

Today's Prelims Topics

Chandrayaan 4

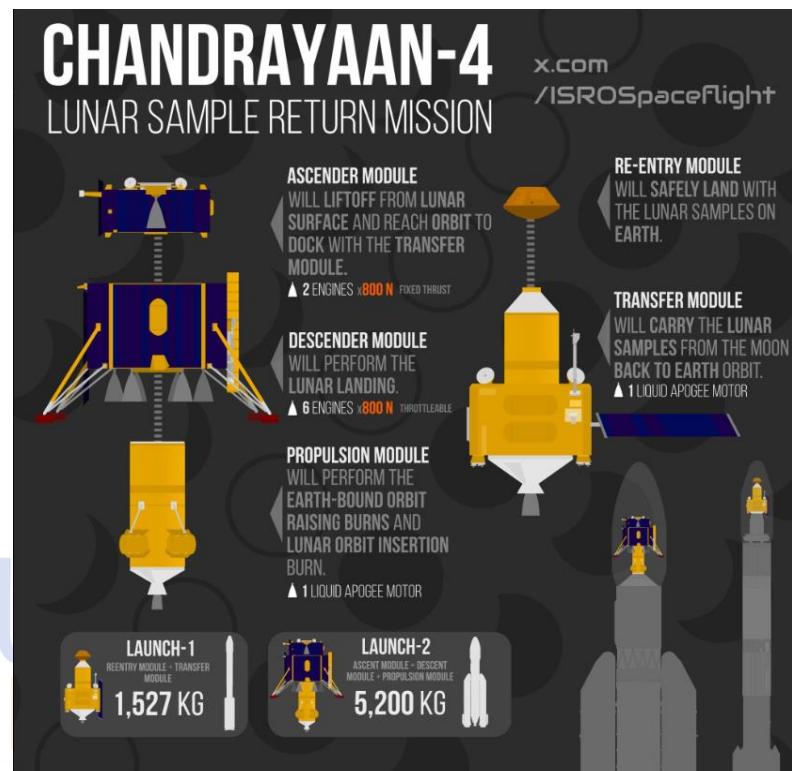
Context

According to ISRO, a series of space-docking experiments will be conducted before the launch of Chandrayaan-4 mission.

About Chandrayaan 4

- **Mission Objective:** It aims to bring rock and soil samples back from the Moon.
- **Modules:** The Chandrayaan-4 spacecraft will consist of **5 modules, unlike Chandrayaan-3, which had 3.**

- **Ascender Module (AM):** To Collect and transfer samples.
- **Descender Module (DM):** To Facilitate landing and sample collection.
- **Re-entry Module (RM):** Safely returns samples to Earth.
- **Transfer Module (TM):** It will enable module docking and transfer.
- **Propulsion Module (PM):** To power maneuvers.



- **Landing and Sample Collection:** Two modules will detach from the main spacecraft, land on the Moon and collect samples.
 - One of these will then launch itself back to the main spacecraft in lunar orbit, where the samples will be transferred.
- **Sample Return:** The samples will be moved to an Earth re-entry vehicle, launched separately, which will return the samples to Earth.
- **Docking Operations:** The mission will involve docking space modules twice, introducing a new capability for ISRO that will be first tested in the already launched Spadex mission.

Related Concepts

- **Docking in Space:** A process where two spacecraft, travelling at high speeds in orbit, align and join together.
- **Hop Experiment:** A test to assess the ability of a lunar lander to lift off from the Moon's surface.

Source:

- [The Hindu - SpaDeX first of many as ISRO prepares for Chandrayaan-4](#)

Tobacco Production & Export

Context

India's tobacco exports likely cross ₹13,000 crore this year.

About Tobacco

- Tobacco cultivation in India was introduced by the **Portuguese in 1605**.
- It is one of the important **commercial crops cultivated in India**.
- **Tobacco types cultivated in India:** Flue-cured Virginia (FCV), Burley, Bidi, Chewing, Natu, Oriental, HDBRG, Lanka, Hookah, Motihari and Jati tobaccos etc.
- **Ideal conditions for growth:**
 - **Frost-Free Climate:** Tobacco requires about 100 to 120 days of frost-free climate to mature.
 - **Temperature:** An average temperature of around 80°F (27°C)
 - **Soil:** Tobacco is grown in warm climates with rich, well-drained soil.
- India is the only country which produces tobacco in **2 seasons**.
- **Highest Production in India:** (1) Gujarat (41%) (2) Andhra Pradesh (22%) (3) Uttar Pradesh
- **Highest Production Worldwide:** (1) China (2) India (3) Brazil

Tobacco Board of India

- It was **established in 1976 as a statutory body** under Section (4) of the Tobacco Board Act, 1975. (**HQ - Guntur, Andhra Pradesh**)
- **Nodal Ministry:** Union Ministry of Commerce and Industry
- **Functions:**
 - To promote the export of tobacco and its related products.
 - To ensure that tobacco growers receive fair and remunerative prices for their produce.

UPSC PYQ

Q. With reference to the "Tea Board" in India, consider the following statements: (2022)

1. The Tea Board is a statutory body.
2. It is a regulatory body attached to the Ministry of Agriculture and Farmers Welfare.
3. The Tea Board's Head Office is situated in Bengaluru.
4. The Board has overseas offices at Dubai and Moscow.

Which of the statements given above are correct? (2022)

- (a) 1 and 3
- (b) 2 and 4
- (c) 3 and 4
- (d) 1 and 4

Answer: D

Source:

- [The Hindu - The projected increase in India's tobacco exports](#)

Excessive nitrates found in groundwater in 440 districts

Context

According to a report by the Central Groundwater Board (CGWB) Excessive nitrates have been found in groundwater in 440 districts as of 2023, an increase from 359 such districts in 2017.

Key Facts of the Report

- **Extent of Nitrate Contamination:**
 - **56% of districts** in India have nitrate levels exceeding the safe limit of **45 mg/litre**.
 - **19.8% of groundwater samples** tested in 2023 had excessive nitrates, marginally lower than **21.6% in 2017**.
 - **States with Highest Contamination:** (1) Rajasthan (**49%**) (2) Karnataka (**48%**) (3) Tamil Nadu (**37%**)
 - **Central and southern states have shown a rise** in nitrate contamination.
 - **Primary Cause:** Excessive use of **synthetic nitrogenous fertilizers** in farming.
- **Fluoride Contamination:**
 - **States Affected:** Rajasthan, Haryana, Karnataka, Andhra Pradesh & Telangana.
 - Fluoride levels exceeding permissible limits are a **major concern** in these states.
- **Uranium Contamination:**
 - **Unsafe Levels:** Uranium concentrations above **30 ppb (parts per billion)** are considered unsafe.
 - Rajasthan and Punjab have the highest number of samples with levels exceeding **100 ppb**.
 - **Affected States:** Rajasthan, Gujarat, Haryana, Punjab, Tamil Nadu, Andhra Pradesh, Karnataka.
- **Stage of Groundwater Extraction:**
 - **National Average:** Groundwater extraction stands at **60.4%**.
 - **Safe Blocks:**
 - **2023:** 73% of blocks classified as safe.
 - **2022:** 67.4% of blocks were safe.
 - **Over-exploited regions:** Rajasthan, Gujarat, Haryana and Punjab (High contamination risk).

Central Ground Water Board (CGWB)

- CGWB is a **subordinate office** of the Union Ministry of Water Resources.
- It was **established in 1970**.
- It is the National Apex Agency entrusted with the responsibilities of providing scientific inputs for management, exploration, monitoring, assessment, augmentation and regulation of ground water resources of the country.

UPSC PYQ

Q. Which one of the following has been constituted under the Environment (Protection) Act, 1986? (2020)

- (a) Central Water Commission
- (b) Central Ground Water Board
- (c) Central Ground Water Authority
- (d) National Water Development Agency

Answer: C

Source: [The Hindu - Excessive nitrates found in groundwater in 440 districts](#)

Ultrablack Brazilian Velvet Ants

Context

Recent research has revealed that the black parts of female velvet ants are ultrablack, absorbing nearly all visible and ultraviolet light.

About Ultrablack Brazilian Velvet Ants

- Velvet ants, despite their name, **are not ants but wasps**.
- They are recognized for their distinctive fluffy appearance.
- Among them, a species native to Brazil's tropical savannas and dry shrub deserts, **Traumatomutilla bifurca**, is noted for its striking black-and-white markings.

Ultrablack: A Rare and Remarkable Shade

- The black parts of female velvet ants have an **ultrablack coloration** that absorbs nearly all visible and ultraviolet (UV) light.
- **Ultrablack** is a rare and remarkable shade in nature, produced through microstructures that trap light.
- Unlike regular black, which comes from melanin, **ultrablack** has no sheen and serves multiple functions, such as **camouflage, thermoregulation, and mate attraction**.
- The ultrablack in velvet ants is created by thin, stacked platelets under a dense layer of hair, similar to the pages of a book.
- Only **female velvet ants** have ultrablack pigmentation.



Source:

- [Indian Express - Scientists discover 'ultrablack brazilian velvet ant'](#)

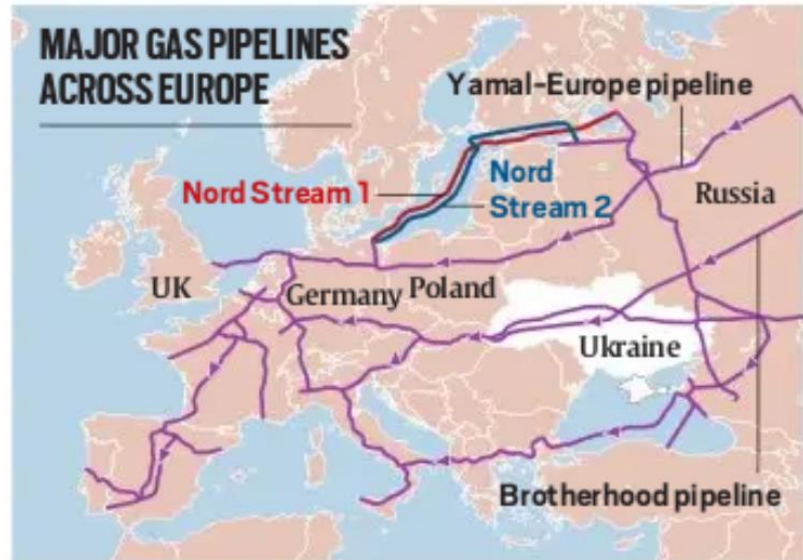
Ukraine halts transit of Russian gas to Europe

Context

Ukraine has stopped the transit of Russian gas to Europe after a pre-war **five-year transit deal** expired.

About Russian Gas Transit Infrastructure

- Before the war, Russia supplied nearly **40%** of the EU's pipeline natural gas, using **4** major routes:
 - **Nord Stream** (Baltic Sea).
 - **Belarus-Poland** pipeline.
 - **Ukraine pipeline network**.
 - **TurkStream** (Black Sea) to Turkey and Bulgaria.
- **Impact of the War:** Gas flows via Nord Stream and Belarus-Poland pipelines were halted in 2022 due to disputes:
 - **Nord Stream pipeline:** Damaged in a **sabotage attack**.
 - **Belarus-Poland pipeline:** Stopped over Russia's demand for **payment in roubles**.
 - **Ukraine pipeline network:** **Stopped** on January 1, 2025.
 - **TurkStream:** Still operational, supplying Turkey and Bulgaria.
- **Decline in Russia's Gas Exports to Europe**
 - Russia's gas supply to Europe has **drastically reduced from 35% to 8%** since the invasion of Ukraine in February 2022.
- **Europe's Energy Diversification**
 - The European Union has compensated for the loss of Russian gas by increasing imports of **liquefied natural gas (LNG)** and diversifying to non-Russian pipeline suppliers.
 - Countries like **Norway, the United States and Qatar** have expanded their market share, replacing Russia as key energy providers.



Source:

- [The Hindu - Ukraine halts transit of Russian gas to Europe](#)

Zeenat - the Tiger Translocated to Similipal Tiger Reserve

Context

Zeenat, the 3 year-old tiger that had been wandering for weeks near the boundaries of three States was brought back to Odisha's Similipal Tiger Reserve (STR).

About Translocation of Zeenat

- Zeenat was recently translocated from the **Tadoba-Andhari Tiger Reserve (TATR)**, Maharashtra to Similipal Tiger Reserve (STR).
- Translocation was aimed to boost the **genetic diversity** of tigers in STR, where inbreeding has caused many tigers to display **pseudo-melanism** (characterized by excessive black stripes).
- The translocation was supervised by the **National Tiger Conservation Authority (NTCA)**.

Similipal Tiger Reserve (STR)

- **Location:** Mayurbhanj District, in the Northern-most part of Odisha.
- It is a **National Park, Tiger Reserve & Biosphere Reserve**.
- **Flora:** Mix of deciduous with some semi-evergreen forests. Sal is the dominant tree species.
- **Fauna:** Tiger, Elephant, Leopard, Barking deer, jungle cat, four-horned antelope etc.
 - It holds the highest tiger population in the state of Odisha.
 - **Black tigers (melanistic tigers) are found here.**
- Around **12 rivers** cut across the Tiger reserve, all of which drain into the Bay of Bengal.
 - Budhabalanga, Palpala Bandan, Salandi, Kahairi and Deo.
- **Prominent tribes:** Erenga Kharias, Mankirdia, Khadia, Kolha etc.
- **UNESCO Biosphere Reserve:** Declared a biosphere reserve in 1994.
 - It is also a part of the **UNESCO World Network of Biosphere Reserves since 2009**.
- STR is part of the **Mayurbhanj Elephant Reserve**, which also includes the Hadagarh Wildlife Sanctuary and Kuldiha Wildlife Sanctuary.

Melanistic Tigers (Black Tigers)

- Black tigers are a rare colour variant of the Royal Bengal tiger, with thick, dark stripes covering their brown skin.
- This is due to a condition called melanism, which results in dark pigmentation in animals.
- This unique appearance results from a mutation in the *Transmembrane Aminopeptidase Q* (Taqppep) gene.
- **In India Melanistic Tigers are found in STR only.**
- According to the Odisha **Tiger Estimation** conducted this year, out of the total 24 adult tigers in Similipal, **13 are pseudo-melanistic.**



Source:

- [The Hindu - Tiger released back into Odisha's Similipal reserve](#)

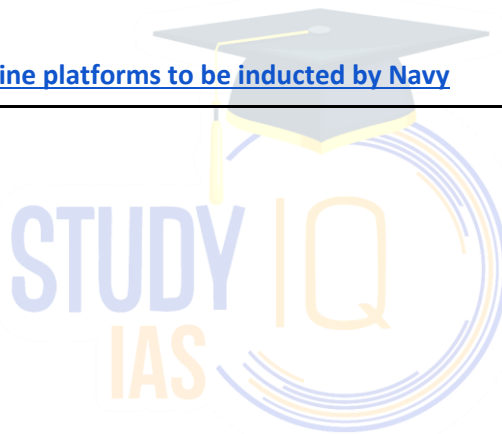
News in Shorts

Scorpene-class submarine among 3 frontline platforms to be inducted by Navy

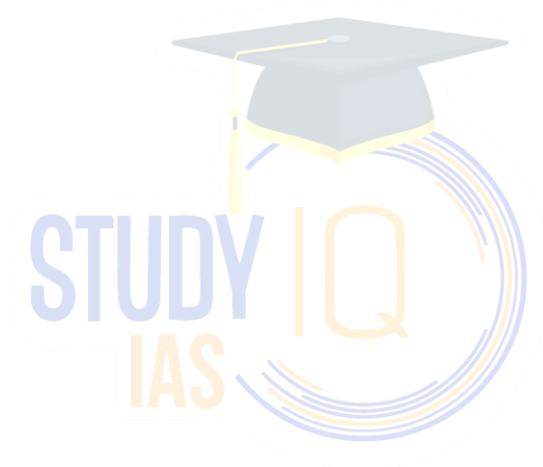
- On January 15, the Indian Navy will commission three advanced platforms at the Naval Dockyard, Mumbai.
- All three platforms were manufactured at **Mazagon Dock Shipbuilders Ltd. (MDL)**, Mumbai.
- **INS Vagsheer**: The 6th and final Scorpene-class submarine.
- **INS Surat**: The **4th** and last **Project-15B stealth destroyer**. It is fitted with advanced weaponry and indigenous systems.
- **INS Nilgiri**: The lead ship of the **Project-17A stealth frigates**.
 - Features advanced stealth technology and reduced radar signatures.
 - Enhanced capabilities compared to Shivalik-class frigates.
 - Equipped with modern sensors, weapons, and advanced navigation systems.
 - Both Nilgiri and Surat can operate various helicopters, including: **Chetak, Dhruv, Sea King** and **MH-60R** helicopters.
- **INS Nilgiri** and **INS Surat** are indigenously designed by the **Navy's Warship Design Bureau**.
- Scorpene-class submarines (including INS Vagsheer) are manufactured under a license from **France's Naval Group**.

Source:

- [The Hindu - 3 frontline platforms to be inducted by Navy](#)



Editorial Summary



Challenges and Setbacks in UN Environmental Summits 2024

Context

Four key UN summits on biodiversity (Colombia), climate (Azerbaijan), land degradation (Saudi Arabia), and plastics (South Korea) failed to deliver meaningful outcomes.

More in news

- Despite participation from governments, researchers, industries, and civil society organizations, these summits achieved partial or no success.
- This marks the fourth consecutive instance of unsatisfactory outcomes in UN discussions addressing biodiversity loss, climate change, and plastic pollution

Key Challenges and Setbacks

- **Divergent National Interests**
 - **Developing Nations:** Demand for increased technology transfer and financial support.
 - Struggle with economic constraints, climate impacts, and developmental challenges.
 - **Developed Nations:** Reluctance to commit more resources due to domestic political and economic pressures.
 - **Examples:**
 - **Colombia Summit:** Gridlock over financing sustainable land-use practices.
 - \$700 billion-a-year requirement for conservation remains unmet.
 - **Azerbaijan Summit:** Developing nations demanded \$1.3 trillion annually; only vague commitments were made.
 - Divisions over transitioning from fossil fuels.
 - **South Korea Summit:** Opposition to a legally binding treaty on plastics by nations reliant on plastics-driven economies.
- **Consensus and Framework Issues:** Disagreements on frameworks to monitor and enforce goals:
 - **Azerbaijan:** Divisions on accountability mechanisms for emission reductions.
 - **Saudi Arabia:** Industrialized nations and African countries clashed over a legally binding drought protocol.
 - African nations sought concrete economic commitments; industrialized nations preferred a broad framework.
- **Impact of Global Crises:** COVID-19, economic instability, and geopolitical conflicts diverted attention and resources:
 - Public health, economic recovery, and social stability became priorities over environmental action.
 - Developing economies faced added challenges of inflation, debt, and climate vulnerabilities.

Implications of Failures

- **Delayed Action:** Critical measures for biodiversity loss, climate change, land degradation, and plastic pollution postponed.
 - Risk of reaching irreversible environmental tipping points.

Interlinked Environmental Crises

- **Climate Change and Biodiversity Loss:** Climate change accelerates habitat destruction, exacerbating biodiversity loss.
 - Degraded ecosystems release carbon, worsening global warming.
- **Plastic Pollution:** Harms ecosystems and contributes to greenhouse gas emissions during

production and degradation.

- **Fragmented Efforts:** Unilateral regional actions could replace multilateral initiatives.
 - Lack of global coherence risks creating new problems.
- **Erosion of Trust:** Repeated failures undermine confidence, complicating future negotiations.
- **Increased Pressure on Future Summits:** Upcoming summits face higher expectations for delivering significant outcomes.

Strategies for Rebuilding Momentum

- **Climate Finance:** Developed nations must fulfill financial and technological commitments to developing nations.
 - Helps bridge trust gaps and fosters equitable negotiations.
- **Enhanced Transparency and Accountability:** Establish robust mechanisms to monitor progress and hold nations accountable.
 - Builds confidence in multilateral processes.
- **Inclusive Diplomacy:** Address geopolitical tensions.
 - Ensure vulnerable nations' voices are heard for equitable participation.
- **Focus on Implementation:** Shift emphasis from ambitious pledges to measurable, tangible actions.
- **Integrated Strategies:** Address interconnections among biodiversity loss, land degradation, plastic pollution, and climate change.
 - Promote ecosystem protection, landscape restoration, and pollution reduction while tackling global warming.

Source: [The Hindu: Four UN environmental summits fell short in 2024. What happened?](#)

Competitive Disruptions in the City Gas Distribution (CGD) Sector

Context

The City Gas Distribution (CGD) sector is currently facing significant challenges due to increased gas costs stemming from a reduction in the allocation of gas supplied under the Administered Price Mechanism (APM).

Reduction in APM Gas Allocation

- The APM gas allocation for domestic piped natural gas (D-PNG) and compressed natural gas (CNG) has **decreased from 72%** in Q2 of the financial year **to 44%** effective November 16.
 - This reduction necessitates reliance on more expensive alternative gas sources, such as:
 - **High-Pressure High-Temperature (HPHT) gas:** Costs approximately 1.5 times that of APM gas.
 - **Imported Regasified Liquefied Natural Gas (RLNG):** Costs about 2 times that of APM gas.
- The **Administered Price Mechanism (APM)** refers to a system where the government, rather than market forces, regulates and controls the prices of certain essential goods or services.
- In the context of energy, particularly natural gas and petroleum products, APM ensures that prices remain affordable for priority sectors like domestic households and public transport while providing stability to the market.

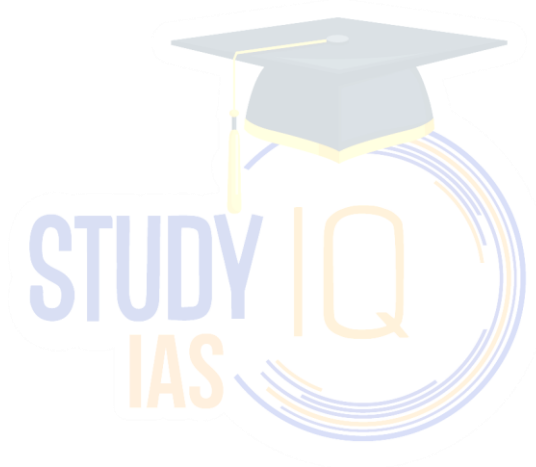
What Are Concerns?

- **Gas Costs and Profitability:** The shift to HPHT and RLNG is expected to increase gas costs for players in the priority segment by around Rs 5.0 per standard cubic metre (scm) or Rs 7 per kg.
 - Given that D-PNG and CNG segments represent two-thirds of sector volumes, this increase will significantly affect overall profitability.
 - With crude prices currently between \$70-75 per barrel, this only marginally mitigates the impact of lower APM allocations, as imported contracted RLNG and HPHT gas are linked to crude prices.
- **Competitive Landscape for CNG:** CNG faces increasing competition from diesel in medium and heavy commercial vehicles, with CNG's cost competitiveness declining over recent quarters.
 - The potential for a price cut in diesel, influenced by expected pro-drilling policies in the US under Donald Trump, could further diminish CNG's market position.
 - New registrations for CNG vehicles have stagnated, particularly in the three-wheeler segment, which accounts for one-third of CNG consumption. Additionally, buses (7% of CNG volumes) are likely to transition to electric options due to government schemes
- **Financial Implications for CGD Companies:** CGD companies may only partially pass on increased gas costs to consumers without significantly affecting volumes.
 - If only half of the cost increase is transferred to consumers, it is projected that earnings before interest, taxes, depreciation, and amortization (EBITDA) for the CNG segment could decrease by approximately Rs 2,300 crore next financial year.
- **Challenges for Smaller Entities:** The commercial and industrial segment, which accounts for one-third of CGD volumes, is unlikely to compensate for declines in profitability due to its price sensitivity. CNG consumption in this segment fell by 25% in 2022-23 due to rising prices from higher RLNG costs.
 - Larger CGD players with established infrastructure and better access to competitive HPHT and RLNG contracts are more likely to withstand these pressures.
 - In contrast, smaller entities lacking strong parentage and relying on spot gas are expected to struggle.

Opportunities for Consolidation

- The current environment sets the stage for consolidation within the CGD sector:
 - There are 11 areas without strong parentage that may be prime targets for acquisition.
 - Additionally, 61 areas backed by public sector undertakings (PSUs) or strong entities require significant capital expenditure amidst constrained cash flows.

Source: [Indian Express: Energy Churns Inside](#)



Tackling delimitation by reversing population control

Context

Recent statements from the Chief Ministers of Andhra Pradesh, N. Chandrababu Naidu, and Tamil Nadu, M.K. Stalin, highlighted significant concerns regarding the proposed delimitation exercise scheduled for 2026.

More in news

- The key issue: Southern states, with lower fertility rates and reduced population growth, risk losing **parliamentary seats**, especially compared to the northern states with higher fertility rates.
- Southern states perceive this as a penalty for their success in **family planning programs**.

Challenges in Reversing Fertility Decline

- **Global Evidence:** Fertility transitions leading to low fertility are largely irreversible by state intervention.
 - While minor reversals may occur naturally, pro-natal policies have failed in countries like **Japan** and **South Korea**.
- **China's Case:**
 - **One-child policy** led to:
 - **Marriage market issues.**
 - Increased **dependency ratio.**
 - **Extreme low fertility**, which is difficult to reverse even after policy relaxation.
 - Quick regulatory measures focusing solely on population numbers ignore **population composition**, creating imbalances.

Demographic Divide in India

- **Convergence in Fertility Decline:**
 - Fertility decline is observed across Indian states, yet the **demographic divide** between northern and southern regions persists.
 - Population momentum in northern states continues to widen the **population counts gap**.
 - **E.g.**, Andhra Pradesh and Karnataka have a TFR of 1.7, while Tamil Nadu and Kerala are at 1.8, both below the national average of 2
- **Political Representation Challenges:**
 - The **current system** bases representation on population counts, risking unfair outcomes for regions excelling in development and population control.
 - A revised system should consider **demographic characteristics** like education and development levels to determine political representation.

Impact on Women

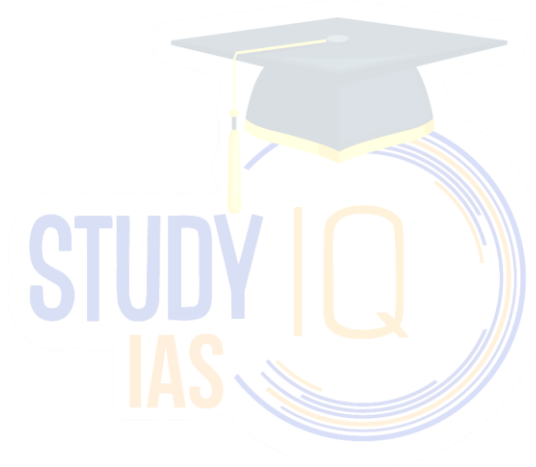
- **Personal Costs of Reproduction:** Women bear significant personal and professional losses in contributing to population growth.
 - State policies to incentivize reproduction often neglect social support systems for women.
- **Proposed Solutions: Guarantee state support** for additional children.
 - Compensate women for their reproductive role through social and financial measures.

Proposed Solutions for Regional Population Imbalances

- **Promoting Migration:** Migration can serve as a short-term measure to address population and workforce imbalances.

- **Revising Political Representation:** Political representation should be based on **capability characteristics**, such as development and demographic factors, rather than absolute population counts.
- **Avoiding Fertility Reversal Policies:** Reversing fertility rates is neither practical nor effective in the long term.
 - Focus should shift to sustainable measures like ensuring equitable representation in governance.

Source: [The Hindu: Tackling delimitation by reversing population control](#)



The race for fighters: the IAF's dilemma

Context

- In recent weeks, China has made significant strides in military technology, unveiling several advanced platforms that underscore its growing technological supremacy.
- These developments highlight a widening technological gap with the Indian Air Force (IAF), which is currently struggling with modernization and delayed deliveries of new aircraft.

More in News

- China introduced two stealth fighter jets, an amphibious naval ship, a comprehensive scientific research vessel for deep-sea exploration, a supersonic civil jet prototype, and a new bullet train claimed to be the fastest in the world.

Chinese Military Modernization

- **Stealth Fighter Jets:** Two new stealth fighter jets were showcased, one featuring a massive delta-wing design with three engines, indicating long-range capabilities, and the other a smaller twin-engine jet with swept wings.
 - The larger jet is attributed to Chengdu Aircraft Corporation, while the smaller one is from Shenyang Aircraft Corporation.
 - The People's Liberation Army Air Force (PLAAF) has already deployed two fifth-generation fighters: the J-35 and J-20.
 - With the introduction of these new jets, often referred to as sixth-generation fighters, China is making substantial progress in military aviation.
- **Aviation Force Size:** The PLAAF and PLAN Aviation together form the largest aviation force in the Indo-Pacific region.
 - A report to the U.S. Congress 2024 noted that the PLAAF is rapidly approaching U.S. technological standards and has over 1,300 fourth-generation aircraft out of a total of 1,900 fighters.

Indian Air Force Modernization Efforts

- **Current Squadron Strength:** The IAF operates 31 fighter squadrons compared to a sanctioned strength of 42 squadrons. It faces delays in modernizing its fleet and lacks any fifth-generation fighters for at least another decade.
 - Recent reports indicate that Pakistan has approved the procurement of 40 J-35s from China, further intensifying regional competition.
- **Planned Acquisitions:** India aims to acquire over 500 fighter jets, primarily through indigenous design and manufacturing. However, many projects are at various stages of development.
 - The LCA variants are expected to form a significant part of this acquisition, with 83 LCA-Mk1As on order but facing delays due to issues with F-404 engines from General Electric.
- **Future Development:** The IAF's ambitious plans include the LCA-Mk2, Advanced Medium Combat Aircraft (AMCA), and Twin Engine Deck Based Fighter (TED-BF) for the Navy. However, these projects have uncertain timelines for delivery.
 - The DRDO is working on indigenous development for these aircraft, but deliveries for LCA-Mk2 and AMCA are not expected until the next decade.
- **Aging Fleet:** The IAF's current fleet includes aging aircraft like MIG-21s, which are being phased out by 2027-28. Other aircraft types such as Jaguars and Mirage-2000s will also begin retiring by the end of the decade.
- **Procurement Challenges:** A critical program that has stalled is the procurement of 114 Multi-Role Fighter Aircraft (MRFA), intended to be manufactured in India with technology transfer from global manufacturers.

- Despite issuing a Request For Information (RFI) in April 2019, there has been no progress on this front.

Engine Supply Issues

The IAF's modernization is significantly hampered by issues related to aero-engine supply:

- The LCA-Mk1A program is particularly affected by delays in GE-404 engine deliveries due to supply chain disruptions caused by COVID-19.
- Future plans include licensing manufacturing agreements for F-414 engines in India, but reliance on foreign technology remains a critical vulnerability.

Source: [The Hindu: The race for fighters: the IAF's dilemma](#)

