Elephant Conservation in India

For Prelims: Asian elephants, IUCN Red List, Project Elephant , Monitoring the Illegal Killing of Elephants (MIKE) programme

For Mains: Human–elephant conflict: causes, impacts, and mitigation strategies, Human-Animal Conflict, Issues of Human-Wildlife Conflict and Solutions.

Source:TH

Why in News?

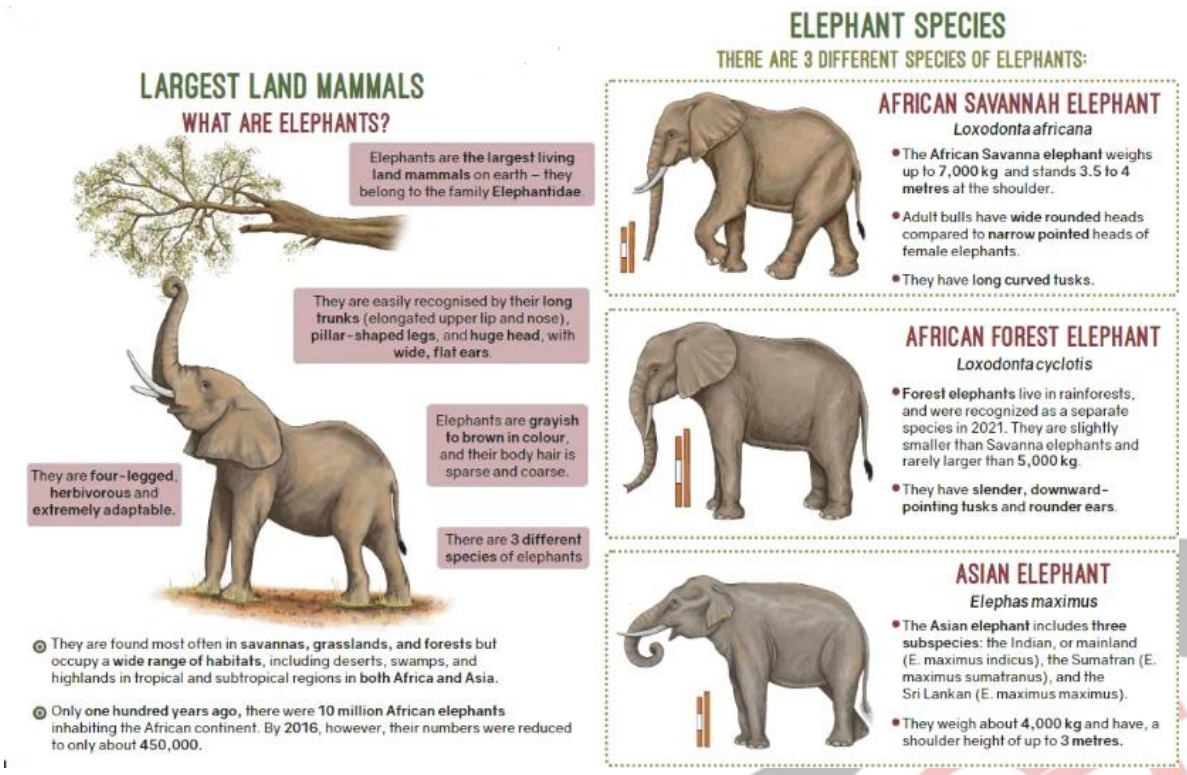
On **12th August,** the Ministry of Environment, Forest and Climate Change (MoEF&CC) celebrated **World Elephant Day** in Coimbatore, focusing on **human-elephant conflict.**

World Elephant Day

- **Patricia Sims of Canada** and the **Elephant Reintroduction Foundation** of Thailand, jointly established **World Elephant Day** on 12th August 2012. Since then Patricia Sims continues to lead the initiative.
- The initiative, partnered with over 100 organisations, aims to raise global awareness on elephant conservation, with millions showing support each year through **World Elephant Day.**

Key Facts About Elephant

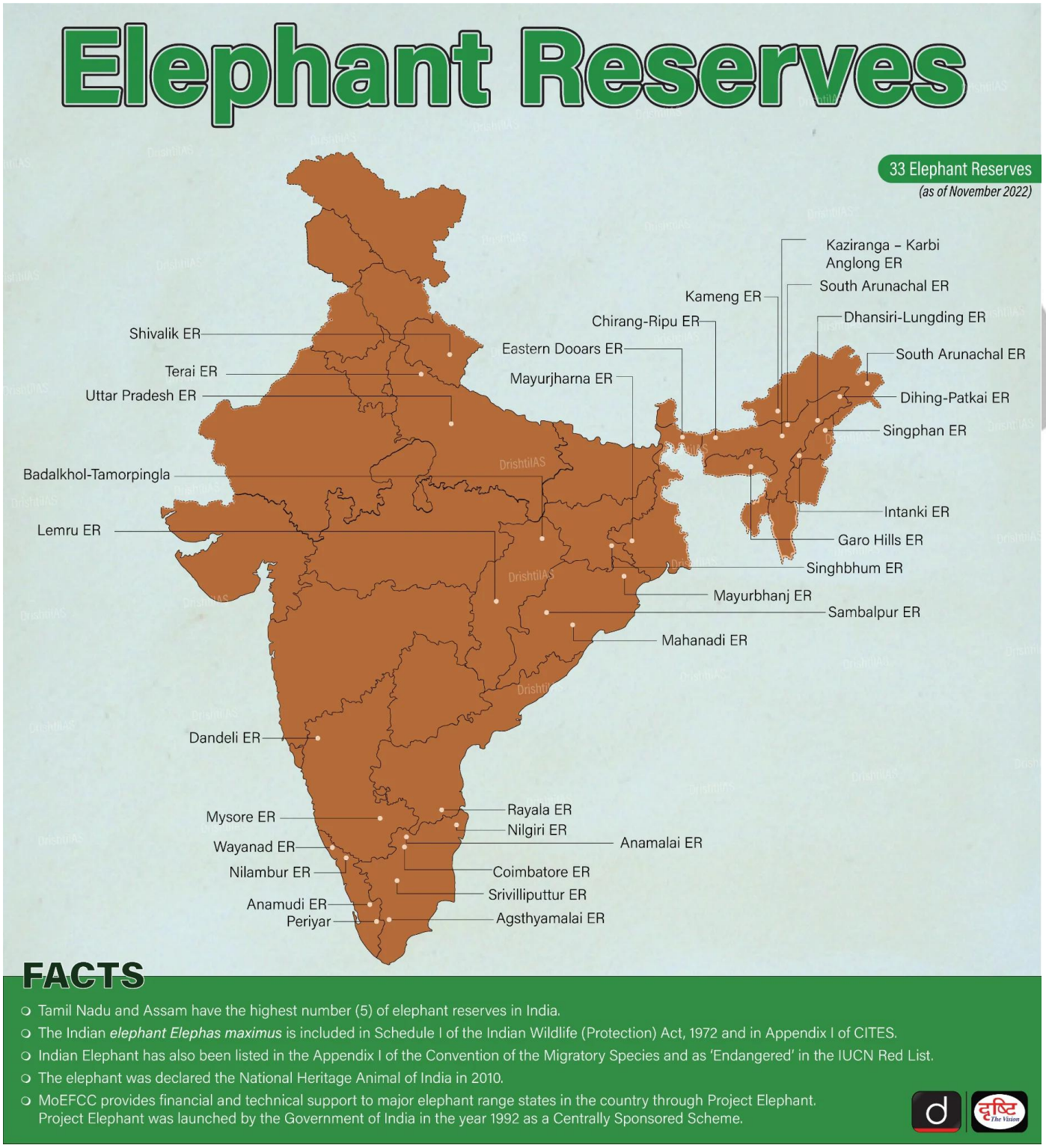
- **Three species**: There are three different species of elephant: the **African Savannah elephant, the African Forest elephant and the Asian elephant.**
    - African elephants have larger ears shaped like Africa, Asian elephants' ears resemble the Indian subcontinent. African elephants have two trunk "fingers", Asians have one.
- **World's Largest Land Animal**: The African Savanna (Bush) elephant is the world's largest land animal.
- **Elephant Lifespan and Reproduction:** Elephants can live up to 65 years. Females **reach puberty at 11,** have a **22-month pregnancy**, and stay fertile into their late 40s. Under ideal conditions, populations can grow by 7% annually.
- **Social Structure:** A **matriarch,** usually the **oldest and most respected female,** leads the family.
- **Tusks**: Enlarged incisor teeth that grow for life. It is used for feeding, digging, and defense; **targeted for ivory**, making elephants vulnerable to poaching.
- **Communication**: Use sound, body language, touch, scent, and seismic vibrations detected through bones.
- **Population Decline**: 90% of African elephants lost in the past century. Asian elephant populations are down by at least 50%. Habitat loss disrupts migration routes and increases human-elephant conflict.



How India is Ensuring the Conservation of Elephants?

- **Elephants in India:** India hosts over **60% of the world's wild Asian elephants (Elephas maximus),** specifically the **Indian elephant subspecies** (Elephas maximus indicus).
  - As the country's **National Heritage Animal,** they play a crucial role as **ecosystem engineers,** aiding in seed dispersal, nutrient cycling, and climate regulation.
  - As **keystone** (ecosystem shapers), **umbrella** (protecting coexisting species), and **flagship species** (symbols of conservation), Elephants sustain tropical forests and perennial rivers.
- **Status of Asian Elephants in India:** The **Asian elephant,** India's largest terrestrial mammal, is found mainly in the **south, northeast, and central regions.**
  - About **28,000–30,000** live in fragmented populations across four regions, making habitat and corridor conservation crucial.
- **Protection Status of Asian Elephants: IUCN Red List** (Endangered), **Wildlife (Protection) Act, 1972** (Schedule I), and **Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)** (Appendix I).
- **Project Elephant:** It is a **centrally sponsored scheme**, launched in **1992** under **MoEFCC, Project Elephant** supports 22 states/UTs in conserving elephants, their habitats, and migration corridors.
  - It focuses on **protection, conflict mitigation, and captive elephant welfare** through funding, infrastructure, and anti-poaching measures.
  - The **Project Tiger and Project Elephant Scheme** has been merged from FY 2023-24 and is now known as **Project Tiger & Elephant.**
- **Project RE-HAB (Reducing Elephant-Human Attacks using Bees):** It is an initiative by the **Khadi and Village Industries Commission (KVIC)** to mitigate human-elephant conflict using "bee-fences".
  - It involves strategically placing bee boxes along elephant paths to deter them from entering human habitations, thus reducing both **human and elephant fatalities.**
- **Achievements in Elephant Conservation:** The wild elephant population in India has increased from **27,669-27,719 in 2007 to 29,964 in 2017,** reflecting the success of conservation efforts.
  - India has designated **33 Elephant Reserves across 14 states**, providing critical habitats for elephants.
  - These Elephant Reserves overlap with **Tiger Reserves, Wildlife Sanctuaries and**

Reserved Forests which are protected under **Wild Life (Protection) Act, 1972, Indian Forest Act, 1927 and other local State Acts.**
    - The MoEFCC and state forest departments have ground-validated **150 elephant corridors across 15 states,** ensuring safe movement for elephants between fragmented habitats.
    - **Project Elephant** has also started using geospatial tools such as **Land Use Land Cover (LULC)** analysis and satellite data to monitor changes in elephant habitats and identify potential threats.
- **Monitoring and Future Directions:** The **CITES-led Monitoring the Illegal Killing of Elephants (MIKE) programme** monitors illegal elephant killings to guide conservation action, while **Wildlife Institute of India Elephant Cell** supports conservation through technical expertise, capacity building, and frontline staff training.



What are the Challenges in Elephant Conservation?

- **Elephant- Train Collisions:** According to a recent MoEF&CC survey, between 2009- 2024, 186 elephants died in train collisions across India, mostly in Assam, West Bengal, Odisha, Kerala, and Uttarakhand.
    - Causes include railway tracks through **elephant corridors, poor visibility, high train speeds, and lack of timely alerts.** These areas also threaten other wildlife like gaurs, deer, and leopards.
- **Habitat Loss and Fragmentation**: Expanding settlements and infrastructure projects shrink and break forests into **small patches.**
    - Identified elephant corridors in India which are essential for **seasonal movement and genetic exchange,** are under heavy human pressure and risk being completely blocked in some areas.
- **Rising Human–Elephant Conflict**: Shrinking habitats push elephants into crop fields and villages, causing major damage to livelihoods.
    - This leads to 400–500 human deaths annually and over 60 elephant deaths, mostly from retaliation.
    - **Climate change** affects elephants by disrupting habitats, water, and food sources, worsening **human-elephant conflict.**
        - Extreme weather events like droughts and floods force elephants into human-populated areas.
- **Poaching for Ivory and Other Body Parts**: Targeted killing of tusked males for ivory has **skewed sex ratios in many populations**.
    - Poaching for meat, skin, and tail hair is still prevalent, particularly in Northeast India, despite the **1989 CITES ivory trade ban.**
- **Infrastructure-Related Threats**: Low-hanging power lines causing electrocution, and injuries from crude bombs meant for other animals pose serious risks.
- **Accidental Deaths**: Elephants often fall into open wells, trenches, and pits, especially in human-modified landscapes, leading to fatal injuries.
- **Limited Resources for Conservation**: Many elephant habitats are in remote areas with poor monitoring and patrolling infrastructure.
    - For instance, Odisha's Similipal has limited forest staff and poor access roads, leading to weak management and a higher risk of poaching and conflict.

What are Measures Needed for Elephant Conservation?

- **Mitigation of Elephant- Train Collision:** MoEF&CC suggested mitigation measures such as **building ramps, underpasses, overpasses,** and installing **Intrusion Detection Systems (IDS)** to monitor and alert train operators about elephant movements.
- **Chili Powder Fences and Beehives:** Surrounding crops with fences coated in a mixture of **chili powder and waste engine oil** serves as a strong deterrent to crop-raiding elephants, thereby reducing human-animal conflict.
    - Installing **beehives along farm boundaries** deters elephants, as they avoid bees; also provides farmers with honey income.
- **Banana Trap Crops:** Planting fodder crops like **banana and napier grass** along forest edges to divert elephants from main crops.
- **Strengthen Habitat Protection:** Reconnect fragmented habitats through land acquisition, **Gram Sabha-**led consent, and voluntary relocation, as recommended by the **Elephant Task Force (2010).**
- **Technological Interventions:** Using **GPS Collar Tracking** monitor elephant movement in real-time for conflict prevention. Predict migration routes and hotspots for human-elephant conflict.
- **Capacity building:** Strengthen forest staff in remote areas with better equipment, veterinary units, and non-lethal conflict training.
- **Community Participation and Empowerment:** Expand programs like **Gaj Yatra program and Gaj Shilpi initiative** involving people to raise awareness about elephant conservation.

Drishti Mains Question:

Asian elephants in India are considered keystone species. Analyze the challenges faced in their conservation and suggest strategies for their long-term survival.

UPSC Civil Services Examination, Previous Year Questions (PYQs)

Prelims

Q. With reference to Indian elephants, consider the following statements: (2020)

1. The leader of an elephant group is a female.
2. The maximum gestation period can be 22 months.
3. An elephant can normally go on calving till the age of 40 years only.
4. Among the States in India, the highest elephant population is in Kerala.

Which of the statements given above is/are correct?

(a) 1 and 2 only
(b) 2 and 4 only
(c) 3 only
(d) 1, 3 and 4 only

Ans: (a)

Mains

Q. The incidences of human-wildlife conflict have increased in recent years leading to negative consequences for both humans and animals. In light of this, analyze the causes and effects of such conflicts. Also suggest solutions to better manage this issue. **(2024)**

Strengthening Disaster Resilience in the Indian Himalayan Region

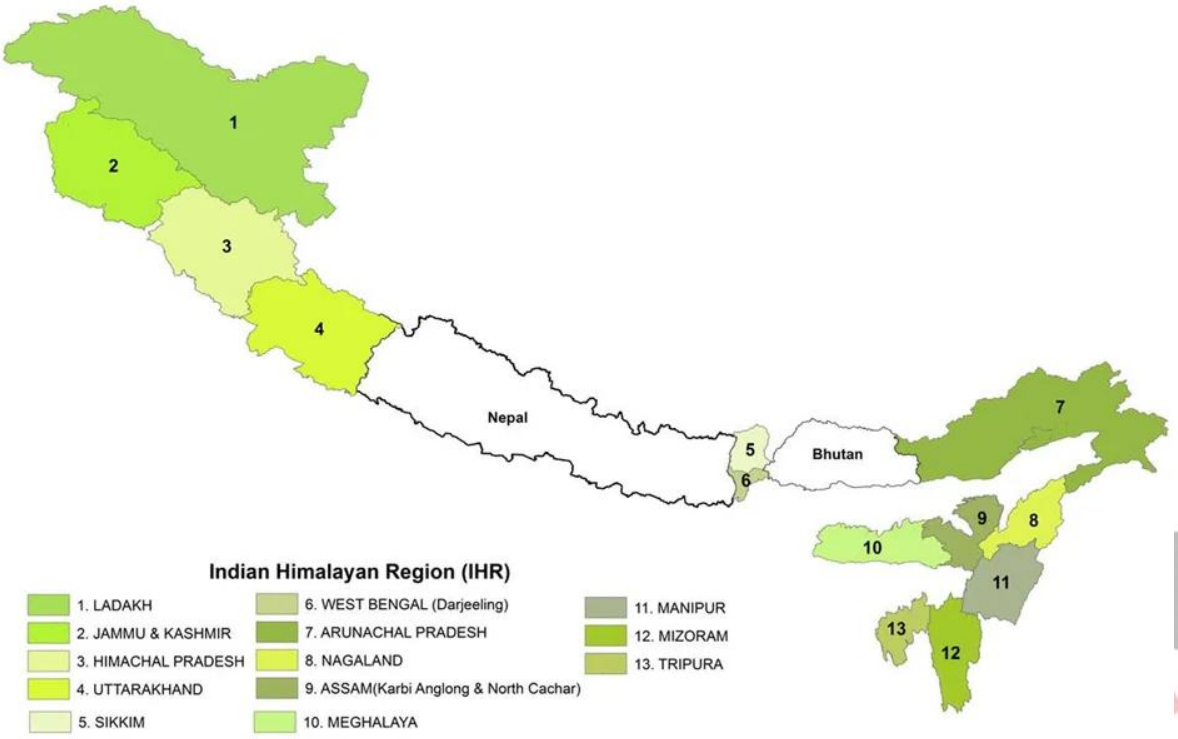
For Prelims: Flash flood, Indian Himalayan Region (IHR), Landslides, Avalanches, Glacial Lake Outburst Floods, Orographic lift

For Mains: Disaster Management in Himalayan Region, Climate Change (impacts on glaciers, extreme events, adaptation)

Source:IE

Why in News?

The **flash flood** that struck Dharali village in Uttarkashi, Uttarakhand, is a stark reminder of the increasing threat of **disasters** caused by **extreme weather events** in the **Indian Himalayan Region (IHR).**



What are the Factors Driving for Frequent Disasters in the Indian Himalayan Region (IHR)?

- **Tectonic Activity and Earthquake Risk:** The Himalayas are still rising because the **Indian plate is colliding with the Eurasian plate.** This ongoing tectonic movement makes the region **one of the most seismically active zones in the world.**
  - Major fault lines like the Dhaulagiri and Indus-Ganga faults, located in **India's Seismic Zone IV and V**, absorb stress from plate collisions, and sudden release of this stress triggers earthquakes.
  - High earthquake potential often triggers **landslides, avalanches, and even flash floods** by destabilising slopes and blocking rivers.
  - **Example: 2005 Kashmir Earthquake (Magnitude 7.6)** caused massive destruction in Jammu & Kashmir.
- **Fragile Geology:** The Himalayas are **geologically young mountains** made of **sedimentary rocks,** which are loose and easily eroded.
  - Steep slopes mean gravity naturally **pulls down loose soil and rock**, leading to frequent **landslides**, especially after rain or seismic tremors.
- **Glacial and Snow-Related Hazards:** The region contains thousands of **glaciers and high-altitude snowfields.** Climate change is accelerating their melt, leading to the **rapid expansion of Himalayan Glacial Lakes.**
  - In the **Hindu Kush Himalayas**, glaciers are melting at unprecedented rates and could lose up to **75% of their volume by 2100.**
  - When these lakes burst (form **Glacial Lake Outburst Floods (GLOFs),** they cause sudden, destructive flooding downstream.
    - For instance, in 2023 a GLOF from South Lhonak Lake destroyed the **Teesta III Dam** at Chungthang, Sikkim.
- **Extreme Rainfall Events and Cloudbursts:** The IHR often receives intense, short bursts of rainfall due to **orographic lift (moist air rising over mountains).**
  - **Cloudbursts** can release more than 100 mm of rain in an hour over a small area, causing flash floods and landslides.
  - In July 2021, **cloudbursts in Chamoli, Uttarkashi**, and Pithoragarh triggered flash floods and landslides, causing severe loss of life and infrastructure.
- **River Dynamics and Flash Floods:** Himalayan rivers are young, fast-flowing, and carry heavy sediment loads.
  - Landslides or glacial melt can **block rivers temporarily**, creating natural dams. When

these **break, sudden flash floods occur**.
    - Additionally, China's proposed dam on the **Brahmaputra** could alter river dynamics and create a potential "water bomb" risk for India.
- **Deforestation and Land Use Changes:** Clearing forests for **roads, hydropower projects, tourism facilities, and agriculture** removes tree roots that naturally stabilise slopes, making them **more prone to erosion, landslides, and excessive water runoff** during heavy rains.
    - In Joshimath (2023), land subsidence was linked to unregulated construction and hydropower tunnelling in fragile hill slopes.
    - Projects like Char Dham caused deforestation and soil loss, especially in sensitive areas like the **Bhagirathi Eco Sensitive Zone,** increasing disaster vulnerability and harming glaciers.

Click here to Read: Indian Himalayan Region

What are the Key Committees and their Recommendations on Disaster Management in India?

- **Mishra Committee (1976):** It was set up to investigate the **sinking of Joshimath,** It recommended halting new construction in slip zones until site stability is confirmed through thorough investigation.
    - It advised against cutting trees or removing boulders in landslide-prone areas for construction or road repair.
- **J.C. Pant Committee (1999):** It classified **31 types of disasters into five categories:** water and climate-related, geological, chemical/industrial/nuclear, accident-related, and biological.
    - It recommended that disaster management be included in the Constitution's **Schedule 7** and called for the enactment of national and state-level disaster laws, along with stricter enforcement of existing regulations such as building codes and safety standards.
    - To ensure strong governance, the committee proposed the creation of a **Cabinet Committee on Disaster Management, the institutionalization of a National Council under the Prime Minister**.
        - It also advocated for a dedicated Ministry of Disaster Management to coordinate efforts across various departments.
    - For capacity building, the committee recommended establishing the **National Centre for Calamity Management and the National Institute for Disaster Management.**
    - On financing, it called for reconstituting the **Calamity Relief Fund,** creating two new national funds for disaster response and prevention, and earmarking at least 10% of plan funds at all levels for disaster risk reduction.
    - It also stressed fostering a **culture of preparedness,** carrying out risk assessments, training human resources, and developing standard operating procedures.

What Measures can be Adopted to Mitigate Disaster Risks in the Indian Himalayan Region?

- **Develop a Comprehensive Early Warning System:** Install and maintain **solar-powered automated sensors and cameras at high-risk glacial lakes** for real-time monitoring and timely alerts to downstream communities.
- **Engineering and Geo-Technical Interventions:** Structural measures like **check dams, spillways, controlled drainage channels**, and catchment dams must be implemented despite logistical challenges posed by high altitudes.
    - These reduce the speed and volume of floodwaters during extreme weather events.
- **Sustainable Tourism Management:** Adopt a **Green Tourism Framework** with tourist caps in peak seasons, promote **eco-friendly models like homestays, enforce waste and water-use norms**, and direct tourism revenue to ecosystem restoration and disaster mitigation.

- **Region-Specific Environmental Impact Assessment (EIA):** The Himalayan ecosystem demands a **customized** **EIA framework** considering its unique geology, climate variability, and hydrology, ensuring that developmental activities do not increase disaster vulnerability.
    - Revise the **National Building Code** for hill regions to mandate earthquake-resistant and landslide-resilient designs.
- **Mainstreaming Climate and Disaster Resilience in Development:** Developmental projects in the IHR must **integrate disaster risk reduction** as per the **Sendai Framework** **and climate adaptation** to prevent increasing hazard exposure, especially in infrastructure and urban planning.
- **Integrated Watershed and River Basin Management:** Adopt **ridge-to-valley watershed restoration** with afforestation, wetland revival, and stream bank stabilisation, restore traditional water systems.
    - enforce floodplain construction limits, and establish basin-level governance for upstream–downstream disaster links.
- **Community Awareness and Preparedness:** Educate and engage downstream populations on cascading hazards like landslides, flash floods, and glacier melt, empower **Panchayats for local preparedness**, and promote participatory hazard mapping with community-owned shelters.
- **Integrated Multi-agency Coordination:** Encourage collaboration between **National Disaster Management Authority (NDMA), National Remote Sensing Centre (NRSC)**, **Central Water Commission**, State governments, and scientific institutions for risk assessment, monitoring, and mitigation.

Conclusion

Balancing development with ecological safeguards is essential for **Himalayan stability.** Strengthening land-use regulations, climate-resilient infrastructure, and community preparedness supported by initiatives like the **National Mission on Himalayan Studies (NMHS)** can reduce disaster risks while advancing goals for safe and sustainable settlements.

Drishti Mains Question:

Discuss the reasons for disasters in the Indian Himalayan Region and evaluate the challenges in managing these disasters effectively.

UPSC Civil Services Examination, Previous Year Questions (PYQs)

Prelims

Q. When you travel in Himalayas, you will see the following: (2012)

1. Deep gorges
2. U-turn river courses
3. Parallel mountain ranges
4. Steep gradients causing land sliding

Which of the above can be said to be the evidence for Himalayas being young fold mountains?

(a) 1 and 2 only
(b) 1, 2 and 4 only
(c) 3 and 4 only
(d) 1, 2, 3 and 4

Ans: (d)

Mains

Q. Bring out the causes for more frequent landslides in the Himalayas than in Western Ghats. **(2013)**

Q. Describe the various causes and the effects of landslides. Mention the important components of the National Landslide Risk Management Strategy. **(2021)**

Q. Vulnerability is an essential element for defining disaster impacts and its threat to people. How and in what ways can vulnerability to disasters be characterized? Discuss different types of vulnerability with reference to disasters. **(2019)**

Iron-Age Settlement Discovered in Topra Kalan

Source: IE

Why in News?

Evidence of **human settlements** dating back around **1500 BC** has been discovered from **Topra Kalan village** in Haryana.

- This period marks the transition from the **Indus Valley Civilization (Bronze Age)** (3300 BC to 1300 BC), to the **Iron Age in India** (around **1500 BC to 600 BC).**

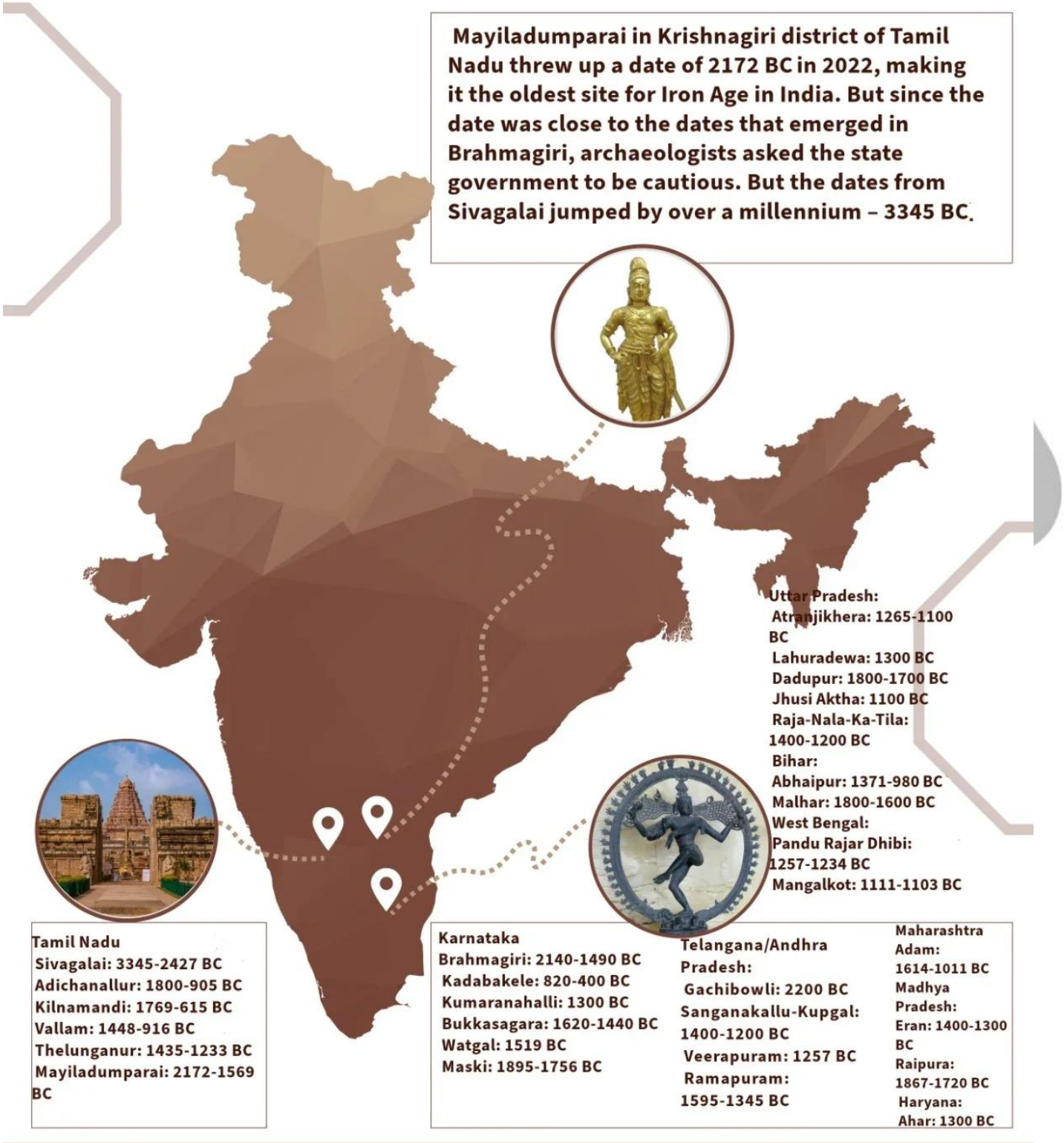
What are the Key Archaeological Evidences Discovered at Topra Kalan?

- **Topra Kalan village: Topra Kalan village** is the **original site of the Delhi-Topra Ashokan pillar,** which bears the **Mauryan Emperor Ashoka's edicts.**
  - It was **relocated to the national capital** in the **14th century** by **Firoz Shah Tughlaq.**
  - It is linked to **ancient Buddhist activity** as documented by **Sir Alexander Cunningham** and **Hiuen Tsang**, highlighting its significance in the **Mauryan period (322- 185 BC).**
- **Key Archaeological Evidences Discovered:**
  - **Artifacts such as Painted Grey Ware (PGW)**, **stamped pottery**, **moulded bricks**, **beads**, and various pottery types like **Black-and-Red Ware**, reflecting cultural phases of **late Bronze Age** and **early Iron Age** Northern India.
  - Structural remains such as **walls, platforms**, and **room-like enclosures** were uncovered at **4-5 meters depth**, alongside a **dome-like construction** believed to be a **Buddhist stupa.**

What are the Key Features of the Iron Age in India?

- **About:** The Iron Age is a **prehistoric period** that followed the **Bronze Age** & it was characterized by the **widespread use of iron for tools, weapons,** and other **implements.**
  - Iron making involved **collecting ore, melting it, and shaping tools.**
- **Iron in India:** The **Rigveda** mentioned **ayas** which referred to **copper/alloys** & **iron is not mentioned** in this period.
  - In later texts like the **Atharvaveda**, **ayas/karshnyas** refers to **iron** & other metals mentioned are **rajata** (silver), **trapu** (tin), and **sisa** (lead).
  - But in the **early historic period**, **ironworking** appears in **Buddhist texts** and **Kautilya's Arthashastra**, showing its use became important then.

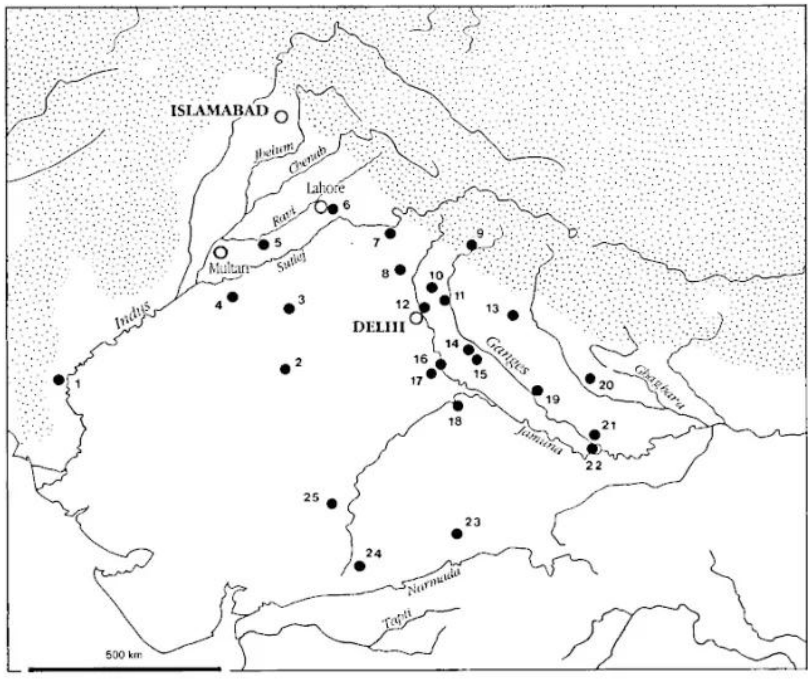
Iron Age sites



- **Associated Cultures:**
  - **In North India:**
    - **Black-and-Red Ware (BRW):** This pottery is distinguished by its **black interiors and red exteriors**, created through an inverted firing technique.

    - BRW is found in the **Harappan context** (Gujarat), **Pre-Painted Grey Ware (PGW) context** in northern India, and in **Megalithic contexts** in southern India, marking an important phase during the Iron Age.

- **Painted Grey Ware (PGW) Culture: PGW culture** is known for its **grey pottery decorated with black geometric patterns.**
    - Iron artifacts have been found at PGW sites, especially in the **Ganga valley** and **South Indian Megaliths** during the 1st millennium BCE.
- **Northern Black Polished Ware (NBPW) Culture:** The NBPW culture period marked the **widespread use of iron technology** in the **Indian subcontinent.**
    - Characterized by **fine, wheel-made, highly polished black pottery,** NBPW is prominent in northern India.
    - The period from **700 BC to 100 BC** saw the **rise of states and urban centres in the Ganga valley**, marking the **Second Urbanization**. This era also coincided with the **Mauruyan empire** & spread of **Buddhism** in the region.



1 Lakhiyo Pir
2 Jodhpur
3 Sardargarh
4 Satwali
5 Harappa
6 Gharinda
7 Rupar
8 Bhagwanpura
9 Thapli
10 Hulas
11 Hastinapura
12 Alamgirpur
13 Ahichchhatra
14 Jakhera
15 Atranjikhera
16 Mathura
17 Noh
18 Kotwar
19 Pariar
20 Sravasti
21 Sringaverapura
22 Kausambi
23 Besnagar
24 Ujjain
25 Gilund

Distribution of Painted Grey Ware sites.

- The NBPW culture period marked the **widespread use of iron technology** in the **Indian subcontinent.**
- The NBPW culture period marked the **widespread use of iron technology** in the **Indian subcontinent.**
- **Iron Age in South India:** In peninsular India, the Iron Age is represented mainly by the **Megalithic culture** associated with habitation sites like **Naikund** (Vidarbha), where **iron-smelting furnaces** were discovered & **Paiyampalli** (Tamil Nadu), known for abundant **iron slag**.
    - Recent excavations at **Sivagalai, Tamil Nadu** (2019–2022) indicate that iron might have been introduced as early as the **fourth millennium BCE**. Mastery over **fire control technology** was essential for iron extraction in this region.
- **Iron Age in Other Regions:**
    - **Central India (Malwa):** Important sites include Nagda, Eran, and Ahar dating between 750–500 BCE.
    - **Middle and Lower Ganga Valley:** Post-Chalcolithic pre-NBPW sites such

as Pandu Rajar Dhibi, Mahisdal, Chirand, and Sonpur date to around 750–700 BCE.

UPSC Civil Services Examination Previous Year Question (PYQ)

Prelims

Q. With reference to the difference between the culture of Rigvedic Aryans and Indus Valley people, which of the following statements is/are correct? (2017)

1. Rigvedic Aryans used the coat of mail and helmet in warfare whereas the people of Indus Valley Civilization did not leave any evidence of using them.
2. Rigvedic Aryans knew gold, silver and copper whereas Indus Valley people knew only copper and iron.
3. Rigvedic Aryans had domesticated the horse whereas there is no evidence of Indus Valley people having been aware of this animal.

Select the correct answer using the code given below:

(a) 1 only

(b) 2 and 3 only

(c) 1 and 3 only

(d) 1, 2 and 3

Ans: (c)

Q. Regarding the Indus Valley Civilization, consider the following statements: (2011)

1. It was predominantly a secular civilization and the religious element, though present, did not dominate the scene,
2. During this period, cotton was used for manufacturing textiles in India.

Which of the statements given above is/are correct?

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

Ans: (c)

Q. Which of the following characterize/characterize the people of the Indus Civilization? (2013)

1. They possessed great palaces and temples.
2. They worshiped both male and female deities.
3. They employed horse-drawn chariots in warfare.

Select the correct statements using the codes given below:

(a) 1 and 2 only

(b) 2 only

(c) 1, 2 and 3

(d) None of the above

Ans: (b)

Biochar-Led Carbon Drawdown for Sustainable Growth

Source: TH

Why in News?

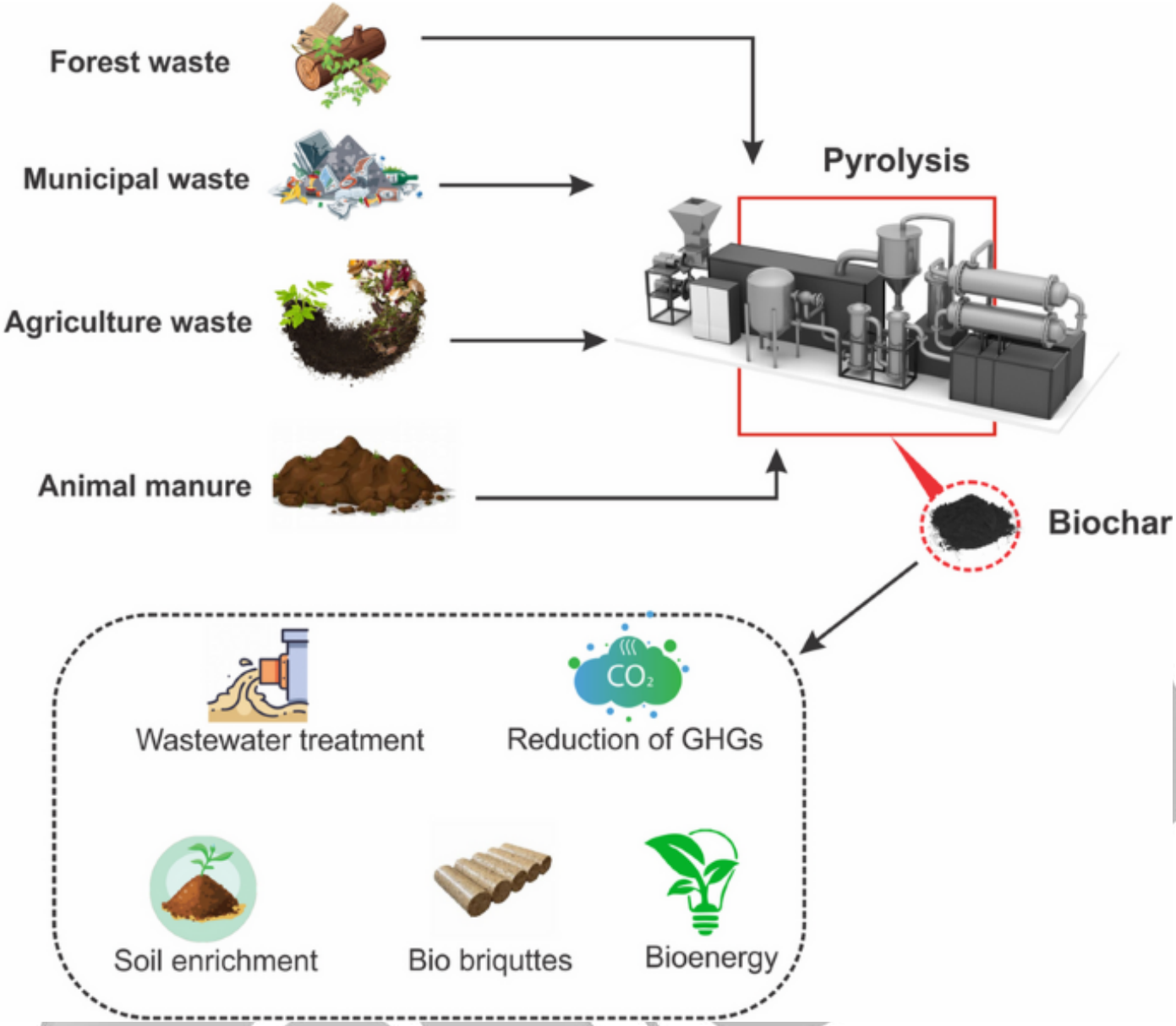
With the **Indian carbon marke**t set to be launched in **2026, CO_2 removal technologies** such as **biochar** are poised to play a pivotal role in **reducing emissions** and ensuring **sustainable growth.**

What are the Key Statistics Related to India's CO2 Emissions?

- **Total Emissions:** India contributes only **4% of global cumulative GHG emissions (1850–2019),** with **per capita emissions at about one-third of the world average**.
  - India reduced its **GDP emission intensity by 36% (2005–2020)**.
  - India is the **3rd largest emitter of greenhouse gases after China and the USA.**
- **Emission Hotspots:**
  - **India’s power sector,** dominated by coal-based thermal plants, is the **largest source of CO_2 emissions**, contributing about **50% of the country’s fuel-related emissions.**
  - The **transport sector, especially road transport**, accounts for around **12% of India’s energy-related CO_2 emissions.**
- These sectoral trends underscore the **urgency of advancing scalable CO_2 removal pathways, with solutions like biochar** offering significant potential to offset emissions and support India’s low-carbon transition.

What are the Potential Applications of Biochar?

- **About: Biochar** is a **carbon-rich charcoal** produced through **pyrolysis of agricultural residue and organic municipal waste**.
  - India produces over 600 million tonnes of agricultural residue and 60 million tonnes of municipal waste yearly. Much of this is burned or dumped, causing air pollution and greenhouse gas emissions.
  - Utilizing **30-50% of this waste for biochar** could remove around 0.1 gigatonnes of CO_2-equivalent each year.



- **Potential Applications of Biochar:**
  - **Carbon Capture:** Biochar's **stable structure** enables it to **sequester carbon** in soil for **100 to 1,000 years**, making it an effective **long-term carbon sink** that also enhances **soil organic carbon** and aids in the **restoration of degraded soils**.
    - Modified biochar can **adsorb CO_2** from **industrial exhaust gases**, but its **efficiency** is currently lower than **conventional carbon capture technologies**.
  - **Power Generation: Biochar production** through **pyrolysis** in India can generate approximately **20–30 million tonnes of syngas** and **24–40 million tonnes of bio-oil** as **valuable byproducts.**
    - **Syngas** can produce **8–13 Terawatt-hour (TWh) of electricity** annually.
    - **Bio-oil** can substitute **12–19 million tonnes of diesel or kerosene**, helping reduce **crude oil imports** and cutting **fossil fuel emissions** by over **2%**.
  - **Agriculture:** Applying **biochar** improves **water retention**, especially in **semi-dry** and **nutrient-depleted soils**. This leads to a **30-50% reduction in nitrous oxide emissions**, a potent **greenhouse gas** with **273 times** the warming potential of **CO_2**, making its mitigation critical for climate action.
  - **Construction Sector:** Incorporating **2-5% biochar** into concrete improves **mechanical strength**, increases **heat resistance by 20%**, and captures approximately **115 kg of CO_2 per cubic metre**.
  - **Wastewater Treatment:** Biochar is a **cost-effective** way to clean polluted water. India

produces over **70 billion litres** of wastewater daily, but **72% remains untreated**.

What are the Other Key CO_2 Removal Technologies?

- **Bio-based Solutions:**
  - **Afforestation & Reforestation**: **Large-scale tree planting** to absorb atmospheric CO_2.
  - **Agroforestry:** Integrating trees with crops/livestock for **carbon sequestration** and livelihood benefits.
  - **Soil Carbon Sequestration:** Practices like **conservation tillage** and **cover cropping** to enhance soil organic carbon.
- **Ocean-based Solutions:**
  - **Artificial Upwelling/Downwelling:** Moving nutrient-rich waters to surface or transporting CO_2-rich surface waters to depths.
  - **Seaweed Cultivation & Sinking:** Farming fast-growing **seaweeds** for carbon storage via **harvest or sinking.**
- **Bioenergy with Carbon Capture and Storage (BECCS):** It **combines biomass energy with CO_2 capture** and **geological storage,** enabling **renewable power** with net negative emissions.
- **Direct Air Capture (DAC):** It involves **chemical processes extracting CO_2 directly** from air for underground storage or product use.
  - **Eg**: Climeworks (Switzerland), Carbon Engineering (Canada).
- **Carbon Capture, Utilisation, and Storage (CCUS): CCUS captures CO_2 from industrial emissions** for reuse (synthetic fuels, building materials) or storage.

Keywords for Mains

- **Black Gold for Green Future**: Carbon sequestration & improved soil health
- **Nature's Carbon Vault:** Long-term, stable carbon storage with environmental co-benefits
- **Bioenergy Trifecta:** Biochar, syngas, and bio-oil produced via pyrolysis
- **Circular Carbon Economy:** Closing the loop in energy and material use
- **Farm to Fuel:** Decentralized rural biochar units generating local energy and livelihoods

Conclusion

Promoting biochar and other **CO_2 removal technologies** can turn the climate challenge into **sustainable growth opportunities,** helping India meet its **Paris Agreement goals** and build a **low-carbon, climate-resilient future.**

Drishti Mains Question:

In light of the recent push towards biochar production in India, discuss the role of CO_2 removal technologies in mitigating climate change. What are the challenges and opportunities associated with their large-scale deployment?

UPSC Civil Services Examination, Previous Year Question (PYQ)

Q. What is the use of biochar in farming? (2020)

1. Biochar can be used as a part of the growing medium in vertical farming.
2. When biochar is a part of the growing medium, it promotes the growth of nitrogen-fixing microorganisms.
3. When biochar is a part of the growing medium, it enables the growing medium to retain water for a longer time.

Which of the statements given above is/are correct?

(a) 1 and 2 only
(b) 2 only
(c) 1 and 3 only
(d) 1, 2 and 3

Ans: (d)

Q. With reference to the usefulness of the by-products of the sugar industry, which of the following statements is/are correct? (2013)

1. Bagasse can be used as biomass fuel for the generation of energy.
2. Molasses can be used as one of the feedstocks for the production of synthetic chemical fertilizers.
3. Molasses can be used for the production of ethanol.

Select the correct answer using the codes given below:

(a) 1 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

Ans: (c)

India's 3rd Voluntary National Review on SDGs

Source: PIB

Why in News?

NITI Aayog presented its **3rd Voluntary National Review (VNR) Report** on the **Sustainable Development Goals (SDGs)** at the **High-Level Political Forum (HLPF)** convened by the **UN-Economic and Social Council (ECOSOC)**.

- India presented the **first voluntary national review of SDGs in 2017 & second in 2020.**

Note: VNR is a country-led, voluntary process that promotes the sharing of experiences to accelerate the implementation of the **2030 Agenda for Sustainable Development Goals (SDGs).**

- VNR highlights India's **Whole-of-Government and Whole-of-Society Approach** to Achieving the SDGs.
- **NITI Aayog** is the **nodal authority** for SDG implementation and VNR preparation in India.

What are the Key Highlights of India's 3rd Voluntary National Review (VNR)?

- **Implementation Strategy:** India employs **data tool**s like the **SDG India Index, North-Eastern**

Region District SDG Index, and **Multi-dimensional Poverty Index (MPI)** to **monitor progress, identify lagging areas, and guide policies**.
    - Its emphasis is placed on **localizing SDGs** through **sub-national and district-level actions.**
- **Key Progress:**
    - **SDG 1 (No Poverty):** An estimated **248 million people** have escaped **multidimensional poverty** between **2013-14 and 2022-23,** highlighting effective poverty alleviation strategies.
    - **SDG 2 (Zero Hunger):**
    - The **PM Garib Kalyan Anna Yojana** has provided vital nutritional support to **millions**, aiming to assist approximately **81.35 crore beneficiaries**. Starting in 2024, the scheme will continue for the next five years.
    - **SDG 3 (Good Health and Well-being): POSHAN Abhiyaan** and **Ayushman Bharat** have **expanded access to quality nutrition and healthcare.**
        - **Out-of-pocket health expenditure** as a percentage of total health spending declined from **62.6% in 2014-15 to 39.4% in 2020-21.**
    - **SDG 7 (Clean Energy Transition):** Initiatives such as the **National Green Hydrogen Mission**, **PM-KUSUM**, and **PM Surya Ghar Muft Bijli Yojana** have accelerated India's adoption of **sustainable energy sources.**
    - **SDG Progress Through Digital Financial Inclusion:** India's **Jan Dhan–Aadhaar–Mobile (JAM)** based **Digital Public Infrastructure (DPI)** drives **inclusive, transparent services**.
        - India accounted for **48.5% of global real-time payment volume in FY 2025,** driven by a **41.7% increase in UPI transaction volume.**

UN High-Level Political Forum (HLPF)

- **About**: HLPF is the **main United Nations platform** dealing with **sustainable development,** and was formally **established in July 2013.**
    - It meets **every year under the auspices of the Economic and Social Council**, and **every four years** under the auspices of the **General Assembly.**
- **Functions:** It adopts **negotiated declarations** and serves as a **central platform** for **follow-up** and **review of the 2030 Agenda for Sustainable Development and its 17 SDGs.**
    - It is **responsible for guiding the entire UN policy framework** on **sustainable development**.
- **Reporting Mechanism:** Member countries are required to voluntarily present their progress through **VNR reports**.
    - The VNR enables member states to **report periodically on SDG progress** through a **voluntary, transparent, and accountable process,** fostering knowledge sharing and best practices.

Drishti Mains Question:

How does Voluntary National Review contribute to the implementation of the Sustainable Development Goals (SDGs)? Discuss its significance in fostering transparency, accountability among countries.

UPSC Civil Services Examination Previous Year Question (PYQ)

Q. With reference to the United Nations, consider the following statements: (2009)

1. The Economic and Social Council (ECOSOC) of UN consists of 24 member States.
2. It is elected by a 2/3rd majority of the General Assembly for a 3-year term.

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

Ans: (b)

Q. Sustainable development is described as the development that meets the needs of the present without compromising the ability of future generations to meet their own needs. In this perspective, inherently the concept of sustainable development is intertwined with which of the following concepts? (2010)

(a) Social justice and empowerment
(b) Inclusive Growth
(c) Globalization
(d) Carrying capacity

Ans: (d)

Mains

Q. Access to affordable, reliable, sustainable and modern energy is the sine qua non to achieve Sustainable Development Goals (SDGs).” Comment on the progress made in India in this regard. (2018)

Tuvalu

Source: TOI

In a historic first, **Tuvalu** is set to **relocate its population to Australia** under the **Falepili Union Treaty (2023),** marking the **world’s first planned migration** due to climate change-induced sea-level rise.

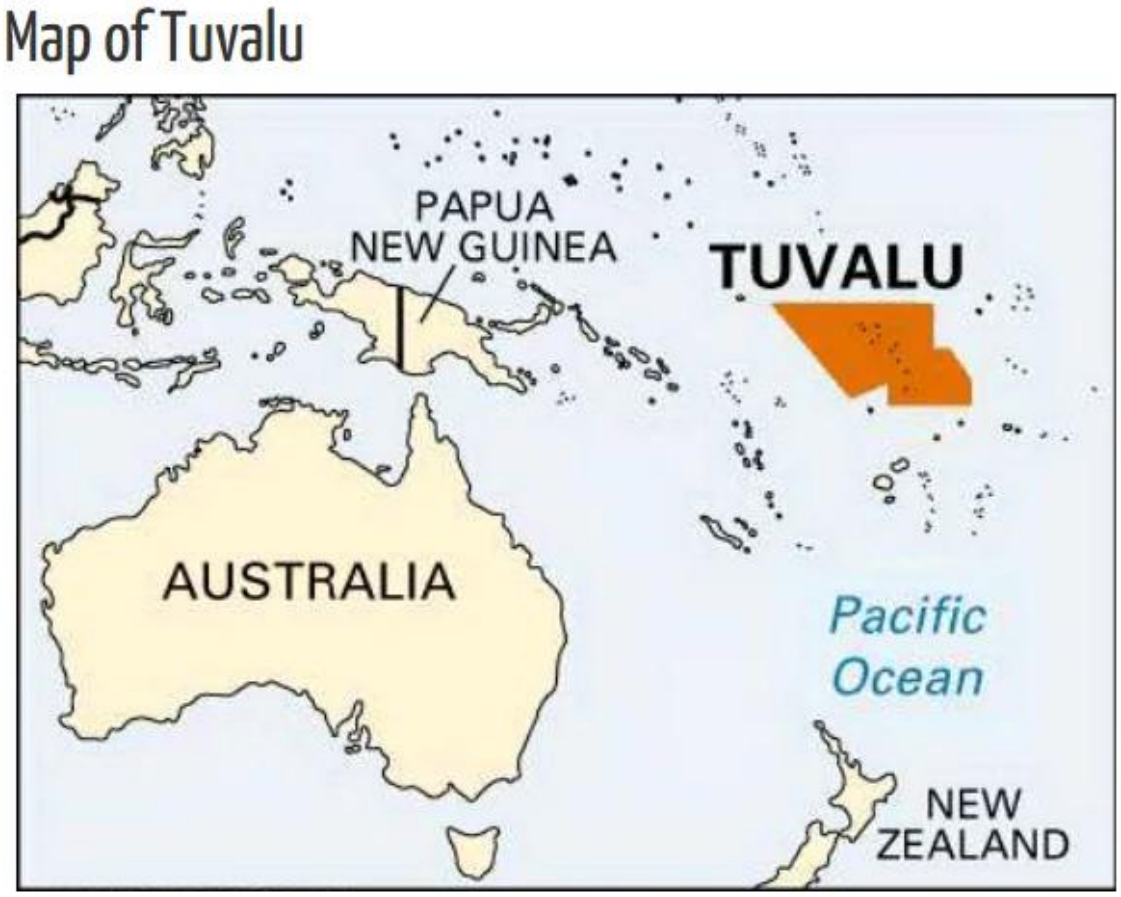
- **Falepili Union Treaty:** Australia will accept 280 **Tuvaluans annually** as **permanent residents** through a ballot-based “climate visa” starting in 2025, granting them equal rights to health care, education, housing, and jobs.
  - Residents may return if conditions improve, though worsening floods and storms make this unlikely.
- **Reason for Migration**: Rising **sea levels threaten Tuvalu’s existence**, with **NASA** predicting **submergence of most of its land by 2050.**
  - Tuvalu's average elevation is only **2 meters above sea level**, making the nation highly prone to floods, storms, and coastal erosion.

Tuvalu

- Formerly known as the **Ellice Islands**, Tuvalu is a **Polynesian island country** located midway between **Hawaii and Australia** in the South Pacific Ocean. It comprises **nine islands** (four **reef islands** and five **coral atolls**).
  - Tuvalu, with **Funafuti** as its capital, gained independence from the **United Kingdom** in October 1978.
- With no rivers, it has a **tropical climate** and one of the smallest populations in the world, around 11,000.
- Tuvalu, a **United Nations** designated **Least Developed Country,** has a public sector–dominated

economy supported by **fishing licences.**

- The **Tuvalu Trust Fund,** set up with contributions from Australia, New Zealand, the UK, Japan, and South Korea, provides financial stability and funds development projects such as upgrading schools and fisheries centres.



Read more: [Tuvalu's Fight Against Rising Sea Levels]

NASA’s Lunar Nuclear Reactor

Source: IE

NASA is accelerating its plans to build a **nuclear reactor on the moon by 2030,** with the goal of establishing a permanent human presence on the lunar surface, all while adhering to the **Artemis Accords.**

- **Reactor Specifications**: The reactor is expected to generate **100 kilowatts of power**, which is smaller than on-shore wind turbines (typically generating 2-3 megawatts).
    - Nuclear reactors are explored because **solar power is unreliable on the Moon due to extended darkness,** and nuclear energy provides consistent power for habitats, rovers, and missions, particularly in shadowed craters.
    - The UN's 1992 **Principles Relevant to the Use of Nuclear Power Sources in Outer Space** recognize **nuclear energy as essential for deep-space missions,** especially when solar power is insufficient.
- **Global Competition**: Nasa’s push comes after similar plans by **China and Russia** to set up automated nuclear power stations on the moon by 2035.
    - Other countries, including **India and Japan**, are also trying to explore the moon and

establish human settlements.

- **Legal Framework:** The **1967 Outer Space Treaty** allows peaceful use of **nuclear power** in space, setting guidelines for transparency, safety, and international cooperation.
    - Also, the **Artemis Accords** provides for international cooperation in space exploration, emphasizing **transparency, peaceful use, and responsible use of space resources.**

Read more: Exploring Space, Advancing Life on Earth, India Joins Artemis Accords

---

GeM Marks 9 Years of Transforming Public Procurement

Source: PIB

The **Government e-Marketplace (GeM)** marked its **9th Foundation Day** with the theme **"Ease, Access and Inclusion."**

Government e-Marketplace

- **About: GeM**, launched in **2016** by the **Ministry of Commerce**, is an **online platform** for procurement of **goods and services** by **Central and State Government Ministries**, **Departments**, **Public Sector Units (PSUs)**, and their **affiliates.**
    - It is managed by **GeM Special Purpose Vehicle (SPV)**, a **100% government-owned**, **not-for-profit** entity.
    - The **Ministry of Finance** has made purchases through **GeM mandatory** for government purchases under the **General Financial Rules, 2017**.
- **Objective:** It promotes **transparency**, **efficiency**, and **fairness** in **government procurement**, streamlining processes and curbing **corruption**.
    - Independent assessments, including from the **World Bank**, validate GeM's impact, noting an **average cost saving of nearly 10% in government procurement.**
- **Inclusivity:** It empowers over **10 lakh MSEs**, **1.3 lakh artisans and weavers**, **1.84 lakh women entrepreneurs**, and **31,000 startups** in the **GeM** ecosystem.
    - Also, GeM has introduced **GeMAI**, India's first **generative AI-powered public sector chatbot**, with **voice and text support** in **10 Indian languages**.

Read More: Government e-Marketplace
