16th Jan, 2025

1. **The red flag as China's expansionist strategy rolls on**
   GS 2 (International relations)

- **Why in News:** Recent developments along the **China-India border** have heightened tensions, with China's actions—including constructing a dam on the Brahmaputra and creating new counties in Ladakh—challenging India's territorial integrity and sovereignty. These incidents, along with China's broader regional expansionism, have raised alarms about both water security and territorial disputes in South Asia.

- **Transboundary Water Issues and Strategic Concerns**
  o **Chinese Dam on the Brahmaputra**: China's plan to construct a massive hydropower dam on the **Yarlung Zangbo river** could reduce water flow to downstream countries, threatening agriculture, fisheries, and biodiversity in India and Bangladesh.
  o **Strategic Vulnerability**: The potential for devastating floods during monsoon seasons or geopolitical tensions due to the dam's water release presents significant strategic concerns for India.
  o **India's Response**: India is accelerating its own hydropower projects and constructing reservoirs in Arunachal Pradesh to counteract potential water shortages and mitigate risks posed by the Chinese dam.

- **Border Disputes and Cartographic Aggression**
  o **Chinese Territorial Claims:** China's actions, such as the creation of new counties and renaming locations in Arunachal Pradesh, are part of its ongoing strategy of cartographic aggression to assert territorial control.
  o **Lack of Legal Validity**: Despite China's territorial assertions, international law requires effective administrative control and sovereignty, making China's cartographic actions legally unsubstantiated.
  o **Strategic Leverage**: China's ongoing strategy of establishing settlements in disputed regions complicates India's efforts to maintain territorial integrity, despite its legal sovereignty over the areas.

- **South Asia's Bilateral Engagement with China**
  o **Bilateral Approach**: Unlike Southeast Asian countries, South Asian nations, including India, address their concerns with China individually due to the power imbalance.
  o **Need for Regional Cooperation**: India, as the dominant regional power, should spearhead a collective response to China's territorial and water-related disputes to strengthen South Asia's position.
  o **Multilateral Strategy:** A unified approach involving diplomatic engagement and regional cooperation would enhance South Asia's capacity to counter China's assertiveness and ensure regional security.

2. **SC Ruling on Clean Public Toilets as a Fundamental Right**
   GS 2 (Governance)

- **Why in News:** The **Supreme Court of India** delivered a significant judgment, declaring that **access to clean public toilets** is a **basic right** and essential for **human dignity**. This decision comes as part of a broader effort to address sanitation issues and ensure that public toilets are available, accessible, and maintained for everyone, regardless of gender or disability.

- **Key Points of the Judgment:**
  - Toilets are a "facet of human rights" and the failure to provide these adequately in courts "reflects a deeper flaw in the justice system".
  - **Right to Sanitation:** The court emphasized that having access to clean and functional toilets is not just a matter of convenience but is a fundamental right under Article 21 of the Indian Constitution, which guarantees the right to life and personal liberty.
  - This right also includes the need for a safe and hygienic environment, especially in public spaces like courts, tribunals, and highways.
  - **Gender-Sensitive Facilities**: The judgment specifically mentioned the need for gender-sensitive toilets that cater to all people, including men, women, persons with disabilities, and transgender persons.
  - The court said that States and Union Territories have a responsibility to ensure these facilities are available, accessible, and maintained throughout the year
  - **Public Health and Welfare:** The judgment also stressed that providing clean public toilets contributes to public health and well-being. It highlighted that the absence of basic sanitation facilities undermines the welfare state model, which is supposed to provide essential services to all citizens.
  - The Supreme Court directed that separate toilet facilities be constructed for all genders, especially in courts and tribunal buildings.
- **Why sanitation should be a basic human right for all?**
  - According to the **World Health Organization,** around half the people in the world are in danger of disease because they don't have access to a clean, safe toilet.
  - Close to 494 million people are still forced to defecate in the open.
  - **WaterAid's research** shows that **every two minutes, a child under five dies from a disease linked to unsafe water and sanitation**.
  - Investment in water and sanitation boosts the economy. A toilet is not just a toilet, it's also an opportunity-maker, a dignity-provider and a lifesaver.
- **India's Sanitation Policies**
  - **Swachh Bharat Abhiyan (Clean India Mission):** Launched in 2014, this nationwide campaign aimed to eliminate open defecation and ensure that every household has access to a toilet.
    - Under SBM-Grameen, substantial progress has been made, including the construction of over **11.73 crore** household toilets, resulting in more than **5.57 lakh ODF Plus villages**.
    - This initiative significantly contributed to public health, with WHO reporting **300,000 fewer diarrheal deaths by 2019 compared to 2014**.
  - **Jal Shakti Abhiyan (Water Power Mission):** Started in 2019, this mission aimed to address water scarcity and improve water conservation. It focuses on five key areas: harvesting rainwater, renovating old water bodies, reusing treated wastewater, interlinking rivers, and recharging groundwater. The mission successfully renovated over 1.54 lakh water bodies.
  - **Community-Led Total Sanitation (CLTS):** This approach involves communities taking responsibility for their own sanitation needs. By 2015, more than 7.5 lakh villages in India had become open defecation-free through this initiative, with communities leading the change.
  - **E-Toilets**: These are self-cleaning, eco-friendly toilets installed in public places. They automatically clean and disinfect themselves after use, ensuring hygiene without needing manual cleaning.
  - **Bio-Digesters**: In rural areas, bio-digesters are used to treat human waste through bacterial decomposition. These toilets produce biogas and water and don't require connection to a sewage system, offering a low-maintenance and sustainable solution.
  - **Mobile Toilets**: Mobile toilets are temporary, movable sanitation facilities installed in public places like bus stands, railway stations, and crowded marketplaces. They provide hygiene facilities during large events or in areas lacking permanent toilets.
  - **World Toilet Day**, celebrated annually on **November 19**, is an official United Nations observance aimed at raising global aw areness and action to address the urgent sanitation crisis.

3. **Kashi Tamil Sangamam (KTS 3.0)**
   GS 1 (Art and Culture)

- **Why in News:** The government recently launched the registration portal for the **third edition of the Kashi Tamil Sangamam (KTS 3.0)**, scheduled to take place from **15th February to 24th February 2025** in **Varanasi, Uttar Pradesh**. This 10-day event aims to strengthen the cultural and intellectual connections between **Tamil Nadu** and **Kashi (Varanasi)**, two iconic cultural and spiritual hubs of India.
- **What is Kashi Tamil Sangamam (KTS)?**
    o **Kashi Tamil Sangamam** is a significant cultural initiative that aims to celebrate and reinforce the centuries-old bond between the two cultural regions
        ▪ **Tamil Nadu** in the south
        ▪ **Kashi (Varanasi)** in the north
    o This initiative is part of the broader vision of **Ek Bharat Shrestha Bharat** (Unified India), which seeks to promote cultural integration and understanding across different regions of India.
    o It also aligns with the vision of the **National Education Policy (NEP) 2020**, which emphasizes integrating traditional knowledge systems with modern education.
    o **What Makes KTS Special in 2025?** This year's edition (KTS 3.0) holds special significance as it coincides with the **Mahakumbh Mela** in Varanasi and the **Pran Pratishtha** (inauguration) of the Shri Ram Lalla temple in **Ayodhya**.
    o **Central Theme:** The central theme of this year's event is **Maharishi Agasthyar**, a revered sage whose contributions to Tamil literature, philosophy, science, linguistics, and culture have deeply influenced both Tamil Nadu and India's knowledge traditions.
        ▪ **Maharishi Agasthyar's legacy** is celebrated for his intellectual brilliance, and his teachings continue to shape the cultural and spiritual life in Tamil Nadu, making him the central figure of KTS 3.0.
    o The connection between **Tamil Nadu** and **Kashi (Varanasi)** is not only historical but also deeply spiritual.
    o In ancient times, Tamil scholars considered it a significant part of their education to visit **Kashi**, regarded as one of the most important spiritual and cultural centers in India.
    o The legacy of Kashi is also reflected in Tamil Nadu, with several temples named after **Kashi Vishwanath** and various references to **Kashi** in Tamil literature and culture.
    o A key example of this connection is the **story of King Parakrama Pandya** of Tamil Nadu, who brought a **Shiva Lingam** from Kashi to build a temple in
    o He is believed to have installed the lingam at **Sivakasi** after the cow carrying it refused to move further, symbolizing the divine wish.
    o Similarly, the **Kasi Viswanathar Temple** in **Tenkasi** was built by the Pandyas as a tribute to Kashi for devotees unable to travel to Varanasi
    o The **spiritual journey** of pilgrims from Tamil Nadu often involved traveling to **Rameswaram** first, then taking a dip in the **Koti Teertha** (a holy water tank), before proceeding to Kashi for darshan (worship). The journey was considered incomplete without both places.
- **Agastya Muni**
    - Agastya was a revered **Vedic sage of Hinduism**. He was born on **Shravanashukla Panchami in Kashi.**
    - Sage Agastya in Hinduism is revered for his wisdom, teachings, and significant role in various narratives.
    - He guides Rama, provides blessings, performs sacrifices, and symbolizes determination, illustrating the transient nature of life and empowering others.
    - Agastya has been mentioned in all the four Vedas of Hinduism.
    - He is one of the seven most revered rishis (the Saptarishi) in the Vedic texts,

Agasthyar's legacy to be the focus of Kashi Tamil Sangamam 3.0

The Hindu Bureau
NEW DELHI

The event, to be held at the Namo Ghat in Varanasi, will be held from Feb. 15 to 24

Announcing that the theme of the third edition of Kashi Tamil Sangamam will be the legacy and philosophy of Maharishi Agasthyar, Union Education Minister Dharmendra Pradhan said here on Wednesday that the intellectual brilliance of Agasthyar was the bedrock of the Tamil language and literature as well as the shared values, knowledge traditions and heritage of the country.

The event, to be held at the Namo Ghat in Varanasi, will begin on February 15 and will conclude on February 24.

The Minister also inaugurated the registration process for the Sangamam, and said the Centre expected 1,200 delegates from Tamil Nadu this time. The Sangamam will be held against the backdrop of the Kumbh Mela, Mr. Pradhan said.

The Union Education Ministry is the key organiser of the event. A document on Agasthyar temples in Tamil Nadu and another one on Siddha medicine will be released during the event, Mr. Pradhan said.

The last date of registration for the event is Febru-

ary 1. The participants will be selected after a Tamil quiz on February 2. The portal, kashitamil.iitm.ac.in, is hosted by the Indian Institute of Technology, Madras.

Responding to questions, Mr. Pradhan said the Centre had not used the Sangamam for any political purposes and the intention was cultural integration and upholding of the inseparable and timeless bonds between Tamil Nadu and Kashi.

The participants will be from five categories – students, teachers, and writers; farmers and artisans; professionals and small entrepreneurs; women from various sectors; and those involved in start-ups, innovation, edu-tech and research. "This year, an additional group of around 200 students of Tamil origin studying in various Central universities will be a part of this event to enliven the bond between Kashi and Tamil Nadu. Participation of youth in all categories will be encouraged this year," Mr. Pradhan said.

- **Saptarishi:** Agastya, Atri, Bhardwaja, Gautama, Jamadagni, Vashistha, and Vishvamitra (list by **Jaiminiya Brahmana**)
- He and his wife **Lopamudr**a are the celebrated authors of **hymns 1.165 to 1.191** in the **Sanskrit text Rigveda (1200 BC) and other Vedic literature**.
- Agastya appears in numerous itihasas and Puranas including **Ramayana and Mahabharata.**
- He is one of the **seven or eight most revered Rishis** in the Vedic texts.
- **Attributed author**: Agastya Gita found in Varaha Purana, Agastya Samhita found embedded in Skanda Purana, and the Dvaidha-Nirnaya Tantra text.
- He is a great yogi who has mastered **Kriya Yoga**, which is where he gained a lot of power.
- He is regarded as a significant link between **Vaisnavism and Shaivism.**
- He is the founder of Kerala's martial art Kalaripayattu, the southern style of Varmakkalai.
- **Popular work:** Agastya Samhita; Naadi Shastra**The Cultural and Philosophical Connection**

4. **Discovery of Semi-Dirac Fermions**
   GS 3 (Science and Tech)

- **Why in News:** Physicists recently made a significant discovery of a **new type of particle** called the **semi-Dirac fermion**. This discovery expands the understanding of particles that can exist under special conditions in certain materials.
- **Key Concepts:**
  - **Fermions and Bosons**:
    - **Fermions** are particles that make up matter (e.g., electrons protons), and they obey the Pauli exclusion principle (no two fermions can occupy the same quantum state).
    - **Bosons** are particles that mediate forces (e.g., photons).
  - **Dirac Fermions**: These fermions have mass and are not their own anti-particles. They are often found in materials like **graphene** (a single layer of carbon atoms).
  - **Semi-Dirac Fermions**: These are exotic particles that behave like **Dirac fermions in one direction** but **don't have mass** when moving in a perpendicular direction. This unique behavior makes them stand out from other known particles.
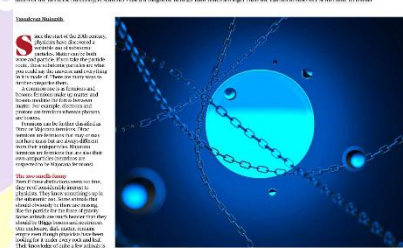- **Discovery Process:**
  - **Material Chosen**: The researchers studied a material called **Zirconium Silicon Sulphide (ZrSiS)**, which is a **layered crystalline material**. This material was chosen because of previous findings suggesting it could host these unusual particles.
  - **Research Findings**: When the researchers applied a strong **magnetic field** to ZrSiS, they found that the electrons in the material behaved differently than expected. The energy of the electrons (called **cyclotron energy**) in ZrSiS increased according to a **B2/3 scaling**, a unique feature associated with semi-Dirac fermions. This behavior was different from the energy scaling in materials like **graphene**, where the energy increases with the square root of the magnetic field strength (**B1/2**).
  - **Quasiparticles**: The **semi-Dirac fermion** discovered is technically a **quasiparticle**. A quasiparticle behaves like a single particle but is actually made up of many smaller particles or energy packets. For example, **protons** are quasiparticles made up of quarks and gluons. Similarly, semi-Dirac fermions can behave like fermions, despite their unusual mass properties in different directions.
- **Why It's Important?**
  - **New Particle in the Particle Zoo**: The discovery of **semi-Dirac fermions** adds a new and unique "animal" to the subatomic "zoo" of particles that physicists study. The more unusual particles physicists discover, the better they can understand the fundamental laws of nature.
  - **Condensed Matter Physics**: This discovery was made in the field of **condensed-matter physics**, which studies how matter behaves in different conditions, such as in solids and liquids. Unlike high-energy

particle physics, which requires massive machines like the **Large Hadron Collider**, condensed matter physics can sometimes discover new particles using simpler, tabletop experiments.

- o **Practical Implications**: The study of materials like ZrSiS helps scientists understand how particles behave in **strong magnetic fields** and other extreme conditions, potentially leading to new technologies and applications in the future.

5. **Key Developments and Implications of Gurpatwant Pannun Assassination Plot Case**
   Recent events of importance

- **Why in News:**
  - o The Indian government has taken steps to address allegations of an assassination plot targeting Khalistan separatist Gurpatwant Singh Pannun, based on inputs provided by the United States.
  - o A high-level committee set up by the Ministry of Home Affairs (MHA) investigated the case and **recommended legal action against an individual**, marking a critical development in the matter.
  - o **The timing of this report is pivotal**, coinciding with the transition to the Trump administration in the United States.

- **Gurpatwant Pannun Assassination Plot Case:**
  - o **Background of the case:** The US authorities provided evidence alleging the involvement of Vikash Yadav, a former Indian official, in a plot to assassinate Pannun, a US-Canada dual citizen and leader of the banned Sikhs for Justice group.
  - o **Formation of committee:**
    - ▪ The Indian government established a high-powered committee to probe the matter, investigate leads, and ensure due process.
    - ▪ The committee conducted independent inquiries.
    - ▪ Collaborated with US authorities, exchanging visits and scrutinizing evidence.
  - o **Key findings of the committee:**
    - ▪ The committee **identified criminal links and antecedents of the implicated individual**.
    - ▪ **Recommended expeditious legal action against the accused.**
    - ▪ **Proposed systemic and procedural improvements to prevent similar incidents.**

COMMITTEE HAS SUBMITTED REPORT: MHA

Pannun plot: Govt panel for legal steps against 'individual' with 'criminal links'

Panel set up after US shared inputs on alleged role of ex-official Vikash Yadav

MAHENDER SINGH MANRAL
NEW DELHI, JANUARY 15

E. Clean slate, due process

A HIGH-POWERED committee set up by the Union government to examine inputs provided by the United States on an alleged plot to kill Khalistan separatist Gurpatwant Singh Pannun has submitted its report and recommended "legal action against an individual", the Ministry of Home Affairs (MHA) said in a **CONTINUED ON PAGE 2**

THE MHA statement, days before US President-elect Donald Trump is sworn in, signals an attempt to approach the new US administration with a clean slate. It seeks to portray that 'due process' was followed, while distancing the government from the "individual". **PAGE 8**

- **US Allegations and Global Context:**
  - o **US indictment:**
    - ▪ Vikash Yadav, along with another Indian national, Nikhil Gupta, was implicated in a plot to pay an assassin $100,000 to kill Pannun in New York.
    - ▪ Gupta was detained in Prague and later extradited to the US.
    - ▪ Yadav, no longer a government employee, faced legal challenges in India, including an extortion case
  - o **Broader implications:**
    - ▪ The revelations followed **Canadian Prime Minister Justin Trudeau's earlier accusations** against Indian officials in the killing of Hardeep Singh Nijjar, another Khalistan separatist.
    - ▪ **India rejected Trudeau's claims but responded seriously to US allegations, signaling a different approach.**

- **Strategic and Political Implications:**
  - o **Maintaining bilateral relations:**
    - ▪ India's timing of the report and its clean-slate approach aims to **strengthen ties with the incoming US administration under Donald Trump.**
    - ▪ Meetings with outgoing and incoming US National Security Advisors emphasize India's intent to insulate future engagements from past incidents.

- o **Commitment to due process:**
  - The extensive investigation underscores India's adherence to **procedural fairness**.
  - By highlighting the accused as a rogue element, **the government distances itself from the individual's actions.**
- o **Response to accountability demands:**
  - The committee's recommendations for systemic reforms signal India's commitment to transparency and accountability.
  - Steps to enhance control mechanisms and coordinated responses **aim to prevent recurrence.**
- o **Prioritizing Indian legal jurisdiction:**
  - The committee's recommendation for expeditious legal action within India preempts any US attempts to extradite or try Yadav in American courts.
  - This move asserts India's sovereignty over its legal proceedings.
- o **Canada relations:** The report's release **provides an opportunity for future Canadian leadership to rebuild ties** strained over allegations against India.
- **Conclusion:**
  - o The Indian government's measured response to the Pannun assassination plot reflects its **focus on balancing international relations**, ensuring legal accountability, and upholding due process.
  - o By addressing systemic gaps and strengthening procedural safeguards, **India aims to navigate the complex geopolitical dynamics while maintaining its global credibility.**

6. **New US AI export rule excludes India from benefits of closest allies**
   GS 2 (International Relations)

- **Why in News:**
  - o The Joe Biden administration, days before leaving office, introduced a regulatory framework titled 'Framework for Artificial Intelligence Diffusion' that categorizes countries into three tiers for AI hardware export restrictions. The first tier includes 18 close US allies with minimal restrictions, while the third tier severely restricts exports to countries of concern.
  - o The rules aim to maintain US control over advanced AI chips and models, but their enforcement will depend on the incoming Trump administration.
- **Three-Tier Framework for AI Hardware Export Restrictions**
  - o **Tier 1: Closest US Allies**
    - Includes 18 countries like Australia, Canada, Germany, Japan, and the UK.
    - No restrictions on computing power deployment by US companies.
    - Security requirements are minimal.
  - o **Tier 2: Majority of Countries, Including India**
    - Most countries fall in this category, including India.
    - Limited to importing around 50,000 advanced AI chips through 2027, which could double with a US agreement
    - India is placed in the middle tier, facing some limitations on importing GPUs, potentially impacting its plan to acquire 10,000 GPUs for the IndiaAI Mission.
    - Large AI data centers could face challenges, but smaller firms remain unaffected.
  - o **Tier 3: Restricted Countries** (severely restricts exports to countries of concern)
    - Includes nations like Russia, China, North Korea, and Libya.

- Export of US AI technology to these countries is nearly prohibited.
- **Special Provision for India and China**
  - The law also envisions a special review called the **General Validated End User**.
  - **This list includes only two countries: India and China**.
    - **India:** Indian companies that get this authorisation can use the exported items for civilian & military purposes, but not for nuclear use.
    - **China:** Chinese companies with this authorisation can only use the technology for civilian use.
- **Why did the US impose these caps?**
  - To prevent adversaries like China, Iran, and Russia from accessing advanced AI technologies.
  - To build a trusted technology ecosystem while addressing national security risks.
  - The policy aims to protect US technological leadership without stifling innovation.
- **Potential Impact on India**
  - **Short-term Impact:**
    - Experts feel that India's initial plan to procure 10,000 GPUs for the ₹10,000-crore IndiaAI Mission is unlikely to be affected.
    - Subsidised GPUs will be provided to startups, academia, and researchers for training AI models.
  - **Long-term Concerns:**
    - Licensing uncertainties and trade negotiations may challenge large-scale AI deployments.
    - Companies like Reliance and Yotta, aiming to build AI compute infrastructure, could face delays.
    - Scaling up AI data centers requiring several hundred thousand GPUs may become difficult.
- **India's Response and Options**
  - Current demand can be fulfilled, but future scaling may require reassessment of restrictions by the incoming Trump administration.
  - India could secure General National Validated End User authorisations due to its non-re-exporter status and support from Nvidia and AMD.
  - The country's AI market is projected to grow to $17 billion by 2027 at an annual rate of 25%-35%.
- **Nvidia's Criticism of the AI Diffusion Rules**
  - Nvidia, dominating the AI GPU market, criticized the Biden administration's new AI diffusion rules as:
    - **Overreaching and Bureaucratic**: Described the 200+ page regulatory framework as excessive, secretive, and lacking proper legislative review
    - **Harming US Competitiveness**: Claimed the rules impose unnecessary controls over semiconductor and software design and marketing, weakening US innovation and global leadership.
    - **Contrasting Trump's Approach**: Praised the first Trump administration for fostering AI growth through industry competition without compromising national security, contrasting it with Biden's policies.
  - Nvidia suggested the new rules would hinder innovation rather than mitigate any threats.

7. INS Surat, INS Nilgiri and INS Vaghsheer commissioned
GS 2 (Security)

- **Why in News:** Three frontline combatants were commissioned into the Indian Navy at the Naval Dockyard in Mumbai: **INS Nilgiri**, the lead ship of the Project 17A stealth frigate class; **INS Surat**, the fourth and final ship of the Project 15B stealth destroyer class; and **INS Vaghsheer**, the sixth and final Scorpene-class submarine.
- **What is INS Nilgiri?**
  - **Nilgiri-Class Stealth Frigates: An Overview**
    - The Nilgiri-class stealth frigates, developed under Project 17A, are advanced follow-on vessels of the Shivalik-class (Project 17).

- These multi-mission frigates are designed for blue-water operations, capable of handling both conventional and non-conventional threats.

  o **Key Features and Capabilities**
    - Integrated construction for faster building times.
    - Equipped with supersonic surface-to-surface missiles, Medium Range Surface-to-Air Missiles (MRSAM), upgraded 76 mm guns, and rapid-fire close-in weapon systems.
    - Versatile roles in anti-surface, anti-air, and anti-submarine warfare.

  o **INS Nilgiri: Lead Ship of Project 17A**
    - **Construction and Launch**: Keel laid in December 2017; launched in September, 2019.
    - **Sea Trials**: Began in August 2023, followed by comprehensive harbour and sea trials.
    - **Delivery**: Handed over to the Navy in December 2024.

  o **Other Ships in the Class**
    - The remaining six frigates — **Himgiri, Taragiri, Udaygiri, Dunagiri, Vindhyagiri** — are under construction at Mazagon Dock Shipbuilders Limited (MDL), Mumbai, and Garden Reach Shipbuilders and Engineers (GRSE), Kolkata.

- **What is INS Surat?**
  o **INS Surat: Overview of Project 15B Destroyers**
    - INS Surat is the fourth and final stealth guided missile destroyer under Project 15B, following **INS Visakhapatnam**, **INS Mormugao**, and **INS Imphal**, commissioned over the last three years.
    - It represents an advanced iteration of the **Kolkata-class destroyers** built under Project 15A.

  o **Key Features of INS Surat**
    - **India's First AI-Enabled Warship**: Utilizes indigenously developed artificial intelligence solutions for enhanced operational efficiency
    - **Specifications**:
      - Displacement: 7,400 tonnes.
      - Length: 164 metres.
      - Speed: Achieved speeds exceeding 30 knots (56 km/h) during sea trials.
    - **Advanced Armaments**: Equipped with state-of-the-art surface-to-air missiles, anti-ship missiles, torpedoes, and modern sensors for network-centric warfare.

  o **Project 15B: Evolution of Stealth Destroyers**
    - Built as an advanced variant of the Kolkata-class destroyers under Project 15A (INS Kolkata, INS Kochi, INS Chennai).
    - Contract Signing: January 2011, for four destroyers designed by the Indian Navy's Warship Design Bureau and built by MDL.

  o **Role of Destroyers in Naval Operations**
    - High-speed, manoeuvrable warships with greater strike capability and endurance.
    - Critical assets for offensive operations and network-centric warfare, integrating force elements using advanced IT and communication tools.

- **What is INS Vaghsheer?**
  o **INS Vaghsheer: Overview of the Kalvari Class Submarine**
    - INS Vaghsheer is the sixth and final submarine of the modern Kalvari class built under Project 75, designed for stealth and versatility in naval operations.

  o **Design and Capabilities**
    - **Based on the Scorpene Class**: Developed from the Scorpene design by French defence major Naval Group and Spanish entity Navantia.

- **Diesel-Electric System**: Primarily "attack" or "hunter-killer" submarines, built to target and destroy adversary naval vessels.
- **Silent and Versatile**: Known as one of the world's most silent and versatile diesel-electric submarines.
  - o **Mission Versatility**
    - **Wide Range of Missions**: Includes anti-surface warfare, anti-submarine warfare, intelligence gathering, area surveillance, and special operations.
    - **Armament**: Equipped with wire-guided torpedoes, anti-ship missiles, and advanced sonar systems.
  - o **Naming and Heritage**
    - **Named After Sandfish**: INS Vaghsheer is named after a species of sandfish found in the Indian Ocean.
    - **Historical Significance**: The Kalvari class submarines take their names from decommissioned classes, including Kalvari, Khanderi, Karanj, and the Vela class (which included Vela, Vagir, Vagshir), reflecting the early Soviet-origin Foxtrot class submarines of the Indian Navy post-Independence.
- **Commissioning Ceremony of Three Vessels**
  - o **About the news**
    - Prime Minister Narendra Modi presided over the commissioning of INS Nilgiri, INS Surat, and INS Vaghsheer, marking the first time a destroyer, a frigate, and a submarine have been commissioned together in the Indian Navy.
  - o **Significance of the Vessels**
    - **Indigenous Construction**: All three vessels are Made in India, underscoring India's growing self-reliance in defense capabilities.
    - **Development Timeline**: The journey from design to commissioning of these ships spanned 10 to 15 years, reflecting the long-term investment in naval infrastructure.
  - o **Strategic Importance**
    - **Enhancing Naval Power**: The addition of these platforms strengthens India's defense capabilities, contributing to the Navy's force level needed to deter regional threats.
    - **Bolstering Maritime Influence**: These ships are key to enhancing India's strategic maritime presence in the Indian Ocean Region and beyond.
  - o **Dual Military and Economic Significance**
    - The commissioning of these vessels holds both military and economic importance, strengthening India's defense posture and reinforcing its role as a key player in global maritime security.

8. **Growing Plants in Space: The Future of Sustenance Beyond Earth**
   GS 3 (Science and Tech)

- **Why in News:**
  - o ISRO achieved a significant milestone by successfully germinating lobia (black-eyed pea) seeds in space as part of its **Compact Research Module for Orbital Plant Studies (CROPS)**.
  - o This development highlights the importance of cultivating plants in extra-terrestrial environments, paving the way for sustainable life on celestial bodies like the Moon and Mars.

How and why are plants grown in space: Takeaways from ISRO's success

- **Why Grow Plants in Space?**
  - o As space missions extend over years, traditional food supplies fall short due to their limited shelf life and nutritional degradation over time.

- o Growing plants in space addresses these challenges by:
  - **Sustaining Food Supply**: Plants provide a renewable source of nutrition.
  - **Oxygen Production**: Photosynthesis in plants releases oxygen, making the air aboard spacecraft breathable.
  - **Recycling Systems**: Plants create a closed-loop system by recycling carbon dioxide and organic waste.
  - **Mental Health Benefits**: Tending to plants helps reduce stress and enhances astronauts' overall well-being.
- **Challenges of Growing Plants in Space:**
  - o Growing plants in space presents several obstacles, primarily due to the microgravity environment:
    - **Root Growth and Water Delivery**:
      - In microgravity, roots lack the directional pull of gravity and fail to grow downward.
      - Water clings to surfaces rather than reaching the roots, complicating nutrient absorption.
    - **Radiation and Temperature Fluctuations**:
      - High levels of radiation can damage plant DNA and hinder growth.
      - Extreme temperature variations in space require insulation to protect plants.
    - **Light Limitations**:
      - In regions of low sunlight, photosynthesis is disrupted, reducing oxygen production.
- **Techniques for Space Farming:**
  - o Scientists have developed innovative methods to grow plants in space:
    - **Hydroponics**: Uses liquid solutions to deliver water and nutrients directly to plants, eliminating the need for soil.
    - **Aeroponics**: Plants grow with their roots suspended in air, using mist for nutrient delivery. This method reduces water and fertiliser usage while eliminating the need for pesticides.
    - **Soil-like Media**: Mimics terrestrial soil to support plant growth, often supplemented with slow-release fertilisers.
  - o The **'Veggie' system** aboard the International Space Station (ISS), a space garden about the size of a carry-on bag, exemplifies these approaches.
- **ISRO's Experiment with Lobia:**
  - o ISRO's CROPS module functioned as a miniature greenhouse, simulating Earth-like conditions in space:
    - **Medium**: Highly porous clay pellets were used, retaining water and providing nutrients via slow-release fertilisers.
    - **Light**: Eight LEDs (four warm, four cool) simulated a 16-hour day and an 8-hour night for photosynthesis
    - **Temperature and Atmosphere**: Conditions were regulated between 20–30°C, with Earth-like air composition
    - **Water Delivery**: An electric valve controlled from Earth injected water into the soil-like medium.
  - o The seeds germinated on the fourth day, with leaves emerging a day later, demonstrating the success of the experiment.
- **Ideal Space Crops:**
  - o Plants are chosen based on their growth efficiency, nutrient content, and adaptability to confined environments. Common space crops include
    - **Leafy Greens**: Lettuce, spinach, and kale grow quickly and are nutrient-dense.
    - **Beans and Peas**: Protein-rich and capable of fixing nitrogen in the medium.**Root Vegetables**: Radishes and carrots thrive in compact
    - **Grains**: Wheat and rice are essential for long-term sustenance.
    - **Fruits**: Tomatoes and strawberries offer a sweet, nutritious addition to space diets.
- **Significance of Space Farming:**
  - o Cultivating plants in space is a cornerstone of future interplanetary missions.
  - o By providing fresh food, recycling resources, and enhancing mental health, space-grown crops contribute to the sustainability of long-term extra-terrestrial habitats.
  - o Advances like ISRO's CROPS experiment underscore India's growing expertise in this critical field.

- **Conclusion:**
    - The successful growth of lobia seeds in ISRO's space module is a step forward in addressing the challenges of space farming.
    - As humans prepare for extended missions and the colonisation of other planets, innovations in space agriculture will play a pivotal role in ensuring sustainability and self-sufficiency beyond Earth.