1. **Beetle-fungi Alliance** : Recently, researchers from the Kerala Forest Research Institute (KFRI) uncovered a serious ecological and economic threat facing Kerala, which produces 90% of India's natural rubber. A destructive alliance between the **ambrosia beetle (Euplatypus parallelus)** and two fungal pathogens—**Fusarium ambrosia** and **Fusarium solani** , has begun decimating rubber plantations across the state.
   - **About Ambrosia Beetle :** Belong to the wood-boring insect families. Found in Eastern Africa, India, Sri Lanka, China, Japan, Southeast Asia, Central and South America
     - **Feeding Behavior**: Prefer dead or dying trees to cultivate ambrosia fungi, which serve as their primary food source.
     - **Attraction Mechanism**: Drawn to trees that emit volatile organic compounds (like ethanol) when stressed or weakened.
     - First reported in India in 2012 in cashew plantations of Goa.
     - Recently detected in the Irrity-Kannur rubber belt of Kerala.
     - **Fungal Association**: Carries fungal pathogens into host trees and cultivates them within tunnels (galleries) bored into the bark.
   - **About Fusarium ambrosia:** It is cultivated by beetles inside host trees as a food source.
     - Considered **weakly pathogenic** but plays a role in tree decline when beetles bore into stressed trees.
     - Carried in **mycangia** (specialized organs) of beetles and inoculated into tree xylem.
     - Reported in Asia, Africa, and recently in India, often associated with invasive ambrosia beetles.
   - **About Fusarium solani:** Fusarium solani species complex (FSSC)
     - A **soil-borne** fungus found globally and **pathogenic** to plants, humans, and animals.
     - **Plant Pathogen**: Causes root rot, stem canker, and fruit rot in crops like legumes, cucurbits, and potatoes.
     - **Human Pathogen**: Opportunistic infections in immunocompromised individuals.
2. **Brahmaputra :** Recently, China officially commenced construction on a massive $170 billion hydropower project on the **Yarlung Zangbo** River, just before it enters India’s Arunachal Pradesh and becomes the **Brahmaputra.**

- The development has raised serious concerns in India, especially in Arunachal Pradesh, due to potential risks of sudden flooding, ecological degradation, and disruption to India's own hydropower initiatives in the Northeast.



- **About Brahmaputra :** A major Himalayan river system in Asia, vital for water, agriculture, and biodiversity. It stretches **over 2,900 km**, flowing through **Tibet, India, and Bangladesh**.
  - Originates from the **Chemayungdung Glacier** in **southwestern Tibet** near the sources of the Indus and Satluj rivers. In Tibet, it is known as **Yarlung Tsangpo.**
  - **India (Arunachal Pradesh)**: Enters as **Dihang**; after merging with Lohit and Dibang rivers near Sadiya, it becomes the **Brahmaputra**.
  - **Assam**: Flows westward, forming river islands like **Majuli** and **Umananda**.
  - **Bangladesh**: Known as the **Jamuna**, it merges with the **Ganga** and **Meghna**, forming the **Sundarbans Delta**.
  - **Major tributaries** : Subansiri, Manas, Teesta, Lohit, Dibang, Kameng etc

3. **Sickle Cell Disease (SCD) :** Recently, India achieved a major milestone under the **National Sickle Cell Anemia Elimination Mission,** having screened over 6 crore individuals for **Sickle Cell Disease (SCD**) out of the targeted 7 crore.
   - **About SCD :** A hereditary blood disorder caused by mutations in the gene responsible for producing hemoglobin.
     - **Cell Shape Abnormality**: Unlike healthy disc-shaped red blood cells, affected individuals have red blood cells shaped like a crescent or sickle.
     - **Health Impact**: Leads to reduced red blood cell lifespan and chronic anemia.
       - ✓ Causes poor oxygen delivery and blockages in blood vessels.
       - ✓ Can result in acute pain episodes, severe infections, and tissue death (necrosis).
       - ✓ Long-term damage to organs like the heart, lungs, and kidneys is common.
     - **Prevalence in India**: Primarily affects tribal populations in Odisha, Jharkhand, Chhattisgarh, Madhya Pradesh, and Maharashtra.
     - **Treatment**: Gene therapy and stem cell transplantation

- **National Sickle Cell Anaemia Elimination Mission:** Launched as part of the Union Budget 2023.
  - **Vision**: To eliminate SCD as a public health problem in India by the year 2047.
  - **Objective**: Improve healthcare access and outcomes for all SCD patients.
    - ✓ Reduce the prevalence of the disease, especially among tribal populations.
    - ✓ Promote awareness, screening, behavioural change, and counselling.
  - **Target Population**: Universal screening of **7 crore individuals** aged **0–40 years** in high-prevalence tribal regions.
  - **Key Activities**: Awareness generation campaigns, large-scale screening and testing, Genetic counselling and community engagement, Inter-ministerial and state collaboration for coordinated efforts.
  - **Focus States (17 high-prevalence states)**: Gujarat, Maharashtra, Rajasthan, Madhya Pradesh, Jharkhand, Chhattisgarh, West Bengal, Odisha, Tamil Nadu, Telangana, Andhra Pradesh, Karnataka, Assam, Uttar Pradesh, Kerala, Bihar, and Uttarakhand.

4. Fusariosis : Recently, Indian researchers at the Bose Institute developed a fungus-resistant variety of pineapple by overexpressing the **AcSERK3** gene, providing a sustainable and effective solution against **Fusariosis**

- **About Fusariosis** : Caused by the aggressive fungus **Fusarium moniliforme** and considered one of the most serious threats to pineapple cultivation.
  - **Impact on Crop**: Deforms the plant's stem.
    - ✓ Causes blackening of leaves.
    - ✓ Rots the fruit internally, making it unfit for consumption.
    - ✓ Leads to significant crop losses and highly unreliable harvests.
- **Key Highlights :** Scientists have discovered a key gene: **Somatic Embryogenesis Receptor Kinase (SERK)**, which helps activate **plant immune responses**.
  - By **overexpressing AcSERK3**, researchers boosted the pineapple's **natural defence system**.
  - The genetically enhanced plants showed **greater resistance to Fusarium fungus** compared to normal varieties.
- **About Pineapple :** Most economically important fruit of the **Bromeliaceae family**.
  - Grows best at **low elevations** with **temperatures between 15–30°C**.

- Highly **drought-tolerant**, due to **special water-storage cells**.
- **Rainfall :** Tolerates **600–2500 mm/year** (Optimum range: 1000–1500 mm/year)
- **Soil Conditions:** Adaptable to various soils but **cannot tolerate waterlogging**.
- Can be cultivated as a **monocrop or intercrop** (especially with coconut).

- **India:** Assam, Meghalaya, Tripura, Manipur, West Bengal, Kerala, Karnataka and Goa
- **World :** Thailand, Philippines, Brazil, China etc

5. **Devadasi System :** Recently, in a landmark move to enhance protection and rehabilitation for women affected by the **Devadasi system**, the Karnataka government is finalising a new draft law titled the **Karnataka Devadasi (Prevention, Prohibition, Relief and Rehabilitation) Bill**.
   - This proposed legislation aims to replace the outdated **Karnataka Devadasi (Prohibition of Dedication) Act, 1982**.
   - **About Devadasi system:** A cultural and religious practice historically prevalent in South and parts of Western India.
     - **Meaning of Devadasi**: A girl who is "dedicated" to the worship and service of a deity or temple for life.
     - **Age of Dedication**: Typically, girls between the ages of **8 and 16 years** were inducted into the system.
     - **Original Role**: Maintained temples and performed religious rituals.
     - Trained in and performed classical Indian art forms such as **Bharatanatyam** and **Odissi**.
   - **Need For Protection :** The Devadasi system leads to sexual exploitation and violates child rights and constitutional protections.
     - It targets young Dalit girls, reinforcing patriarchal and caste-based discrimination.
     - Devadasis face poor health, economic marginalization, and lack of social security.
6. **WiFEX-II :** Recently, the Indian Institute of Tropical Meteorology (IITM) announced the launch of WiFEX-II, an advanced phase of its decade-long **Winter Fog Experiment**, aimed at providing accurate, runway-specific fog forecasts for additional airports across north India.
   - **About Winter Fog Experiment :** Launched in winter 2015 at Indira Gandhi International Airport (IGIA), New Delhi and led by Indian Institute of Tropical Meteorology (IITM), under the Ministry of Earth Sciences (MoES).

- **Supported by**: India Meteorological Department (IMD) and National Centre for Medium Range Weather Forecasting (NCMRWF).
- **Significance**: One of the world's few long-term open-field experiments focused exclusively on **fog**, a major winter hazard in the Indo-Gangetic Plain.
- **Objectives :** To improve **now-casting (next 6 hours)** and **forecasting** of winter fog at various temporal and spatial scales.
  - ✓ To reduce the **adverse impact of fog** on **aviation, transportation**, and the **economy**.
  - ✓ To help prevent **loss of human life** caused by fog-induced accidents.

7. Smart Nano-Materials: Recently, scientists at the Centre for Nano and Soft Matter Sciences (CeNS), Bengaluru, developed **multi-layer nanomaterial** capable of detecting hazardous chemicals and explosives such as TNT and RDX, even at extremely low concentrations.

- **About Experiment** : A **trilayer nanomaterial** comprising: Reduced Graphene Oxide (rGO), Silver Nanoparticles (Ag) and Cerium Oxide (CeO_2)
  - **Unique Role of Each Layer**:
    - ✓ **Silver Nanoparticles (Ag)**: Enhance Raman signals, enabling **high-sensitivity detection** through Surface-Enhanced Raman Spectroscopy (SERS).
    - ✓ **Cerium Oxide (CeO_2)**: Prevents silver oxidation, improves stability in **hot and humid conditions**, and enhances **electron transfer** for clearer signals.
    - ✓ **Reduced Graphene Oxide (rGO)**: Suppresses **fluorescence noise**, allowing for **accurate and clean detection** of molecular fingerprints.
  - **Fabrication Method**: Developed using **Physical Vapor Deposition (PVD)** — a **scalable and reproducible** technique that ensures **uniform layering**.
- **Real-World Applications : Aviation Security**: Rapid, reliable detection of explosive traces on luggage or surfaces.
  - ✓ **Forensic Science**: Enhanced evidence collection in crime scenes involving explosives or toxins.
  - ✓ **Environmental Monitoring**: Trace-level detection of industrial pollutants or chemical leachates.