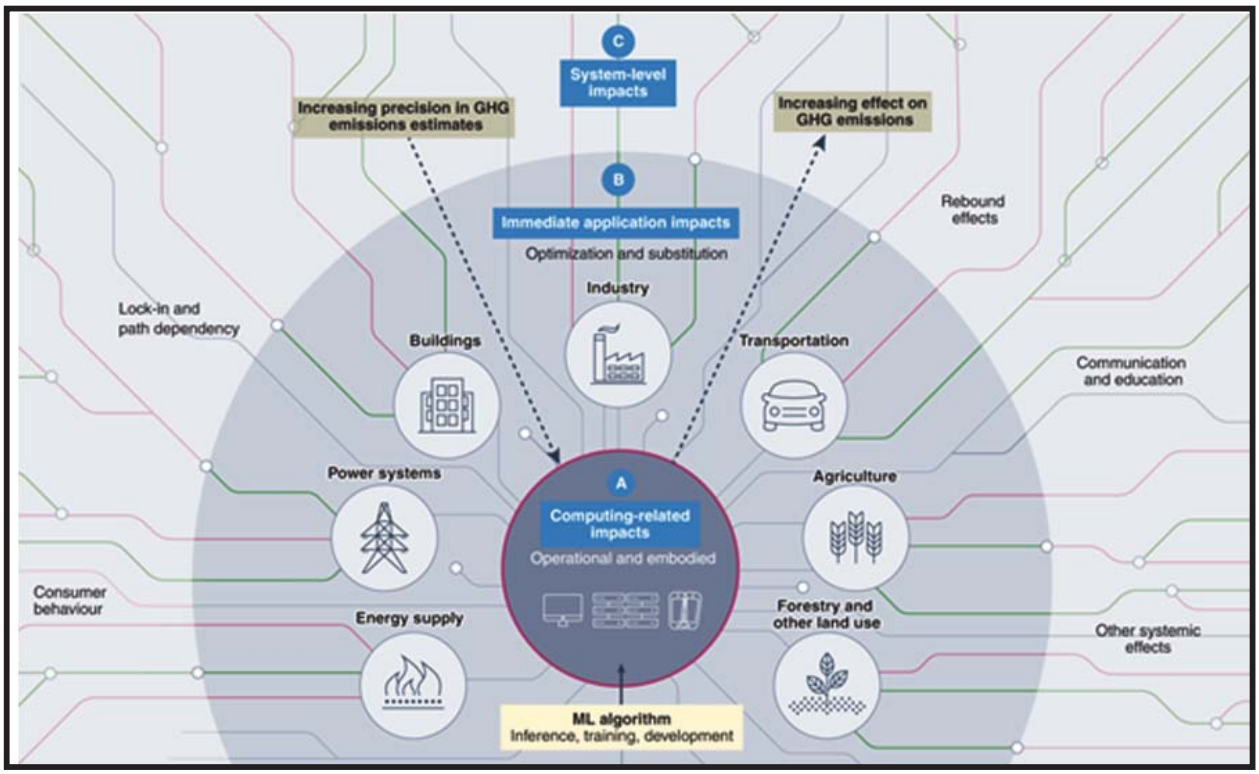
Q. Give reasons for the increase in frequency and intensity of heat wave in India in recent time. How does heat wave affect human and animal lives?

9. ARTIFICIAL INTELLIGENCE AND ITS CLIMATE COST

Context: While there is an allure to national dreams of economic prosperity and global competitiveness, underwritten by AI, there is an environmental cost to it.

Positive impact of AI on Ecology	Negative impact of AI on ecology
◦ **Conservation and Biodiversity**: AI can aid in the monitoring and management of wildlife and ecosystems. For example, AI-powered image recognition algorithms can analyze satellite imagery or camera trap photos to identify and track species.	◦ **Energy Consumption and Carbon Footprint**: The computing power required for AI algorithms can lead to significant energy consumption and carbon emissions. The infrastructure supporting AI, including data centers and high-performance computing systems, can have an environmental impact if not powered by renewable energy sources.
◦ **Ecological Modeling and Predictions**: AI techniques, such as machine learning, can analyze large datasets and complex ecological systems to develop models and predictions. This can assist researchers in understanding ecosystem dynamics, species interactions, and the impacts of environmental changes.	◦ **Data Privacy and Ethical Concerns**: The use of AI in ecological research and monitoring involves the collection and analysis of large amounts of data, raising concerns about data privacy, security, and potential misuse.

◦ **Ecological research**: AI can help identify patterns, detect trends, and make forecasts, thereby supporting ecological research and decision-making.	◦ **Bias and Accuracy**: Biases present in training data can lead to biased outcomes, potentially impacting ecological research and decision-making. It is crucial to address these biases and ensure accuracy and fairness in AI applications.
◦ **Environmental Monitoring and Pollution Management**: AI-based sensors and monitoring systems can continuously collect and analyze environmental data, such as air and water quality, temperature, and weather patterns. This can facilitate real-time monitoring of ecosystems.	
◦ **Wildlife Protection and Anti-Poaching Efforts**: Intelligent surveillance systems equipped with AI algorithms can identify and track suspicious activities, detect poachers, and alert authorities in real-time, enhancing wildlife protection efforts.	
◦ **Precision Agriculture**: AI can optimize agricultural practices by analyzing data from sensors, drones, and satellites to provide insights into crop health, soil conditions, and water usage. This can help farmers make informed decisions, reduce resource wastage, and minimize the environmental impact of farming practices.	



To maximize the positive impacts of AI on ecology and minimize potential negatives, it is important to develop and deploy AI technologies in an environmentally conscious and ethically responsible manner. This includes promoting transparency, addressing biases, ensuring data privacy, and integrating AI with other approaches for comprehensive ecological research and management.

Practice Question

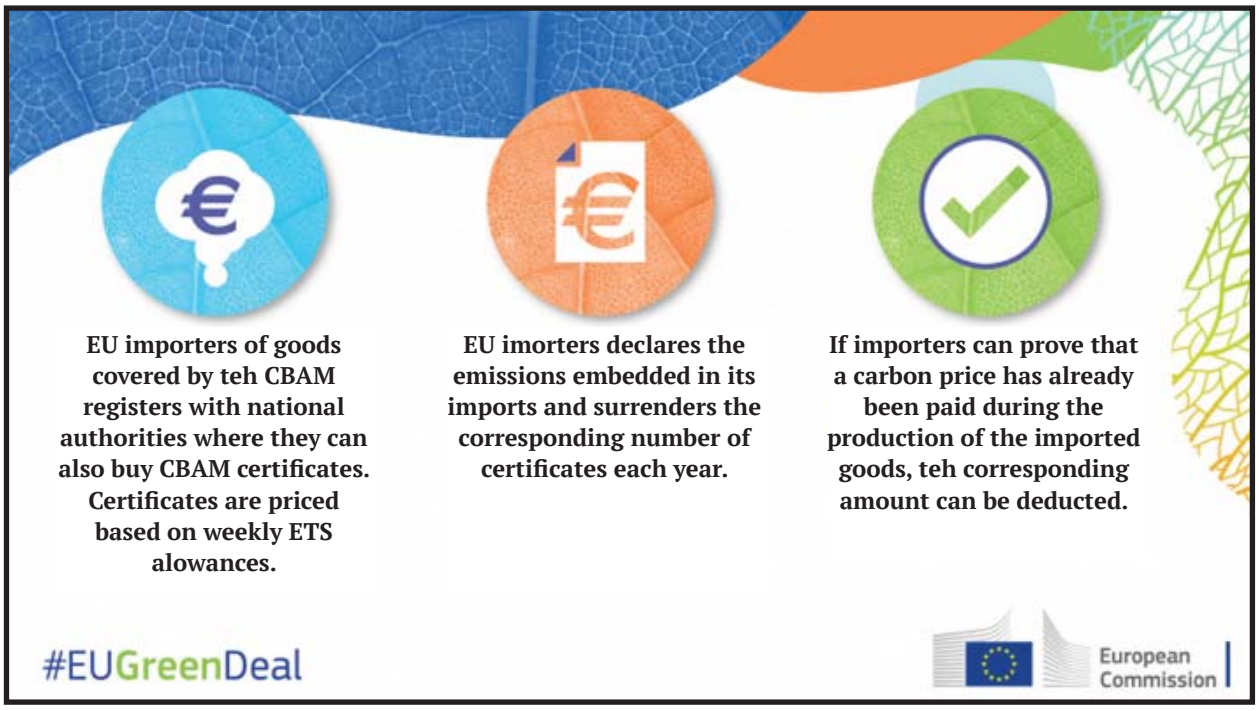
Q. Critically analyze the impact of the Artificial Intelligence on the Environment and Biodiversity of India and world.

10. CARBON BORDER ADJUSTMENT MECHANISM

Context: The European Union (EU) proposes to introduce a framework for levying a carbon tax on imports of products that rely on non-green or sub-optimally sustainable processes and where carbon emissions are deemed to have not been adequately priced.

What is Carbon Border Adjustment Mechanism (CBAM)

- The EU's Carbon Border Adjustment Mechanism (CBAM) is a landmark tool to put a fair price on the carbon emitted during the production of carbon intensive goods that are entering the EU, and to encourage cleaner industrial production in non-EU countries.
- The gradual introduction of the CBAM is aligned with the phase-out of the allocation of free allowances under the EU Emissions Trading System (ETS) to support the decarbonisation of EU industry.



Significance

- **Reduce carbon emissions**: It may persuade non-EU nations to implement stricter environmental laws, which would cut down on global carbon emissions.
- **Prevent carbon leakage**: By deterring businesses from moving to nations with laxer environmental standards, it can stop carbon leakage.
- **Fund EU climate initiatives**: The money made through CBAM will be used to fund EU climate initiatives, which other nations can use to promote green energy.

Impact on India

- **Impacting exports**: India's exports of metals including iron, steel, and aluminium goods to the EU may suffer as a result of the mechanism because these will be subject to increased scrutiny.
- **Higher carbon tariffs**: India is quite concerned about the direct and indirect emissions from iron, steel, and aluminium since increased emissions would result in higher carbon tariffs to be paid to the EU.

Practicce Question
Q. What is Carbon Border Adjustment Mechanism? Discuss its impact on India.

11. BALANCING GLOBAL NUTRITION AND CLIMATE CHANGE

Context: It is high time for India to develop technologies that not only fulfill food and nutritional needs but also addresses climate change.

Impact of Climate on the Nutrition

- **Agriculture**: Climate change can disrupt agricultural systems, leading to reduced crop yields and lower nutritional quality of food.
- **Food security**: Extreme weather events can destroy crops, livestock, and fisheries, leading to food shortages and reduced access to diverse and nutritious diets.

- **Water resources**: Changes in precipitation patterns can lead to water scarcity, affecting irrigation systems and crop growth. Water stress can reduce agricultural productivity and limit the availability of fresh water for drinking and hygiene, further compromising nutrition.
- **Nutritional content of crops**: Studies have shown that higher CO2 concentrations can reduce the protein, zinc, and iron content of staple crops like wheat, rice, and legumes. These changes can contribute to nutrient deficiencies and negatively impact human health.
- **Food safety and hygiene**: Climate change can increase the risk of foodborne illnesses. Warmer temperatures can promote the growth of pathogens, such as bacteria and fungi, in food production, processing, and storage.
- **Nutrition of vulnerable populations**: Climate change disproportionately affects vulnerable populations, including children, pregnant women, the elderly, and those living in low-income communities.

Role of science and technology is solving issues

Challenge/ Problem	Examples of science, technology, and innovation
Biotic stresses	• Disease- or pest-resistant crops • Pest-resistant eggplant • Rust-resistant wheat varieties • Improved agronomic practices (for example, push-pull mechanisms)
Abiotic stresses	• Salt-tolerant crops (for example, quinoa, potato) • Climate-resistant crops
Improving crop productivity	• Conventional breeding • Advanced genetic engineering • Low-cost diagnostic toolkit for extension workers
Improving livestock agriculture	• High-nutrient, low-cost animal fodder • Liquid nitrogen and low-cost alternatives for animal semen preservation • Low-cost diagnostic toolkits for livestock veterinarians
Lack of water availability	• Water storage technologies (subsurface water technologies, aquifers, ponds, tanks, low-cost plastic water tanks, natural wetlands, reservoirs) • Canal irrigation • Micro-irrigation technologies, drip irrigation, bubbler irrigation, microsprinkler irrigation
Soil	• Synthetic and organic fertilizers • Zero or conservation tillage • Soil microorganisms • Natural nitrogen fixation

Addressing the impacts of climate change on nutrition requires a comprehensive approach involving sustainable agriculture practices, improved water management, climate-resilient food systems, and social safety nets to support vulnerable populations.

Practice Question

Q. "Climate change can disrupt agricultural systems, leading to reduced crop yields and lower nutritional quality of food." Comment.

12. HIMALAYAN ECOSYSTEM

Context: The recent report stated that loss of forest is much more pronounced in the Himalayan states when compared to rest of India.

Introduction:

- The Himalayan Mountains are the highest mountain range in the world sometimes referred to as the **Third Pole**. These ranges are the source of some of **Asia's major rivers** and also help to regulate our planet's climate **making them crucial** for the human well-being and ecosystem health.
- The extensive mountain ecosystem is **highly vulnerable** to climate change, warming faster than the rest of the world. **Unchecked deforestation** is adding to the challenges making the region even more fragile.

Importance of Himalayas

- **Critical role in controlling the weather:** The Himalayan range work as a barrier blocking the cold and dry winds of Central Asia. They also **trap the monsoon winds** of the Indian Ocean leading to good rainfall in Northern India.
- **Source of fresh water:** Some of the most important rivers of Asia like **Ganga** and **Brahmaputra** originate from the Himalayan region providing **fresh water for millions of people in South Asia.**
- **Ecosystem services:** The Himalayas provides significant ecosystem services such as **carbon sequestration, water storage, maintenance of,** and food security to pastoral communities making them **essential for human as well as flora and fauna** in the region.
- **Ecosystem health: The Himalayas region is one of the global biodiversity hotspots housing huge biodiversity** and species population which are important for ecological functions and food chain.
- **Medicinal resources**: The Himalayas are home to a diversity of medicinal resources. Plants from the forests have been used for millennia to treat several conditions. Research and new discovery**. E.g. Ayurveda.**
- **Agriculture in hilly regions**: The **local community** in the region is involved in growing several crops like amaranth, buckwheat, high altitude rice, etc. They are critical to the food security of these mountain communities.
- **Tourism and recreation**- Hill stations or duns in Himalayan ranges provide a range of tourism opportunities to the visitors while **economic benefits** to the local population. The region is also home to numerous **pilgrimage sites**.

Impacts of deforestation and climate change on Himalayan ecosystem

- **Shrinking Himalayan glaciers:** Climate change poses a growing threat to the glaciers found in the Himalayan mountain ranges. Over the next few decades, according to **2019 IPCC report**, the Hindu Kush Himalayas faces the risk of **losing over 60% of its glaciers** by 2100.
- **Reduced water availability:** Studies conducted by the **ISRO** show that approximately **75% of the Himalayan glaciers** are retreating at an alarming rate. Reduction of ice cover will also **reduce the albedo** effect thus trapping the heat and **accelerating the glacier melting**.
- **Rising frequencies of disasters:** Deforestation and climate change together are disturbing the **stability of the Himalayas** resulting in increasing frequency of disasters like landslide, floods etc. The **Chamoli disaster of 2021** was the direct manifestation of this change.
- **Decline in biodiversity:** Deforestation has caused the **loss of the habitat** of the Himalayan species. **Snow Leopard** and **Red Panda** are some of the species facing severe threat in the last couple of decades.

Conclusion

Himalayas have played an essential role in sustaining the life in the region and the country as whole. But due to **population pressure** and over-exploitation of natural resources, the range is becoming increasing fragile leading to frequent disasters. Ecologically responsible development, cooperation of countries falling in the range, and arresting the causes of global warming are some of the ways to reverse the trend.

Practice Question

Q. Critically analyse the impacts of the climate change on the Himalayan ecosystem.

13. ENVIRONMENT DRIVEN TAXES

Context: Recently, there has been growing awareness of the imposition of 'environmental taxes', and a very large basket has already been designed in different countries.

Introduction

Environment-driven taxes, also known as environmental taxes or green taxes, are fiscal measures imposed by governments to encourage environmentally friendly behavior and discourage activities that have a negative impact on the environment. These taxes are typically designed to internalize the environmental costs associated with specific activities or products.

According to the **OECD** (2006), there are about **375 environmentally related taxes** in the OECD countries.

Factors for imposing of environmental taxes

- **Internalizing Environmental Costs:** Environment-driven taxes aim to internalize these costs by assigning a price to environmental degradation, pollution, and resource depletion.
- **Encouraging Sustainable Behaviour**: By making environmentally harmful activities more expensive, these taxes encourage the adoption of cleaner technologies, energy efficiency, waste reduction, and the use of renewable resources.
- **Funding Environmental Initiatives**: The revenue generated from environment-driven taxes can be directed toward projects such as renewable energy development, environmental research, conservation efforts, and the development of sustainable infrastructure.
- **Promoting Innovation**: As the cost of polluting activities increases, businesses are incentivized to invest in research and development to find more environmentally friendly alternatives.
- **Reducing Externalities**: Environment-driven taxes help reduce these externalities by making polluting activities more expensive. This helps address market failures and ensures that the costs of environmental damage are borne by those responsible for it.
- **Supporting International Commitments**: Environment-driven taxes can assist in meeting international commitments (like **INDC**) by providing a domestic policy tool to incentivize emissions reduction, energy transition, and sustainable development.

Eco-tax in India:

Some examples of "ecotax" in India at a regional level are

- **Clean energy tax** by the Government of India introduced in 2010, imposed on coal, peat and lignite
- **Gujarat Green Cess** imposed on electricity, presently stayed by the courts.
- **Vehicle entry tax** introduced in Himachal Pradesh in 2004
- **Tax on old vehicles** introduced by 6 States in India for discouraging old vehicles which impact ecological balance.
- **Cess on non-biodegradable substances**, introduced by Sikkim State in 2005
- **Goa Green Cess** imposed by Goa in 2013.

Other related taxes at global level

- **EU's carbon border tax:** European Union governments have reached a deal on the world's first major carbon border tax, as part of an overhaul of the bloc's flagship carbon market that aims to make its economy carbon-neutral by 2050.
- **The Fit for 55 package** is a set of proposals to revise and update EU legislation and to put in place new initiatives with the aim of ensuring that EU policies are into line with the climate goals agreed by the Council and the European Parliament.
- **Taxes on plastic bags in Ireland** were introduced in 2002. The use of plastic bags in the litter was reduced from 5% to 0.13% in 2015.
- **Deposit refund packaging scheme in Finland** was first introduced in 1950, where a refund was provided on the deposit of used beverage packaging. Similar schemes are also in place in the UK and the USA.

- **Landfill tax in the UK** was introduced in 1996 to reduce the amount of waste sent for landfilling and boost waste recycling.
- **Tax on nitrogen emissions in Sweden** was introduced in 1992 to discourage activities with nitrogen emissions.
  - This resulted in a reduction in nitrogen emissions by 30-40%.

The main objective of environment-driven taxes is to internalize the environmental costs associated with various activities, creating economic incentives for individuals and businesses to adopt more sustainable practices. By pricing environmental externalities, these taxes encourage the conservation of resources, the reduction of pollution, and the transition to a greener economy.

Practice Question

Q. Discuss the essentiality of the Environment driven taxes in India.

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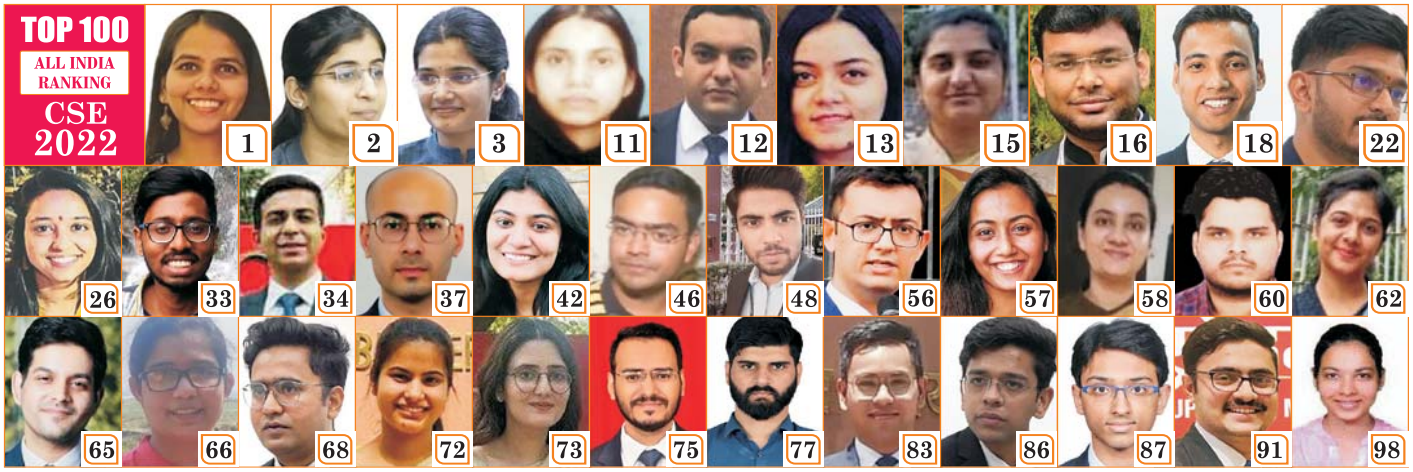

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