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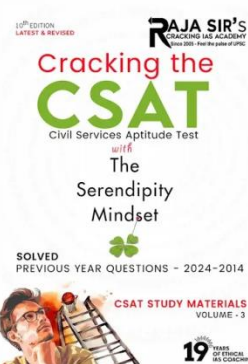
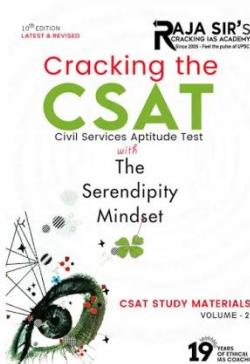
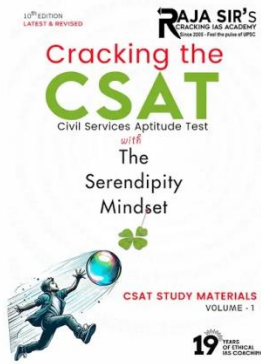


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1. Weighing in on business as usual with China

Recent Developments in India-China Relations

Current State of Affairs

- Recent discussions have raised the possibility of a thaw in India-China relations, particularly concerning foreign direct investment (FDI). Indian External Affairs Minister S. Jaishankar highlighted on September 12, 2024, that while 75% of "disengagement problems" have been resolved, the **militarization of the border** remains a significant issue. National Security Adviser Ajit Doval's meeting with Wang Yi in St. Petersburg reiterated a commitment to expedite complete disengagement, but crucial areas like **Depsang Plains** and **Demchok** remain contentious. India maintains that any normalization of relations is contingent upon restoring peace along the LAC.

Historical Context

- The tensions between India and China have deep roots, particularly after China's incursions in 2020, which altered the status quo in Eastern Ladakh. The Indian government emphasizes a return to the status quo ante, yet recent developments suggest a potential acceptance of a "new normal" that favors China's strategic interests. The inability of Indian forces to access 15 traditional patrolling points raises concerns about sovereignty and security.

Economic Implications: FDI from China

Economic Survey 2024 Insights

- The *Economic Survey 2024* proposes that India should engage more with Chinese supply chains through FDI, viewing this as a solution to investment shortages and a means to enhance participation in global markets. This approach is seen by some as a pragmatic response to economic needs, despite the ongoing geopolitical tensions.

Risks of Increased FDI from China

1. **Trade Deficit and Dependency:** India's trade deficit with China **exceeded \$105 billion in 2023**, indicating a growing economic vulnerability. Exports to China have declined, exacerbating this imbalance.
2. **Historical Precedents:** Countries like those in ASEAN, which received substantial Chinese investments, have not seen a corresponding reduction in imports from China. Instead, imports have surged as Chinese firms increased their role in regional supply chains.
3. **National Security Concerns:** There is a fear that increased Chinese investments could lead to strategic vulnerabilities. Past experiences suggest that China may leverage economic ties to gain strategic advantages, complicating India's security landscape.

Chinese Demands and India's Position

Key Demands from China

1. **Level Playing Field:** Chinese firms seek equal treatment in India's market.
2. **Visa Facilitation:** Easier visa processes for Chinese nationals.

3. **Resumption of Direct Flights:** Restoring air connectivity between the two countries.
4. **Stationing Journalists:** Allowing Chinese journalists to operate in India.

Strategic Playbook of China

- China's tactics suggest a broader strategy of attrition, aiming to incrementally reshape the geopolitical landscape in its favor. This approach has been effective in other regions, such as the South China Sea, where China has established control over contested territories.

Economic and Strategic Considerations

China's Industrial Policy and Global Ambitions

- China's recent policy directions emphasize a strong state role in the economy, focusing on strategic sectors such as electric vehicles and renewable energy technologies. The July 2024 **Third Plenary Session of the Communist Party** reiterated a commitment to state-driven industrial policies, which could limit opportunities for Indian companies.

Investment Scrutiny and Domestic Prioritization

- China's policies regarding technology and investment flows aim to maximize domestic value chains. Reports suggest that Chinese automakers are advised to keep advanced technologies within China and only **export semi-finished products**. This reinforces the notion that China's economic engagements are designed to strengthen its position globally rather than foster genuine partnerships.

Recommendations for India's Economic Strategy

1. **Selective FDI:** Focus on sectors where India has strengths and can benefit from technology transfer without compromising national security. This includes prioritizing sectors like pharmaceuticals and renewable energy.
2. **Strengthening Domestic Capabilities:** Enhance domestic manufacturing capacities to reduce dependency on Chinese imports and improve resilience in critical sectors.
3. **Strategic Partnerships:** Explore partnerships with other nations to diversify supply chains and attract FDI from non-Chinese sources, thereby reducing vulnerabilities.
4. **Policy Safeguards:** Implement stringent policies to scrutinize Chinese investments, especially in sensitive sectors such as telecommunications and defense, to mitigate security risks.

Conclusion

- Navigating the complex landscape of India-China relations requires a careful balance between economic engagement and national security considerations. While decoupling from China entirely is impractical, a selective and strategic approach to FDI, coupled with efforts to bolster domestic industries, will be essential for India to safeguard its interests and enhance its position in global supply chains.

2.

Saturn's rings set to 'disappear' briefly in March 2025

Recently, **NASA** confirmed that **Saturn's rings will briefly disappear** in March 2025 due to their **alignment with Earth**, making them **appear edge-on** from earth.

- This optical phenomenon **occurs every 13 to 15 years**, with the last occurrence in **2009**.
- Saturn takes about **29.4 Earth years** to complete one orbit around the Sun and is tilted at an angle of **26.73 degrees** so rings appear to change orientation. **In March 2025, only the edges of the rings will be visible, reflecting minimal light.**

Saturn and its Rings

- Saturn is the **sixth planet from the Sun** and the **second largest** (after **Jupiter**) in the solar system.
- It has a ring system, made up of **ice and rock**, which is the most complex among all planets.
 - Saturn's rings span about **282,000 kilometers in width** but are **incredibly thin, measuring just 10 to 30 meters thick**.
 - The planet has **7 primary rings**. Each ring orbits Saturn at **different speeds**.
 - If laid edge-to-edge, Saturn's ring system could stretch the distance between Earth and the Moon.
- As per NASA, Saturn has the **highest number of moons (146) in the solar system**. Like Jupiter, **Saturn is a gaseous planet** primarily composed of **hydrogen and helium**.
- **Missions to Saturn: Pioneer 11, Voyager 1, and Voyager 2, Cassini**

spacecraft.

- NASA estimates that **Saturn's rings will permanently disappear in the coming 300 million years due to "ring rain,"** a process that drains water from the rings at a rapid rate.

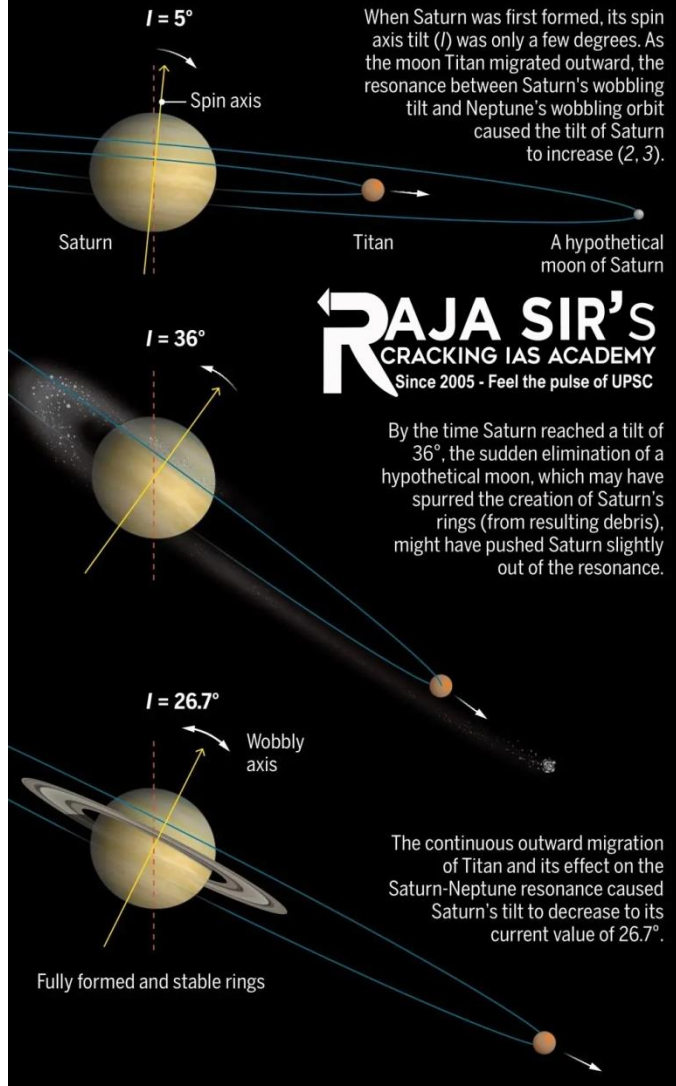
Saturn's Tilt

- **Substantial Tilt: Saturn** has a tilt of 26.73 degrees and is unlikely to have had a tilt during its formation stages.
 - Currently, **Neptune, Uranus and Saturn have a substantial tilt,** suggesting that this feature did not arise during the formation stages.
- **Reason for Tilt:** Various theories suggest that Saturn got its tilt **due to gravitational interactions with its neighbour Neptune.**
 - But the new study argues that Saturn is no longer under Neptune's gravitational influence.
 - Further, it stated that instead, Titan — Saturn's largest satellite — may have been responsible, as per observations from **NASA's Cassini spacecraft,** which orbited Saturn from 2004-2017.
 - **Titan's Migration:** Titan is migrating from Saturn at about 11 centimetres per year, 100 times faster than previous estimates.
 - Titan's fast **migration caused the planet to tilt further,** reducing Neptune's gravitational influence on Saturn.
 - **Role of Former Moon (Chrysalis):** Scientists **conducted simulations of the planet's axis of rotation** and how it has changed over time, **it revealed that a former moon could be involved,** as removing the moon gives Saturn its tilt, according to the model.
 - Chrysalis likely orbited Saturn for several billion years,

roughly 160 million years ago, Chrysalis became unstable and came too close to its planet. This encounter likely pushed the moon away or destroyed it.

A lost moon, a young ring, and Saturn's tilt

Wisdom *et al.* propose a model that could explain how the current tilt of Saturn's spin axis may be linked to how the planet gained its rings from the destruction of a hypothetical moon 100 million to 200 million years ago.



3.

A break from the past, a new beginning in Sri Lanka

Introduction

- The swearing-in of **Anura Kumara Dissanayake** as Sri Lanka's newly elected President on September 23, 2024, marked a significant turning point in the nation's political history. This event symbolized a transition from the Colombo-centric elite's dominance to a broader coalition of **non-elite social forces**, reflecting a shift in the class structure of political power.

End of Elite Dominance

- Since Sri Lanka's independence in 1948, the nation's electoral democracy had largely favored the political dominance of Westernized elites. However, Dissanayake's election is seen as a break from this pattern, highlighting the power of democratic processes and elections to occasionally produce significant change. His victory signals a bloodless, peaceful transfer of power and a shift towards addressing the deep-rooted corruption and cronyism that benefited privileged social classes for nearly seven decades.

Political Background and Rise of Anura Kumara Dissanayake

- Dissanayake is the leader of the **National People's Power (NPP)** movement, which emerged in 2019 as an electoral front for the **Janatha Vimukthi Peramuna (JVP)**. The JVP, initially a radical left-wing underground movement formed in the 1960s, aimed to achieve revolutionary socialism in South Asia, inspired by **Marxism and**

Maoism. The movement led two unsuccessful armed insurrections in 1971 and 1987-89.

- In the aftermath of the 1987-89 defeat, a new generation of JVP leaders, including Dissanayake, abandoned armed struggle and focused on electoral politics. This shift allowed the JVP to become a parliamentary party, though it remained a small opposition force in a system dominated by the **Sri Lanka Freedom Party (SLFP)** and the **United National Party (UNP)**.

Formation and Evolution of the National People's Power (NPP)

The NPP was formed in 2019 as a response to the JVP's political deadlock and its desire to break the traditional two-party system. With a moderate, centrist reform ideology, the NPP aimed to be a "third force" in Sri Lankan politics. Despite contesting in the 2019 presidential and 2020 parliamentary elections, the NPP initially received limited success, securing only 3% of the vote and three parliamentary seats.

Catalysts for the NPP's Rapid Rise

Two significant developments paved the way for the NPP's rise as a major political force:

1. **Economic Crisis:** The COVID-19 pandemic worsened Sri Lanka's economic situation, leading to social discontent, especially due to the government's austerity measures prescribed by the International Monetary Fund (IMF). Widespread poverty and income inequality polarized the society, pushing people away from traditional elite-led parties.
2. **Social Crisis and Aragalaya Movement:** The 2022 Aragalaya protest

movement played a crucial role in shifting the political landscape. Its demand for systemic change and anti-corruption resonated with the NPP's reform agenda, contributing to Dissanayake's electoral success.

Challenges Ahead for the New President

- Dissanayake faces numerous challenges in consolidating his power. With only three NPP members in Parliament, he must hold early parliamentary elections to form a stable government. He is expected to form a caretaker cabinet and dissolve Parliament soon to pave the way for elections, ideally by late November 2024.
- Additionally, Dissanayake's electoral base is primarily Sinhalese, and expanding support among Tamil and Muslim minorities will be critical for building an inclusive, ethnically pluralistic government.

Economic and Governance Reforms

- The new President must address the external debt crisis while promoting economic growth with social justice and equity. Reworking the austerity program agreed with the IMF will be essential to prevent further social unrest.
- Moreover, Dissanayake's commitment to eradicating corruption will be a major test of his leadership. Although institutional corruption is deeply entrenched, the new government must make meaningful efforts to purify public life and governance. The public expects 'genuine change,' and Dissanayake's ability to fulfill this expectation will determine the credibility and success of his presidency.

	<p>Transformation of Sri Lanka's Political System</p> <ul style="list-style-type: none">• Dissanayake's victory signifies a broader transformation in Sri Lanka's political party system. The NPP's rise, along with the consolidation of the Samagi Jana Balawegaya (SJB) as the leading opposition party, has weakened traditional elite-led parties like the UNP, SLFP, and Sri Lanka Podujana Peramuna (SLPP). The NPP and SJB now represent two opposing poles in Sri Lankan politics, with the SJB filling the space vacated by the UNP's decline as a mass party. <p>Conclusion</p> <ul style="list-style-type: none">• The election of Anura Kumara Disanayake represents a historic shift in Sri Lankan politics, breaking decades of elite dominance. His presidency offers the potential for transformative reforms and a new political era. However, the challenges ahead—securing parliamentary support, addressing ethnic inclusivity, managing economic crises, and eradicating corruption—will determine the success of this new chapter in Sri Lankan governance.
<p>4.</p>	<p>The misplaced move of 'one nation one election'</p> <p>Introduction to the Concept</p> <ul style="list-style-type: none">• The idea of simultaneous elections (for Lok Sabha, State Assemblies, and local bodies) was first proposed by the Prime Minister due to frequent elections keeping him on the campaign trail. This led to the formation of a high-level committee, headed by former President Ram Nath Kovind, to examine its feasibility.

Formation of the Committee

A high-level committee was set up with notable members such as:

- Amit Shah (Home Minister)
- Ghulam Nabi Azad (former Leader of Opposition)
- K. Singh (former Finance Commission Chairman)
- Subhash C. Kashyap (former Lok Sabha Secretary-General)
- Harish Salve (senior advocate)
- Sanjay Kothari (former Chief Vigilance Commissioner)
- Arjun Ram Meghwal (Minister of Law and Justice, special invitee)

The committee submitted its report in March 2024, shortly before the general elections. The concept of simultaneous elections was also part of the ruling Bharatiya Janata Party's manifesto.

Key Recommendations

The committee recommended simultaneous elections for two main reasons:

- **Cost Savings:** Conducting elections only once every five years would significantly reduce financial costs.
- **Minimizing Disruptions:** Frequent elections impose the model code of conduct, which hampers developmental projects.

Constitutional Amendments

Implementing simultaneous elections requires constitutional amendments, particularly:

- **Amendments to Article 172:** State Assemblies' fixed tenure would be altered to align their elections with the Lok Sabha.

- The amendment would need a **special majority** in Parliament (two-thirds of members present and voting). The ruling NDA, however, lacks the required numbers, making it difficult to pass the Bill without Opposition support.

Challenges to Passing the Amendment Bill

- The NDA has approximately 292 members, but 362 votes are required to pass the constitutional amendment.
- Opposition parties are generally against the 'one nation, one election' proposal, creating a significant roadblock to passing the Bill.

Financial Considerations

- The Election Commission of India (ECI) was allocated ₹466 crore for conducting the 2024 general elections, a relatively modest amount in the national budget.
- State governments also bear costs for logistical support during elections, but the overall expenditure for frequent elections is not considered enormous.
- While political parties spend significantly on elections, savings from reduced election frequency are unlikely to be directed toward developmental activities such as building infrastructure.

Federalism and Autonomy Concerns

- **Impact on Federalism:** Simultaneous elections would undermine the autonomy of State Assemblies, which are independent of the Lok Sabha under India's federal system.
- **Kesavananda Bharati Case:** The landmark Supreme Court ruling

established that the basic structure of the Constitution, including federalism, cannot be altered by Parliament. Curtailing State Assemblies' tenure would violate this principle, raising concerns about the constitutionality of the amendment.

Political and Social Implications

- **Accountability:** Frequent elections hold elected representatives accountable to the public, forcing them to engage with citizens regularly.
- **Political Party Activity:** If elections are held only once in five years, political parties may become lethargic, reducing their effectiveness in addressing people's aspirations.
- **Government Course Correction:** Frequent elections allow governments to gauge public sentiment and make necessary course corrections.

Conclusion

- Simultaneous elections could disrupt the federal balance of the Constitution, making it a contentious issue. Furthermore, it is not considered a pressing concern for most ordinary citizens. The proposal, while ambitious, faces both political and constitutional challenges that may prevent its successful implementation.

Final Thoughts

- The benefits of simultaneous elections, particularly cost savings and developmental efficiency, require closer scrutiny. Without empirical evidence supporting these claims, and considering the potential risks to India's federal structure, the proposal remains a controversial and difficult undertaking.

5. Going bullish on investment in Tamil Nadu

C.N. Annadurai's Vision and Tamil Nadu's Democratic Journey

- In **1968**, **C.N. Annadurai**, a pioneering leader and former Chief Minister of Tamil Nadu, visited Yale University as part of the **Chubb Fellowship Program**. During this visit, he characterized India as the "**experiment station for democracy**," highlighting its potential to construct an economic model rooted in democratic principles. Annadurai warned that without **population control**, any economic progress would be insufficient to eradicate poverty—a foresight that remains relevant today.

Tamil Nadu: A Model of Economic Reconstruction-

- Over the past **50+ years**, Tamil Nadu has undergone a significant transformation from a largely **agrarian economy** to a recognized **industrial powerhouse**.
- This shift has been facilitated by democratic governance and inclusive, people-centric policies.
- The State's efforts in reducing its **total fertility rate (TFR)** have played a crucial role in alleviating poverty, allowing for targeted investments in **education, healthcare, and infrastructure**.
- This holistic approach has not only driven economic growth but also improved the overall quality of life for its citizens.

The “China+1” Strategy and Tamil Nadu’s Competitive Edge

- As global supply chains adapt to the "**China+1**" strategy, Tamil Nadu has positioned itself as a key contender for international investments.
- The State is often referred to as the "**Detroit of India**," as it contributes a remarkable **35% of India’s automobile exports**.
- It hosts major global automotive manufacturers, including **Hyundai, Daimler, Renault, Nissan, BMW, and Stellantis**. Recently, **Ford** announced the resumption of operations at its Chennai facility, further underscoring the State's automotive significance.

A Leader in Electronics Manufacturing

- In addition to its automotive prowess, Tamil Nadu is a dominant force in **electronics manufacturing**, contributing **33% of India’s electronics exports**.
- This sector services major global brands such as **Apple, Dell, HP, Samsung, and Google Pixel**.
- The State’s combination of a **skilled labor force**, robust **supply chains**, and **world-class infrastructure** positions it as a prime destination for electronics and technology-driven industries.

Investment-Friendly Policies

The Tamil Nadu government has introduced **strategic policies** aimed at attracting foreign investments. These include:

- **Tax breaks** for investors.
- **Land at subsidized rates**.
- A **single-window clearance system** that streamlines the process of setting up operations.

- These initiatives have helped Tamil Nadu consistently rank among the top States in India for **ease of doing business**, making it an attractive location for global investors seeking reliable partnerships.

Skilling, Innovation, and Global Partnerships

- Tamil Nadu's ability to draw global investments is also rooted in its focus on **skilling and innovation**.
- Recent partnerships with leading corporations such as **Google, Applied Materials, Jabil, PayPal, Nokia, Microchip, Yield Engineering Systems, and Trilliant Networks** have been secured to enhance the State's research and development capabilities.
- These collaborations are expected to create numerous new jobs, introduce advanced technologies, and integrate global best practices, thereby transforming Tamil Nadu into a global hub for innovation.

The Dravidian Model of Governance

- Central to Tamil Nadu's success is the **Dravidian Model of governance**, which prioritizes **social justice, inclusive growth**, and equitable resource distribution. This model ensures that economic progress translates into improved quality of life for all citizens.

Notable achievements include:

- The **highest Gross Enrolment Ratio (GER)** in higher education in India at **47%**.
- **42% of India's registered women workforce** in factories are employed in Tamil Nadu, reflecting its commitment to gender equity in the workforce.

Commitment to Diversity, Equity, and Inclusion (DEI)

- The State's approach to **Diversity, Equity, and Inclusion (DEI)** is evident in policies that provide **payroll subsidies** to investors who hire **women, transgender individuals, and people with disabilities**. This commitment not only enhances social responsibility but also attracts global corporations that value inclusive practices.

Renewable Energy Leadership

- Tamil Nadu is a front-runner in India's renewable energy sector, with **57% of its installed capacity** derived from renewable sources.
- The State aims to increase this figure to **75%** and is working towards expanding green cover to **33% of its total area**.
- Its geographic advantages, including abundant **wind, solar, and offshore energy** resources, solidify its position as a leader in clean energy initiatives.

Conclusion: A Bullish Outlook for Investors

Tamil Nadu presents a compelling opportunity for global investors. With its **robust manufacturing sector**, a **highly skilled and adaptable workforce**, and a **steadfast commitment to sustainability and inclusive governance**, the State is poised to become a significant player in the global economy. The message to investors is clear: "**Go bullish on Tamil Nadu, join the bull run.**"

6. Russia's geopolitical pivot to Asia, a new India chapter

Russia's Shift from Europe to Asia

- In 2022, Russia decisively turned away from its economic ties with Europe, realigning its trade towards Asia.
- This shift effectively dissolved the **neoliberal interdependence** between Russia and Europe, leading to global economic repercussions.
- The seeds of this realignment were planted as early as the 2007–08 financial crisis but were delayed until 2022 due to Russia's deep economic entanglement with Western markets, which made it vulnerable to external shocks from **political and ideological conflicts**.

India-Russia Economic Relations: Key Features

- Russia's turn to the east resulted in a significant rise in trade with China, but it was the growth in India-Russia relations that attracted greater attention.
- Despite lacking common borders and well-established logistical routes, the two countries managed to significantly enhance their trade relations.
- Russia saw new opportunities in the Indian market, previously considered uncharted territory for Russian business, which led to discussions on reorienting their economic cooperation.

Factors Behind the Strengthening India-Russia Relations

- **Political Imperatives for Russia:** Russia prioritized political stability in expanding its commercial relations. India's non-involvement in the European conflict provided a reliable framework for Russia to establish

long-term economic strategies.

- **Economic Interests for India:** India's economic interests primarily drove its engagement with Russia, particularly in sectors such as oil and fertilizers, which have helped India manage inflation and climate-related food supply disruptions. Indian companies have also benefited by re-exporting Russian oil to Europe as refined petroleum products.

Significant Growth in Bilateral Trade

- The bilateral trade between India and Russia saw an exponential rise, moving from \$3.5 billion in June 2022 to \$7.5 billion in May 2024.
- This growth in trade surpassed the entire 2021 trade volume within a month, illustrating the rapid deepening of economic ties.
- Indian Prime Minister Narendra Modi and Russian President Vladimir Putin have set an ambitious target of achieving \$100 billion in trade by 2030.

Challenges to Deepening Economic Ties

- **Lack of Economic Complementarity:** Both nations are pursuing domestic industrial agendas—Russia with its **moderate technological nationalism** and India with its 'Make in India' policy—which poses challenges for fostering complementarity between their economies.
- **Sanctions and Trade Barriers:** Western sanctions on Russia and the absence of mechanisms like stable payment systems and investment protection agreements limit the potential for balanced trade. Small and medium enterprises (SMEs) could be key to boosting trade, but structural obstacles like the lack of a single logistics operator or integration of national payment systems persist.

- **Technology and Investment:** While India and Russia once had a robust technology cooperation, especially in the Soviet era, modern-day collaboration lacks large-scale investment projects outside the nuclear and military sectors. There is a need to foster business-oriented cooperation in technology, particularly in areas like construction, modernization of industrial infrastructure, and STEM education.

Midterm Outlook and Prospects

- The Russia-India relationship, while boosted by the Ukraine crisis, faces limitations due to external pressures on India and Russia's own economic vulnerabilities.
- However, opportunities for growth exist in sectors like defense, with Russian products **offering low-cost advantages** in the Indian market.
- Future collaboration could extend to civilian industries such as agricultural and construction machinery, medical equipment, and engineering goods.

The Quality of Trade

- A critical issue lies in the nature of India's exports to Russia. Most Indian exports, like smartphones, are manufactured in foreign assembly plants. To build a more sustainable economic relationship, both countries need to enhance bilateral production chains and address issues of localization to strengthen the foundation of their trade.

Conclusion

- Russia's pivot to Asia, and particularly India, represents a significant realignment in global geopolitics. While trade and economic relations

have grown rapidly, there remain significant challenges to deepening and diversifying these ties. Both nations must overcome structural barriers, focus on complementarity, and enhance their investment and technological cooperation to sustain the momentum of their partnership.

7. How will Nasrallah's killing impact West Asia?

Background and Current Situation

- It has been almost a year since the latest Gaza conflict erupted, and Israel's military focus has now shifted to its northern border with Lebanon, primarily targeting Hezbollah. Over the past week, Israel has launched extensive bombardments on Hezbollah positions in Lebanon, killing at least 700 people and **displacing over 100,000**. Among the dead was Hassan Nasrallah, the long-time Secretary-General of **Hezbollah**.

What Triggered the Conflict?

- The escalation began after Hezbollah fighters in Lebanon were hit by explosions, including pagers and walkie-talkies. In retaliation, Hezbollah launched hundreds of rockets into Israel, including a ballistic missile intercepted over Tel Aviv. Israel responded with intensified airstrikes. The U.S. and France called for a ceasefire, but Israel rejected this, with Israeli Prime Minister Benjamin Netanyahu vowing to continue military operations until Israel's objectives are met, including total victory against Hamas in Gaza.

What is Hezbollah?

- Hezbollah, a **Shia** resistance group formed in 1982 with support from **Iran's Islamic Revolutionary Guard Corps (IRGC)**, arose in response to Israel's invasion of Lebanon. Initially founded to oppose Israeli forces, Hezbollah has evolved into a powerful political and military entity within Lebanon. It has a political party with seats in Lebanon's parliament, a social services wing catering to the Shia population, and a powerful military apparatus. Hezbollah's stated goal includes resistance against Israel and the destruction of what it calls "**the Zionist entity.**" Despite being labeled a terrorist organization by Israel and the U.S., Hezbollah retains significant influence in Lebanon, with widespread support from parts of the Shia community and continued backing from Iran.

Why Are Israel and Hezbollah Fighting?

- The conflict between Hezbollah and Israel stems from Hezbollah's anti-Israel stance, which has been central to its identity since its formation. It has been credited with forcing Israel to withdraw from **southern Lebanon in 2000** after 18 years of occupation. The current escalation can be traced back to the Hamas attack on Israel on October 7, 2023, in which 1,200 Israelis were killed. In response to Israel's retaliatory strikes on Gaza, Hezbollah began firing rockets into Israel in solidarity with Hamas. This led Israel to strike back, initiating a protracted conflict along the Israel-Lebanon border.

Military Capabilities of Hezbollah

- Hezbollah possesses a vast array of weaponry, including **Fateh ballistic missiles** (range of 250 km), **Sayyad surface-to-surface missiles** (100

km), **C-802 anti-ship missiles** (120 km), anti-tank missiles, artillery rockets, and tens of thousands of short-range missiles. Despite these, it is not a match for Israel in terms of conventional military power. Israel, backed by the U.S. and widely believed to have nuclear capabilities, is the most powerful military in the region. However, Hezbollah's guerrilla warfare tactics and asymmetric strategies have historically posed a significant challenge to Israel.

- Since the **2006 Israel-Hezbollah war**, Hezbollah has significantly rebuilt its military capacity, but it has so far limited its response to Israel's recent attacks. The assassination of Nasrallah marks a severe blow to Hezbollah's leadership, as he was instrumental in shaping the organization's current structure and power.

Israel's Objectives

- Israel has been waging war in Gaza for nearly a year but has not yet achieved its stated goals: the destruction of Hamas and the release of hostages held in Gaza. More than 40,000 Palestinians have been killed, and Gaza has been devastated, but without a clear victory, Israeli Prime Minister Netanyahu is unable to end the conflict without jeopardizing his political standing, particularly with far-right allies who oppose any ceasefire with Hamas.
- Hezbollah has maintained that as long as the war in Gaza continues, it will continue to launch rocket attacks on Israel. This puts Israel in a difficult position: while Netanyahu seeks to end Hezbollah's attacks, he cannot afford to agree to a ceasefire with **Hamas**. Faced with no simple solution, Israel has chosen to escalate its actions against Hezbollah, targeting its leadership and military capabilities. The recent escalation is

seen as an attempt by Israel to weaken Hezbollah and force it away from the border regions.

The Future of the Conflict

- Israeli leadership has ruled out a ceasefire on the Lebanese front, and it remains unclear whether a ground invasion of Lebanon is forthcoming. Israel is faced with the challenge of Hezbollah being far more powerful and capable than Hamas. Neither side appears to be deterring the other, leading to a dangerous cycle of escalation.
- The killing of Hassan Nasrallah could be the pivotal moment that pushes Hezbollah to escalate the conflict further, potentially leading to an all-out war. The choices Hezbollah makes in the coming days—whether to regroup and continue fighting or fold under pressure—will significantly impact whether the region descends into a broader conflict involving not just Lebanon and Israel but potentially Iran and other regional players as well.

8. Common Practice Standards must have India outlook

Agroforestry's Potential in India

- India has significant potential to integrate agroforestry with carbon finance projects, specifically through Afforestation, Reforestation, and Revegetation (**ARR**) initiatives.
- The current agroforestry coverage is **28.4 million hectares**, which could increase to 53 million hectares by 2050.
- Agroforestry accounts for 8.65% of India's total land area and

contributes 19.3% of the country's carbon stocks.

- With proper policy support, the sector could contribute an additional carbon sink of 2.5 billion tons of CO₂ equivalent by 2030.

Importance of 'Common Practice' in Carbon Finance

- The term "common practice" is a key criterion in assessing carbon finance eligibility.
 - It determines whether a project is "additional" — meaning, it exceeds what is typically done in a region.
- In ARR projects, common practice determines if similar activities are performed without carbon credits.
- According to carbon standards like **Verra's Verified Carbon Standard (VCS) and the Gold Standard:**
 - Projects deemed "common practice" do not qualify for carbon credits because they don't provide additional environmental benefits.

Challenges of Common Practice for India's Agroforestry

- India's agricultural structure is unique due to small and **fragmented landholdings.**
 - 1% of farmers are small and marginal, owning ***less than two hectares of land.***
- Small farmers practice agroforestry in a scattered, unsystematic way, planting trees alongside crops or on small patches of land.
- While beneficial, these practices often fail to meet the additionality criteria in carbon standards.
 - As a result, many Indian farmers are excluded from carbon finance projects and the associated income opportunities.

Need for India-Centric Approaches to Carbon Standards

- India's agricultural landscape is distinct, requiring a redefinition of the "common practice" criteria.
 - An India-centric approach would recognize that even small improvements in agroforestry are transformative.
- Revising carbon standards to reflect India's fragmented, small-holder model could:
 - Unlock the vast potential for carbon sequestration.
 - Enable more farmers to participate in carbon finance projects.
 - Enhance both environmental sustainability and rural livelihoods.

Economic and Environmental Benefits of ARR Projects for Farmers

- **Economic Benefits:**
 - ARR projects offer farmers additional income streams through carbon sequestration.
 - This provides financial stability in the face of unpredictable weather and fluctuating crop yields.
- **Environmental Benefits:**
 - Agroforestry integrated with ARR improves soil fertility, water retention, and mitigates erosion.
 - This ensures long-term sustainability and increases agricultural productivity.

The Role of Research and International Standards

- Research institutes like The Energy and Resources Institute (TERI) have demonstrated the viability of ARR projects in India.
 - TERI spearheaded 19 projects across seven states, benefiting over

56,600 farmers.

- **Need for Standard Revision:**

- For initiatives to scale, international carbon finance platforms must revise their standards to align with India's agricultural realities.
- Revising the "Common Practice" guidelines would:
 - Include more Indian farmers in carbon finance projects.
 - Boost rural incomes and support sustainable development.

The Path Forward for Agroforestry and Carbon Finance in India

- **Adaptation of International Standards:**

- Carbon credit platforms like **Verra and Gold Standard** need to revise their standards to reflect India's agricultural challenges.

- **Unlocking Agroforestry Potential:**

- By integrating ARR initiatives, India can maximize the potential for sustainable development.
- Millions of small farmers could benefit from carbon credits, contributing to India's economic resilience and environmental sustainability.

Conclusion

India's agroforestry sector has immense potential for carbon sequestration and rural development. However, the sector's growth hinges on revising international carbon finance standards to better accommodate India's unique agricultural structure. By doing so, India can achieve its climate goals while uplifting millions of small and marginal farmers, ensuring a sustainable future for the country.

9. India in Indian Ocean Commission

Indian Ocean Commission (COI)

- The *Indian Ocean Commission* (French: *Commission de l'Océan Indien, COI*) is an *intergovernmental organization* that links *five African Indian Ocean nations*: Comoros, Madagascar, Mauritius, Réunion (an overseas region of France), and Seychelles.
- Created by *the Port Louis Declaration* in 1982, the IOC was institutionalized in Seychelles in 1984 by the General Cooperation Agreement, better known as the "*Victoria Agreement*".
- COI's *principal mission* is to strengthen the ties of friendship between the countries and to be a platform of solidarity for the entire population of the African Indian Ocean region.
- COI's mission also includes development, through projects related to sustainability for the region, aimed at protecting the region, improving the living conditions of the populations, and preserving the various natural resources that the countries depend on.
- It has China, Malta, the European Union, the International Organization of La Francophonie (OIF), India, Japan, and the United Nations as observers.

Significance of COI

- COI is the *only regional organization in Africa composed exclusively of islands*.
- It defends the interests of its member states in the continental and international arena.

- It has projects covering a wide range of sectors like the preservation of ecosystems, sustainable management of natural resources, maritime security, entrepreneurship, public health, renewable energies, and culture.
- This experience and expertise make the COI a key player for achieving Sustainable Development Goals.
- The COI also implements projects which go beyond the geographic framework of its member states to cover the countries of eastern and southern Africa and the island countries of the western front of the continent.
- The **anti-piracy unit** of the Indian Ocean Commission launched many initiatives for **maritime security in Africa under the MASE program**. Under this program, COI established a mechanism for surveillance and control of the Western Indian Ocean with two regional centers.
- The COI has funded several regional and national conservation and alternative livelihood projects through **ReCoMAP, the Regional Programme for the Sustainable Management of the Coastal Zones of the Countries of the Indian Ocean** (PROGECO in French).

Benefits for India with Observer status

- *Presence in the Western Indian Ocean*
 - India will get an official foothold in a premier regional institution in the western Indian Ocean.
 - It will create opportunities for more engagement with islands in this part of the Indian Ocean.
 - Presence in a strategic location that connects Eastern Africa to the Indian Ocean.
- *Influence over the use of Mozambique Channel*

- Part of the Indian Ocean is located between the African countries of Madagascar and Mozambique.
- Considered a choke point in the Indian Ocean.
- The channel is likely to regain its relevance if the hostilities surrounding the Strait of Hormuz escalate in the future.

- *Geo-political reasons*

- India's pivot to Africa is a geopolitical and strategic necessity considering China's influence in the region. The observer status will help India to increase its influence in the Western Indian Ocean.
- As an observer, India can play a crucial role in combating piracy emanating from the East African coast.
- France is an important partner in the COI. India as an observer will have the opportunity to boost cooperation with France and its overseas regions.

- *SAGAR Policy:*

- It will help to extend India's SAGAR (Security and Growth for all in the Region) policy in the region.
- SAGAR aims for the enhancement of capacities to safeguard territories, economic and security cooperation in the littoral nations, and cooperation to deal with natural disasters and maritime threats like piracy and terrorism.

India can contribute as an Observer

- India can help in the capacity building of the members of COI in the following areas:
 - Joint action with the Indian Navy for anti-piracy operations.
 - Patrolling the coastal areas.

- Anti-terrorism training.
- Safeguarding their Exclusive Economic Zones.
- Providing technical expertise in maritime monitoring & surveillance.
- Realize the potential of the COI member countries in the sector of the blue economy.
 - Help the countries to tap the potential of oceans and marine areas for economic development.
 - Use the expertise of state-owned enterprises such as ONGC to identify and develop natural gas resources.
 - Help the countries in achieving the Sustainable Development Goals that include a Goal on Oceans and resource management.
- Help in adapting to Climate Change
- Develop regional and sub-regional climate change mitigation and adaptation strategies.
- Build the resilience of people dependent on the oceans for livelihoods.
- Extending India's satellite services for the benefit of the members covering areas like
 - Telecommunication
 - Tele-Medicine
 - Tele-Education
 - Satellite-aided search and rescue
 - Navigation requirements
 - Training and development communications

Way Forward

- India can genuinely contribute as an observer to COI without being a 'big brother'. The COI offers a good platform for India to expand its

presence in the Western Indian Ocean. Many countries involved with COI are potential partners in **India's SAGAR doctrine**. Both India and COI are to gain from this relationship.

10. Indian Ocean Rim Association

- The Indian Ocean Rim Association is an intergovernmental organisation **established on March 7, 1997**.
- It aims to promote regional cooperation and development among countries bordering the Indian Ocean and those with a significant interest in the region.
- It fosters collaboration in various areas, including economic and trade cooperation, maritime safety, cultural exchange, and disaster risk management, among others, to enhance the well-being and prosperity of member states in the Indian Ocean region.

Secretariat of the Indian Ocean Rim Association

- The Secretariat of the Indian Ocean Rim Association is situated in **Cyber City, Ebène, Mauritius**, and it is hosted by the Government of the Republic of Mauritius.
- This Secretariat plays a vital role in managing, coordinating, servicing, and overseeing the implementation of policy decisions, work programs, and projects that are adopted by the Council of Ministers within the body.

The organisation has 23 members as follows:

1. Commonwealth of Australia,

2. People's Republic of Bangladesh,
3. Union of Comoros,
4. French Republic,
5. Republic of India,
6. Republic of Indonesia,
7. Islamic Republic of Iran,
8. Republic of Kenya,
9. Republic of Madagascar,
10. Malaysia,
11. Republic of Maldives,
12. Republic of Mauritius,
13. Republic of Mozambique,
14. Sultanate of Oman,
15. Republic of Seychelles,
16. Republic of Singapore,
17. Federal Republic of Somalia,
18. Republic of South Africa,
19. Democratic Socialist Republic of Sri Lanka,
20. United Republic of Tanzania, Kingdom of Thailand,
21. United Arab Emirates and
22. Republic of Yemen.
23. France

Structure of the Indian Ocean Rim Association

- **Council of Foreign Ministers (COM):** The highest governing body of the Indian Ocean Rim Association (IORA) is the Council of Foreign Ministers (COM), which convenes on an annual basis.
 - The United Arab Emirates (UAE) held the position of Chair from

November 2019 to November 2021, followed by the People's Republic of Bangladesh, which assumed the role from November 2021 to November 2023.

- **Committee of Senior Officials (CSO):** It meets twice a year to advance IORA's agenda. During these meetings, the CSO reviews recommendations from Working Groups and forums involving officials, businesses, and academics. These recommendations are then used to shape policies and initiatives aimed at enhancing the well-being of people within the member states of the Indian Ocean.

Six Priority Areas of Indian Ocean Rim Association

The Indian Ocean Rim Association (IORA) focuses on a range of areas to promote cooperation and development among its member states. The primary focus areas include:

- **Maritime Safety and Security (MSS)**
 - Enhancing safety and security in the Indian Ocean, which is vital for safe navigation, trade, and environmental protection.
 - MSS was assigned in 2011 by IORA as the top priority area of focus.
 - The '**IORA Working Group on MSS**', also known as the WGMSS, established in 2018 is currently advancing the IORA Action Plan (2017-21) with Member States developing a regional agenda through a 'MSS Work Plan'.
 - Formation of Indian Ocean Dialogue to discuss pertinent issues including MSS.
- **Trade and Investment Facilitation**
 - Working to reduce trade barriers, enhance business environments, and promote investment in the region.

- Indian Ocean Rim Business Forum (IORBF) of IORA shall be injecting business perspectives for the Indian Ocean region.

- **Fisheries Management**

- IORA Fisheries Support Unit leads and manages the efforts of IORA efforts in identifying issues related to fisheries.

- **Disaster Risk Management**

- Collaborating on disaster preparedness and response to mitigate the impact of natural disasters in the region.

- **Tourism and Cultural Exchanges**

- The Jakarta Concord adopted in 2017 commits to fostering tourism and cultural exchanges.

- **Academic, Science and Technology Cooperation**

- The Jakarta Concord which has been adopted by the IORA Heads of State and Government had committed to strengthen academic and technological cooperation.

- **Blue Economy**

- Exploring sustainable and responsible use of marine resources, including fisheries and aquaculture, to support economic growth.

- **Women's Economic Empowerment**

- At the 13th Council of Ministers Meeting in Perth, Australia on November 1, 2013, IORA made a significant commitment to gender equality and women's economic empowerment, designating it as a special focus area.

Importance of the Indian Ocean

- **Geographic Location:** Geographically, it holds a strategic position as it is situated at the nexus of global trade routes, linking the primary

powerhouses of the world economy in the Northern Atlantic and the Asia-Pacific region.

- **Sea Trade Lanes:** The Indian Ocean, as the third-largest ocean interwoven with vital trade routes, wields significant influence over major sea-lanes that carry 50% of the world's container ships, one-third of global bulk cargo traffic, and two-thirds of the world's oil shipments. It remains a crucial lifeline for international trade and transportation.
- **Population along the Coastlines:** It is home to nearly 2.7 billion people, the Member States with coastlines along this ocean exhibit remarkable cultural diversity, boasting a wealth of languages, religions, traditions, arts, and cuisines. Despite this diversity and disparities, they share a common connection through their association with the Indian Ocean.
- **Resource Rich Region:** The Indian Ocean is a valuable reservoir of fishing and mineral resources. It houses significant mineral resources, including nodules rich in nickel, cobalt, and iron, as well as substantial sulphide deposits of manganese, copper, iron, zinc, silver, and gold on the ocean floor.

Indian Initiatives in the Indian Ocean

India has undertaken various strategic initiatives in the Indian Ocean region to enhance regional cooperation, security, trade, and overall stability. Some of these initiatives are as follows:

- **SAGAR (Security and Growth for All in the Region):** The SAGAR doctrine emphasises a holistic approach to security and growth in the Indian Ocean region. It aims to enhance maritime security, promote trade, and support the development of littoral states.
- **Project Mausam:** It seeks to re-establish historic maritime and cultural

	<p>links with countries in the Indian Ocean region. It promotes cooperation in archaeology, historical research, and cultural exchange.</p> <ul style="list-style-type: none"> • Indian Ocean Naval Symposium (IONS): IONS is a forum for naval cooperation among the Indian Ocean littoral states. India plays a pivotal role in this initiative, which aims to enhance maritime security and cooperation in the region. • ASEAN-India Maritime Transport Cooperation: India has been working closely with the ASEAN countries to enhance maritime transport links and connectivity in the Indian Ocean region, promoting trade and economic cooperation. <p>Road Ahead</p> <ul style="list-style-type: none"> • To advance the Indian Ocean Rim Association (IORA), member states should intensify efforts to bolster maritime security, promote economic collaboration, and emphasise sustainable development and environmental conservation. Furthermore, IORA should evolve as an influential forum for resolving regional conflicts, engage with external partners, and adapt its strategies to address evolving regional challenges and opportunities.
<p>11.</p>	<p>Pacific Islands Forum (PIF)</p> <ul style="list-style-type: none"> • Formed in 1971, PIF is an intergovernmental organisation which consists of 18 member states located in the Pacific region. • Member states (18): <ul style="list-style-type: none"> ○ Australia, Cook Islands, Federated States of Micronesia, Fiji,

French Polynesia, Kiribati, Nauru, New Caledonia, **New Zealand**, Niue, Palau, Papua New Guinea, Republic of Marshall Islands, Samoa, Solomon Islands, Tonga, Tuvalu, and Vanuatu.

- Australia and New Zealand are among the wealthiest and largest countries which are part of the organisation.

- **Aim:** To push for **economic growth**, **enhance political governance**, **strengthen regional cooperation** and enhance **climate and maritime security** for the Pacific region.
- **Working:**
 - **Annual Forum:** The Pacific Islands Forum holds an **annual meeting** where leaders from member countries discuss and decide on issues affecting the region. The decisions are implemented by the **Pacific Islands Forum Secretariat (located in Fiji)**.
 - **Dialogue Partners:** The Forum engages with external partners, including countries like the USA, China, Japan, India and the European Union, through the Forum Dialogue Partners process.
 - **Observer Status:** Some territories and organisations, like the Asian Development Bank and the Commonwealth Secretariat, hold observer status.
- **Agenda (2024):** In this year's annual meeting, **climate change** and the **China-US battle for influence** over the strategic region were the dominating discussions.

Significance of PIF-

- The PIF advocates for global climate action and funds resilience efforts

through the **Pacific Resilience Facility (PRF)** to support vulnerable Pacific nations.

- It enhances **cooperation among its 18 small island states**, fostering joint decision-making on key regional issues.
- The forum strengthens the Pacific's ability to navigate **geopolitical tensions** between major powers like the US and China.
- PIF promotes **sustainable economic development** through regional trade and investment initiatives.
- It focuses on **protecting the Pacific's ecosystems** by addressing challenges like ocean pollution and overfishing.

Challenges faced by Pacific Island Forum (PIF) countries

Sea-level rise due to Climate change:

- The recently released World Meteorological Organization (WMO) report revealed that faster-than-average sea level rise, ocean warming, and acidification are **threatening the Pacific Islands**.
- The **South-West Pacific** was worst hit by sea level rises, in some places by more than double the global average in the past 30 years. Several PIF members are among the world's worst-affected countries due to rising sea levels.
- PIF members have been pushing to raise funds for climate action. The **Pacific Resilience Facility (PRF)** is a **regional financing facility** established by PIF to fund initiatives that **enhance the resilience of Pacific Island countries** to climate change and natural disasters.

Tussle between China and the US for influence over the region:

- Earlier, it was **Australia and New Zealand** which functioned as security partners in the region. In recent years, **China has deepened its ties with PIF members**. In 2022, China signed a **security pact with Solomon Islands**.
- China has also **pressured nations in the grouping to reject the inclusion of Taiwan**, with Solomon Islands, Kiribati and Nauru now accepting this position. This has set off **alarm bells in Australia and the US**.

12. Indo-Pacific Oceans Initiative

Indo-Pacific Oceans Initiative (IPOI)

- It was launched by India in November 2019 at the **East Asia Summit (EAS) in Bangkok**, and aims to foster cooperation for a **free, open, and rules-based Indo-Pacific**.
- IPOI emphasizes maritime security, stability, and development, building on India's Security and Growth for All in the Region (SAGAR) vision.
- It operates as a non-treaty-based, voluntary arrangement, relying on existing frameworks like the EAS mechanism.



Key Pillars and Leadership of IPOI

- IPOI has seven pillars, with countries taking the lead in specific areas:
- Maritime Security: UK and India
- Maritime Ecology: Australia and Thailand
- Maritime Resources: France and Indonesia
- Capacity Building and Resource Sharing: Germany
- Disaster Risk Reduction and Management: India and Bangladesh
- Science, Technology, and Academic Cooperation: Italy and Singapore
- Trade, Connectivity, and Maritime Transport: Japan and the US

Significance of IPOI-

- IPOI aims to ensure a rules-based regional order in the Indo-Pacific,

promoting the free movement of goods, services, and people while safeguarding the sovereignty of countries.

- The IPOI strengthens regional maritime security by encouraging cooperation among nations to address shared threats, such as piracy, illegal fishing, smuggling, and other maritime crimes.
- IPOI seeks to strengthen regional capacity for disaster risk reduction and management, promoting cooperation in disaster preparedness and response, thereby mitigating the impact of natural calamities.
- As a non-treaty-based and voluntary initiative, IPOI remains flexible, allowing countries to participate based on shared interests without creating new institutional burdens.

Way Forward

The IPOI has seen incremental progress, with notable bilateral and multilateral partnerships, such as the **Australia-India Indo-Pacific Oceans Initiative Partnership (AIPOIP)** focusing on maritime ecology. Various international maritime frameworks, including ASEAN's Outlook for the Indo-Pacific (AOIP) and the Quad, resonate with the IPOI's goals, which strengthens its role in promoting maritime cooperation.

13. What is "Loss and Damage Fund"?

In the aftermath of the catastrophic landslides that recently impacted Kerala's Wayanad district, a critical discourse has arisen regarding the eligibility of subnational entities to claim compensation through the **Loss and Damage Fund (LDF)** under the **United Nations Framework Convention on Climate Change (UNFCCC)**. The Wayanad district of Kerala experienced a

devastating landslide disaster in early July 2024 due to heavy rainfall and fragile ecological conditions. The landslides in Chooralmala and Mundakkai villages killed at least 144 people and injured 197, after the district received over 140 mm of rain in 24 hours, saturating the soil and weakening its binding to the underlying hard rocks.

- The "Loss and Damage" (L&D) fund is a financial mechanism designed to **address the irreversible consequences of climate change** that cannot be avoided or mitigated through adaptation efforts.
 - **Adaptation** is the proactive response to **climate change**, the art of survival using which communities and countries make deliberate choices to **prepare for and cope with climate-related challenges**.
- This fund recognizes and aims to compensate for the real losses incurred by **communities, countries, and ecosystems** due to the impacts of climate change.
 - These losses extend beyond monetary value and cut to the core of human rights, well-being, and environmental sustainability.

Genesis and Evolution of the L&D Fund:

- **Historical Accountability and Inception:**
 - Over 30 years, there has been a persistent call for affluent nations to acknowledge their role in historic pollution, which has elevated the world's average **surface temperature by more than 1 degree Celsius**.
 - This historic pollution is currently causing significant damage worldwide, especially in the

poorest nations.

- **COP 19 (2013):**

- The formal agreement at the **19th Conference of the Parties (COP 19)** to the **United Nations Framework Convention on Climate Change (UNFCCC)** in Warsaw, Poland, in 2013, led to the **establishment** of the L&D fund.
- This fund was specifically created to provide financial and technical assistance to **economically developing nations** that were incurring Loss and Damage due to climate change.

Subsequent Developments and Challenges

COP 25:

- Following COP 19, the Santiago Network for L&D was established at COP 25. However, at this point, countries did not commit any funds to support the initiative.

COP 26:

- **2021 COP26 climate summit in Glasgow**, aimed to continue discussions over the next three years regarding the **operationalization of the fund**.

COP 27 (November 2022):

- After intense negotiations at COP 27, representatives of the UNFCCC's member states agreed to set up the L&D fund. Additionally, a **Transitional Committee (TC)** was established to figure out how the new funding mechanisms under the fund would operate.

The TC was tasked with preparing recommendations for countries to consider, deliberate on, and potentially adopt by **COP 28**.

Stalemate at TC4 and TC5:

▪ **TC4 Meeting:**

- The fourth meeting of the TC4 concluded with no clear consensus on operationalizing the L&D fund.
- The key points of contention included the hosting of the fund at the **World Bank**, the **foundational principle of common but differentiated responsibilities (CBDR)**, issues related to **climate reparations**, and the eligibility of all developing nations for the funds.

▪ **TC5 Meeting:**

- Recommendations from TC5 have been drafted and forwarded to COP 28.

Challenges Regarding the Loss and Damage Fund

• **Developed Nations' Reluctance:**

- Developed nations, particularly the US, have remained **non-committal about being primary donors to the fund**. Their support is voluntary, raising concerns about the commitment to the fund's objectives.
 - The unwillingness of wealthy nations to fulfill their intended commitments undermines faith in global climate negotiations and hampers the cooperative spirit necessary to address climate change.

- **Uncertainty Surrounding the Fund:**

- There is currently **no indication of the size of the L&D fund**, and any attempt to specify the fund's size was quashed under pressure from the U.K. and Australia.
 - The current draft merely urges and invites developed nations to provide money, without a clear commitment or framework.

- **Diplomatic Breakdown and Global Consequences:**

- Developing nations express discontent, perceiving that their concerns and needs are **not adequately addressed by the international community**.
 - This complicates the path to climate action and raises doubts about addressing other global issues effectively.
- Beyond immediate diplomatic and trust-related repercussions, the watering down of the L&D fund has far-reaching implications. It threatens climate justice and exacerbates the suffering of **vulnerable communities in developing nations**, who have **contributed minimally to global emissions** but bear the brunt of climate change.

- **Security Implications of Climate-Change-Induced Instability:**

- Climate-change-induced instability can have security implications as conflicts and tensions emerge in vulnerable nations.
 - These conflicts threaten to spill across borders, creating security challenges.
- Beyond the immediate consequences, the absence of support for vulnerable communities **can lead to an increase in humanitarian crises**, including food shortages, people

	<p>displacement, and conflicts.</p> <ul style="list-style-type: none"> ▪ This forces communities to cope independently with a worsening climate and its consequences. <p><u>Road ahead</u></p> <ul style="list-style-type: none"> • Global Commitment: Urge developed nations to actively contribute as primary donors to the L&D fund, ensuring a strong financial commitment. • Transparency and Structure: Advocate for transparent discussions to define the fund's size, operational guidelines, and allocation mechanisms, providing clarity and accountability. • Inclusive Diplomacy: Foster open diplomatic dialogues that address the concerns of developing nations, promoting collaboration for effective climate action and global issue resolution. • Security Mitigation: Proactively address security implications of climate-induced instability, implementing measures to tackle humanitarian crises and supporting vulnerable communities.
<p>14.</p>	<p>Bohai Gulf</p> <p>UNESCO recently inscribed China's Migratory Bird Sanctuaries along the Yellow Sea-Bohai Gulf (Phase II) to its World Heritage List.</p> <p>Bohai Gulf:</p> <ul style="list-style-type: none"> • It is the innermost gulf of the Yellow Sea on the coast of Northeastern and North China.

- It is sometimes called **Bohai Sea**, or **Bo Hai** for short; in **earlier times** it was **called the Gulf of Chili** or the **Gulf of Pechili**.
- It is approximately 78,000 sq.km in area, and its **proximity to Beijing**, the capital of China, makes it **one of the busiest seaways** in the world.
- The Bohai Gulf is **enclosed by the Liaodong Peninsula** (northeast) and the **Shandong Peninsula** (south).
- Among the most **important cities** on the Bohai Gulf are **Dalian and Tianjin**; its **shores form** three of the most **famous bays** in the country: **Liaodong Bay, Bohai Bay, and Laizhou Bay**.
- The **Yellow River, China's second longest river, discharges into the gulf**.
- There are both onshore and offshore **petroleum deposits**, and several oil refineries are located there as well as other industries.



Yellow Sea

- It is a **marginal sea of the western Pacific Ocean.**
- **Location:**
 - It is situated **between mainland China to the west** and north, the **Korean Peninsula to the east**, and the **Shandong Peninsula** and **Liaodong Peninsula** to the south.
 - It **connects** with the **Bohai Sea to the northwest.**
- **Size:** Also **referred to in China as Huang Hai** and **in North and South Korea as the West Sea**, the Yellow Sea is 870 kilometres long and 556 kilometres wide.
- **Depth:** It is **one of the largest shallow areas of continental shelf** in the world, with an average depth of 44 metres and a maximum depth of 152 metres.
- **Inflow:** Several major rivers, including the **Yellow River** and the **Yangtze River, discharge** into the Yellow Sea.
- **Islands:** The Yellow Sea is dotted with numerous islands, **the largest** of which include **Jeju Island (South Korea)**, the **Shandong Peninsula islands (China)**, and **Ganghwa Island (South Korea)**.
- **Climate:** The climate is characterized by very **cold, dry winters** and **wet, warm summers.**
- **Currents:**
 - The **warm current** of the Yellow Sea is a **part of the Tsushima Current**, which diverges near the western part of the Japanese island of Kyushu and flows at less than 0.5 mile (0.8 km) per hour northward into the middle of the sea.
 - **Along the continental coasts, southward-flowing currents prevail**, which **strengthen** markedly **in the winter monsoon period**, when the water is cold, turbid, and of low salinity.

15. The colonial — and anti-colonial — roots of Durga Puja

- India is joyously celebrating the festival of Navratri and Durga Puja.
- While this festival holds deep religious significance, its roots in modern times are intertwined with the colonial era.

Robert Clive and the Mythical Beginning-

- **Multiple Origin Stories:** Durga Puja has various origin stories, with one popular tale linked to the aftermath of the Battle of Plassey in 1757.
- **Robert Clive's Role:** Following his victory over Nawab Siraj ud Daula, Robert Clive wished to express gratitude to God. In the absence of a church, Nabakishan Deb, Clive's Persian translator, suggested offering prayers to Goddess Durga. This marked the initiation of Calcutta's first Durga Puja.
- **Historical Scrutiny:** While this narrative is widely known, historical records raise doubts about its accuracy. Nevertheless, it symbolizes the social beginnings of Durga Puja in Calcutta, driven by the connections between Bengali zamindars, merchants, and the East India Company.

Sociological Changes under Colonial Rule-

- **Rise of Zamindars:** With the decline of the Mughal Empire, Bengal's zamindars, hereditary landowners, gained authority, effectively governing their territories. The Permanent Settlement Act of 1793 formalized their role as intermediaries.
- **Emergence of Prosperous Merchants:** Calcutta, as a growing urban center, witnessed the swift rise of affluent Bengali merchants during Company rule. Economic opportunities led to rapid wealth

accumulation by families like the Tagores and the Mullicks.

- **Conspicuous Consumption:** Durga Puja became a platform for the nouveau riche to flaunt their affluence. Lavish celebrations, gold-adorned idols, and entertainment from nautch girls characterized these grand events, fostering competition among rival families.

Durga Puja Takes a Nationalistic Turn-

- **Late 19th-Century Nationalism:** In the late 19th century, feelings of nationalism began to surge among the Bengali intelligentsia. *Bankim Chandra Chattopadhyay's "Ananda Math,"* published in 1882, popularized the phrase "Bande Mataram" and introduced the concept of the "mother" nation.
- **Durga as a Symbol:** Goddess Durga, revered as "Ma" (mother) Durga, came to symbolize the nation and its potential saviour from foreign rule. Durga Puja became an integral part of the burgeoning nationalist movement.
- **Response to Partition:** Lord Curzon's decision to Partition Bengal in 1905 fueled the Swadeshi Movement, with "Bande Mataram" as its rallying cry. Communal festivities, including Durga Puja, played a pivotal role in forging collective consciousness and action.
- **Swadeshi Symbolism:** Durga Puja underwent a transformation during this period, with advertisements promoting indigenous products and festivities emphasizing indigenous values. British elites became less welcome at the pujas, reflecting a growing sense of nationalism.

Shift towards Public Celebrations-

- **1920s Transformation:** In the 1920s, public Durga Pujas emerged, marking a shift from exclusive festivals for the wealthy elite to inclusive

celebrations for all. The first “sarbojanin” or “universal” Puja was organized in 1926 in Calcutta’s Maniktala area.

- **Inclusive Tradition:** These public Pujas, organized by locality, welcomed people regardless of their caste or residence. Temporary temples, known as pandals, sprung up in public spaces, making the festivities accessible to a broader audience.

Conclusion

- The evolution of Durga Puja, from its colonial-era origins to a celebration of nationalism and inclusivity, reflects the dynamic nature of culture and society. It has transformed from an occasion for the elite to showcase wealth to a festival that unites people across backgrounds, embracing unity in diversity. Durga Puja continues to be a cherished tradition that weaves together history, culture, and the essence of Bengal.

16. Landforms of the Earth: Classification and Types

- A **landform is a feature on the Earth's surface** that is part of the terrain.
- Each landform has its **own physical shape, size, materials** and is a result of the action of certain **geomorphic processes and agent(s)**.
 - **Actions of most of the geomorphic processes and agents are slow**, and hence the results take a long time to take shape.
- Every landform has a beginning and **landforms once formed may change in their shape, size and nature slowly or fast** due to continued action of geomorphic processes and agents.

What are the Landforms Made by Running Water?

- In humid regions, **which receive heavy rainfall**, running water is considered the most important of the geomorphic agents in bringing about the degradation of the land surface.
- Most of the erosional landforms made by running water are associated with vigorous and youthful rivers flowing over steep gradients.

1. Erosional Landforms by Running Water:

○ **Valleys:**

- **Valleys start as small and narrow rills** and the rills will gradually develop into long and wide gullies; the gullies will further deepen, widen and lengthen to give rise to valleys.

▪ **Types of Valleys:**

• **Gorge:**

- A **gorge is a deep valley with very steep to straight sides.**
- A gorge is almost equal in width at its top as well as its bottom.
- Gorges form in **hard rocks.**

• **Canyon:**

- A canyon is characterised by steep step-like side slopes and may be as deep as a gorge.
- A canyon is wider at its top than at its bottom. In fact, a canyon is a variant of a gorge.
- Canyons commonly form in horizontal bedded sediment.

○ **Potholes and Plunge Pools:**

- Potholes are **more or less circular depressions formed** because of stream erosion aided by the abrasion of rock fragments.
 - **Once a small and shallow depression forms, pebbles and boulders get collected** in those depressions and get rotated by flowing water and consequently the depressions grow in dimensions.
- **Plunge pools are large potholes, quite deep and wide, formed** because of the sheer impact of water and rotation of boulders.
 - These pools **also help in the deepening of valleys.**
- **Incised or Entrenched Meanders:**
 - Incised or Entrenched Meanders are **very deep and wide meanders** that can be **found cut in hard rocks.**
 - Entrenched meander **normally occurs where there is a rapid cutting** of the river bed such that the river does not erode the lateral sides.
 - Because of **active lateral erosion**, streams flowing over gentle slopes develop sinuous or meandering courses.
 - It is **common to find meandering courses** over floodplains and delta plains where stream gradients are very gentle.
- **River Terraces:**
 - River terraces are **surfaces marking old valley floor or floodplain levels.**
 - They are **basically products of erosion as they result due to vertical erosion** by the stream into its own

depositional floodplain.

- The river terraces **may occur at the same elevation on either side** of the rivers in which case they are called **paired terraces**.
- When the **terraces are seen only on one side** with none on the other or one at quite a different elevation on the other side, they are called **unpaired terraces**.

2. Depositional Landforms by Running Water

a. Alluvial Fans:

- i. Alluvial fans are **formed when streams flowing from higher levels break into foot slope plains** of low gradient.
- ii. Normally a **very coarse load is carried by streams** flowing over mountain slopes.
- iii. This **load becomes too heavy for the streams to be carried** over gentler gradients and gets dumped and spread as a broad low to high cone shaped deposit called alluvial fan.

b. Deltas:

- i. Deltas are **like alluvial fans** but develop at a different location.
- ii. The **load carried by the rivers is dumped and spread** into the sea.
 1. If this **load is not carried away far into the sea or distributed along the coast**, it spreads and accumulates as a low cone.
- iii. Unlike in alluvial fans, the deposits making up deltas are very well sorted with clear **stratification**.

c. Floodplains:

- i. A floodplain (or floodplain) is a **generally flat area of land next to a river or stream.**
- ii. It stretches from the **banks of the river to the outer edges of the valley.**
- iii. A floodplain **consists of two parts.**
 1. **Foodway:**
 - a. The first is the main channel of the river itself, called the **floodway.**
 - i. Floodways can sometimes be seasonal, meaning the channel is dry for part of the year.
 2. **Flood Fringe:**
 - a. Beyond the floodway is the **flood fringe.** The flood fringe extends from the outer banks of the floodway to the bluff lines of a river valley.
- iv. A **river bed made of river deposits is the active floodplain** and the floodplain above the bank is inactive floodplain.
 1. **Inactive floodplains above the banks basically contain** two types of deposits — **flood deposits and channel deposits.**
- v. In plains, **channels shift laterally and change their courses occasionally** leaving cut-off courses which get filled up gradually.
 1. Such areas over flood plains built up by abandoned or cut-of channels contain coarse deposits.
 2. The flood deposits of spilled waters carry relatively finer materials like silt and clay.
 3. The floodplains in a delta are called **delta plains.**

d. Meanders:

- i. Meander is not a landform but is **only a type of channel pattern**. This is because of:
 1. **Propensity of water flowing** over very gentle gradients to work laterally on the banks.
 2. **Unconsolidated nature of alluvial deposits** making up the banks with many irregularities which can be used by water exerting pressure laterally.
 3. **Coriolis force** acting on the fluid water defecting it like it defects the wind.
- ii. The **tendency to meander is reduced**, if there is no deposition and no erosion or undercutting.
- iii. **An oxbow lake is a meander** that is no longer attached to the river.
 1. The water has to find a straighter route downstream during the floods, so the water flows over the ends of the meander.
 2. As the flood starts to go down, the water deposits sediment and covers up the ends of the meander making an oxbow lake.

What are the Landforms Made by Groundwater?

- Groundwater is a strong erosional force, as it works to dissolve away solid rock.
- Rainwater absorbs carbon dioxide (CO₂) as it falls. The CO₂ combines with water to form **carbonic acid**. The slightly acidic water sinks into the ground and moves through pore spaces in soil and cracks and fractures in rock. The flow of water underground is groundwater.

- Carbonic acid is especially good at dissolving the rock limestone.
- **Any limestone or dolomitic region showing typical landforms** produced by the action of groundwater through the processes of solution and deposition is called **Karst topography**.
 - **The karst topography** is also characterised by erosional and depositional landforms.

1. Erosional Landforms by Groundwater:

- **Swallow Holes, Sinkholes, Lapies and Limestone Pavements:**
 - **Swallow Holes:**
 - Small to medium sized round to sub-rounded shallow depressions called swallow holes form on the surface of limestones through solution.
 - **Sinkholes:**
 - They are **very common in limestone/karst areas**.
 - A sinkhole is an **opening more or less circular at the top** and funnel-shaped towards the bottom with sizes varying in area from a few sq. m to a hectare and with depth from a less than half a meter to thirty meters or more.
 - **Lapies:**
 - Lapies are **uneven grooves and ridges** that form when the majority of the limestone's surface is removed by the solution process.
 - **Deep grooves separate the etched**, fluted, and pitted rock pinnacles that make up the weathered limestone surface seen in the karst region.
 - **Limestone Pavements:**

- A limestone pavement is a **natural karst landform consisting of a flat, incised surface** of exposed limestone that resembles an artificial pavement.

- **Caves:**

- In areas where there are **alternating beds of rocks** (shales, sandstones, quartzites) with limestones or dolomites in between or in areas where limestones are dense, massive and occurring as thick beds, cave formation is prominent.
- There **can be a maze of caves** at different elevations depending upon the limestone beds and intervening rocks.

2. Depositional Landforms by Groundwater

Stalactites:

- Stalactites hang as **icicles of different diameters**.
- Normally they are **broad at their bases and taper towards** the free ends showing up in a variety of forms.

Stalagmites:

- Stalagmites **rise up from the floor of the caves**.
- They form **due to dripping water from the surface** or through the thin pipe of the stalactite, immediately below it.
- Stalagmites **may take the shape of a column**, a disc, with either a smooth, rounded bulging end or a miniature crater like depression.

Pillars:

- The stalagmite and stalactites eventually fuse to give rise to columns and pillars of different diameters.

Landform made by Running Water

RIVER LANDFORMS

Different types of landforms formed at different courses of a river - Upper, Middle & Lower

UPPER (MOUNTAIN) COURSE

- Starts at source of river (usually a mountain range)
- Very fast speed of river due to steep slope
- Main action of river is vertical corrasion
- Landforms -
 - V-shaped Valleys (formed due to vertical corrasion)
 - Lao Valley, Hawaii
 - Interlocking Spurs
 - West Liddar valley above Pahalgam, Kashmir
 - Gorges (formed where rocks are too hard and resistant)
 - Indus Gorge, Kashmir
 - Canyons (formed where rainfall is very low)
 - Bryce Canyon, US
 - Rapids and Waterfalls
 - Lava Falls Rapid, US and Niagara Falls, Canada



Corrasion (or abrasion) is the erosion of a rock surface by rock fragments transported over it by water, wind, or ice

MIDDLE (VALLEY) COURSE

- Here, lateral corrasion overtakes vertical
- Confluence of tributaries → More volume of water → More loaded river
- Transportation main event in the region
- Interlocking spurs also formed on both sides of the valley
- Landforms -
 - Meanders
 - Owens River, SE California, US
 - River Cliffs and Slip-off slope
 - White Cliffs of Dover, UK



LOWER (PLAIN) COURSE

- River now heavy with material brought down from upper courses
- Vertical corrasion almost negligible, lateral corrasion still active
- Deposition plays key role in formation of riverbeds and extensive flood plains
- More volume in water; finer material carried to the mouth of river
- Landforms -
 - Floodplains and Levees
 - Ganga-Yamuna floodplain
 - Deltas
 - Sunderbans Delta



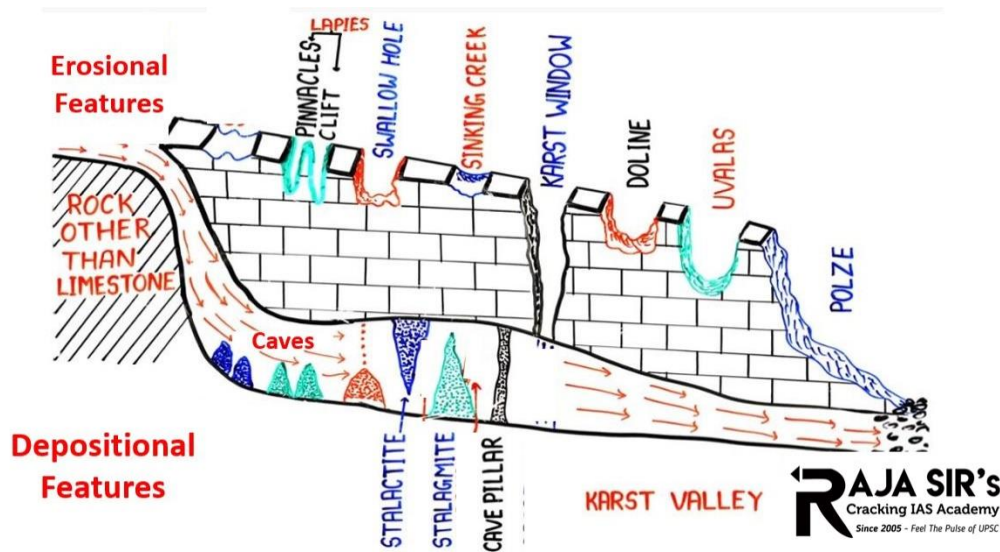




Erosional Landforms	
Gorge	Deep valley with very steep to straight sides
Canyon	Characterised by steep step-like side slopes Wider at its top than at its bottom
Potholes and Plunge Pools	More or less circular depressions formed because of stream erosion aided by the abrasion of rock fragments
Incised or Entrenched Meanders	Very deep and wide meanders that can be found cut in hard rocks.
River Terraces	<ul style="list-style-type: none"> • Surfaces marking old valley floor or floodplain levels • They are basically products of erosion as they result due to vertical erosion
Depositional Landforms	
Alluvial Fans	Formed when streams flowing from higher levels break into foot slope plains of low gradient
Deltas	Like alluvial fans but develop at a different location. The load carried by the rivers is dumped and spread into the sea
Floodplains	Generally flat area of land next to a river or stream. They stretches from the banks of the river to the outer edges of the valley
Meanders	

Landform but is only a type of channel pattern,

Landform made by Groundwater



Erosional Landforms

Swallow Holes	Small to medium sized round to sub-rounded shallow depressions
Sinkholes	Opening more or less circular at the top and funnel-shaped towards the bottom
Lapies	Uneven grooves and ridges formed when the majority of the limestone's surface is removed by the solution process
Limestone	Natural karst landform consisting of a flat, incised

Pavements	surface
Caves	Cave formation is prominent in areas where there are alternating beds of rocks with limestones or dolomites in between
Depositional Landforms	
Stalactites	Hang as icicles of different diameters
Stalagmites	Rise up from the floor of the caves
Pillars	Formed stalagmite and stalactites eventually fuse to give rise to columns and pillars of different diameters

17. Hurricane Milton the ‘storm of the century’

- **In the first week of Oct 2024, Hurricane Milton made landfall near Siesta Key, Florida, causing serious damage with heavy rain, flooding, tornadoes, and strong winds.** Although the storm was unusual, scientists warned about such events due to climate change.

Impact of Hurricane Milton

1. **Casualties and Damage:** The **storm resulted in at least 12 deaths**, mainly in eastern Florida. It destroyed homes, disrupted power for over 3 million customers, and caused flooding on barrier islands.
2. **Extreme Weather Events:** Milton brought over 45.72 cm (**18 inches**) of

rain to St. Petersburg, a level of rainfall that typically happens once in 1,000 years.

3. **Current Status:** The National Hurricane Center reported that Milton has weakened and **moved into the North Atlantic Ocean.**

HURRICANE MILTON **IS ONE FOR THE RECORD BOOKS**

- The **strongest hurricane** in the Atlantic Basin in terms of **pressure** since Hurricane Wilma in 2005.
- The **strongest hurricane** in the Atlantic Basin in terms of **wind speed** since Dorian in 2019.
- The **3rd strongest hurricane** in the Atlantic Basin on record **by wind**, with **maximum winds of 180 mph.**
- The **5th strongest hurricane** in the Atlantic Basin on record **by pressure**, with a **minimum pressure of 897mb.**
- One of the **top rapidly intensifying hurricanes**, increasing **95 mph in 24 hours.** Only Wilma (2005) and Felix (2007) had greater intensification.

Characteristics of Hurricane Milton

Rapid Intensification:

1. **Storm Classification:** Milton quickly **changed from a Category 1 hurricane (winds of 119 to 153 km/h) to a Category 5 hurricane (winds of 252 km/h or higher)** in just 12 hours between October 6 and October 7.
2. **Wind Speed Increase:** By the afternoon of October 7, Milton reached **sustained winds of 285 km/h**, making it one of the **strongest hurricanes recorded in the Atlantic**.
3. **Definition of Rapid Intensification:** A hurricane is considered to **rapidly intensify if its winds increase by at least 56 km/h**. Milton's winds increased by over 145 km/h in just one day.

Uncommon Formation and Path:

1. **Origin:** Milton formed in the **Gulf of Mexico** and moved eastward to hit **Florida's western coast**. Atmospheric scientist Jonathan Lin noted that few hurricanes have taken this path while reaching **Category 3 or higher**.

Factors Contributing to Milton's Unusual Intensity

1. **High Sea-Surface Temperatures:**
 - **Temperature Insights:** On the day **Milton became a Category 5 storm, sea-surface temperatures in the Gulf of Mexico were nearly 31°C**, well above the 26°C needed for hurricanes to form.
 - **Role of Ocean Heat:** Warmer ocean water evaporates more easily, fueling storms. Rising temperatures are linked to climate change, with **global sea surface temperatures increasing by about 0.9°C since**

1850.

2. High Atmospheric Humidity:

- **Moisture Retention:** The atmosphere can hold **7% more moisture for every 1°C rise in temperature**. More moisture makes storms stronger and leads to heavier rainfall.

3. Lack of Wind Shear:

- **Wind Shear Dynamics:** Wind shear refers to changes in wind speed and direction that can disrupt storms. In **Milton's case, low wind shear allowed the hurricane to stay strong.**

Context of Recent Hurricanes

1. Rising Instances of Rapid Intensification:

- **Recent Trends:** Milton's rapid intensification is **not a one-time event; other recent hurricanes, like Otis (Mexico) and Idalia (2023),** have shown similar quick changes in strength.

2. Climate Change Connections:

- **Research Findings:** A **2017 study indicated that global warming** could lead to more frequent rapid intensification of hurricanes as the planet warms.
- **Future Projections:** A recent report warned of a new phase in the climate crisis, predicting more extreme weather events in the coming years.

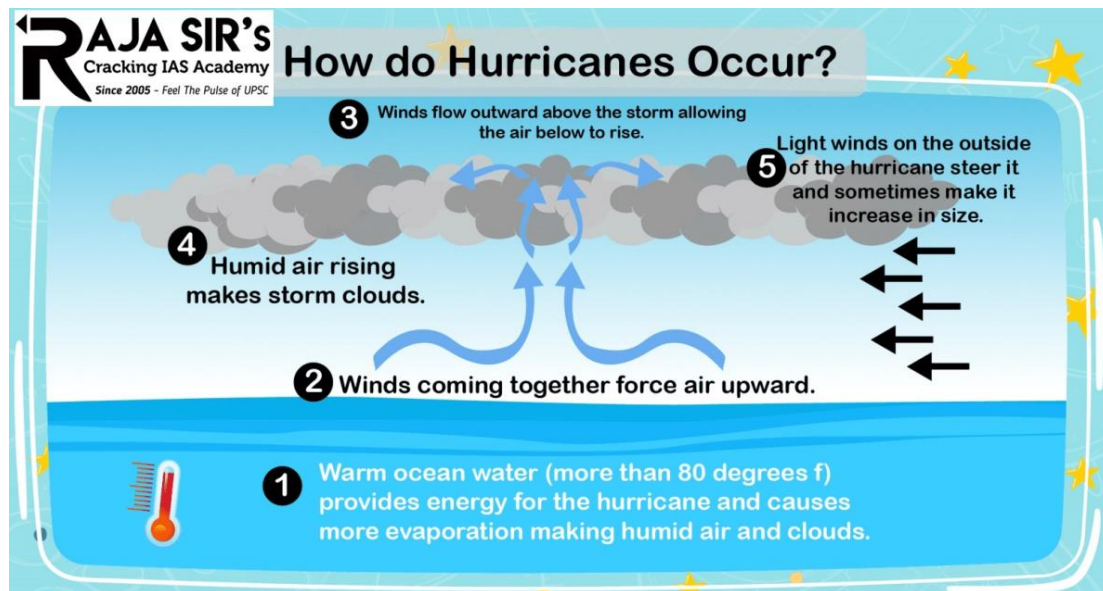
What are Hurricanes?

Hurricanes are intense tropical cyclones characterized by a low-pressure center and thunderstorms that produce strong winds and heavy rain.

1. They are often **referred to as typhoons in the western Pacific and cyclones in the Indian Ocean.**

Formation of a Hurricane:

Hurricanes form under specific conditions, primarily over warm ocean waters.



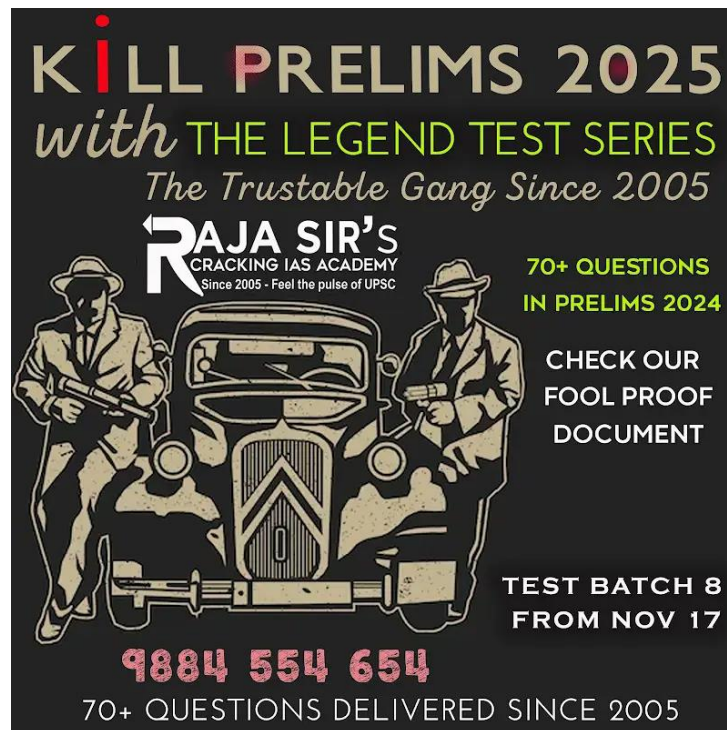
Process:

1. **Warm Ocean Water:** Hurricanes typically form over water that is **at least 80°F (27°C) deep**, as this heat provides the energy needed for the storm.
2. **Evaporation:** **Warm water evaporates, creating moist air that rises.** As the moist air rises, it cools and condenses, releasing latent heat.
3. **Low Pressure Area:** The release of heat warms the **surrounding air**, causing it to rise further and lowering the air pressure at the surface. This creates a low-pressure area.
4. **Coriolis Effect:** The **Earth's rotation causes winds to curve, allowing**

the storm to begin spinning. This is crucial for the development of the organized circulation characteristic of hurricanes.

5. **Convergence:** Air from surrounding areas moves in to fill the **low-pressure center**, and as it does, it rises and cools, leading to more condensation and heat release.
6. **Development of a Tropical Depression:** If the system organizes and the winds reach 23 mph (37 km/h), it becomes a tropical depression.
7. **Tropical Storm Formation:** If the winds reach **39 mph (63 km/h)**, the storm is classified as a tropical storm, and it receives a name.
8. **Hurricane Status:** When sustained winds reach **74 mph (119 km/h)**, it is **classified as a hurricane.**

Once formed, hurricanes can **intensify or weaken depending on environmental conditions**, such as water temperature, wind shear, and land interactions.



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Tropical cyclones, hurricanes, typhoons, and cyclones are circular storms that originate over warm water

It has very low air pressure at the center and winds speeding more than **119km** per hour

Depending on the location of the earth, different terms are used for such storms.

Hurricanes: The east coast of the United States and the Caribbean are often hit by hurricanes since they form in the North Atlantic Ocean and Northeast Pacific. A hurricane's intensity is measured on a five-point wind scale.

Cyclones: The South Pacific Ocean and the Indian Ocean are the breeding grounds for cyclones. These storms affect a wide range of countries, from Australia to Mozambique.

Typhoons: The northwestern Pacific Ocean is home to typhoons, which commonly strike the islands of the Philippines and Japan. While most typhoons occur between May and October, they can form at any time of the year. Different scales are used to measure the severity of a typhoon, with "super typhoons" being reserved for the most devastating storms.

The Saffir-Simpson Hurricane Wind Scale:

- Hurricanes are classified based on their maximum sustained wind speeds using the **Saffir-Simpson Hurricane Wind Scale**. This scale ranges from Category 1 to Category 5, with Category 5 representing the most powerful hurricanes.

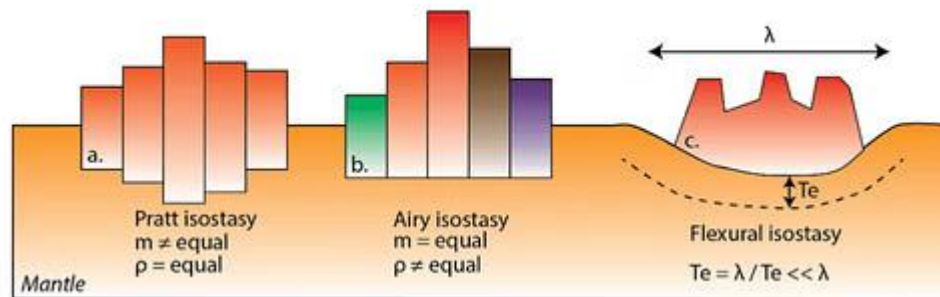
Category	Maximum Sustained Winds (mph)	Potential Damage
1	74-95	Very dangerous winds can damage even sturdy houses.
2	96-110	Extensive damage to roofs and siding, and damage to trees and power lines.
3	111-129	Devastating damage to well-built framed homes, and widespread power outages.
4	130-156	Catastrophic damage to well-built framed homes, with widespread power outages and flooding.
5	157+	Catastrophic damage to even well-built framed homes, with widespread power outages and flooding.

18. Theory of isostasy

Isostasy is a concept in that the **lighter crust is floating** on top of the denser underlying mantle. It is used to explain how varied topographic heights on the Earth's surface can occur. **Isostatic equilibrium** is the ideal state in which the crust and mantle would settle if no disturbing factors existed. Processes that disturb isostasy include the waxing and waning of ice sheets, erosion, sedimentation, and extrusive volcanism. The physical properties of the lithosphere are impacted by how the mantle and crust respond to these perturbations. Understanding the dynamics of isostasy helps us comprehend more complex processes such as mountain development, sedimentary basin formation, continent break-up, and the formation of new ocean basins.

- The theory of isostasy is a fundamental principle that explains the buoyant behavior of the Earth's lithosphere as it floats upon the more fluid asthenosphere (a part of the upper mantle) below.
- The concept is similar to how objects float in water, with buoyancy being determined by the mass and volume of the displaced fluid.
- The Earth's crust (or lithosphere) is in gravitational equilibrium and "floats" at a certain elevation depending on its thickness and density.
- Areas of the Earth's crust that are thicker and more mountainous will extend deeper into the more fluid asthenosphere below.
- Below a certain depth, known as the "**compensation depth**" or "**isostatic depth**", the pressure exerted by the overlying rock column is consistent everywhere, regardless of the surface topography.
- When weight is added or removed from the crust, such as through erosion, deposition, or glacial ice accumulation/melting, the crust adjusts either upward or downward in response until equilibrium is reached again. This process is termed **isostatic adjustment** or

isostatic rebound.



Airy's View

- The earliest model of isostasy, known as Airy Isostasy, was **proposed by George Biddell Airy**, a 19th-century British astronomer.
- The lithosphere, the Earth's outermost shell, is assumed to be a sequence of blocks of constant density in this model.
- While the density of these pieces remains constant, their thickness changes.
- Consider an iceberg drifting in the sea. The "root" of the iceberg lies hidden beneath the water's surface, while the tip protrudes. The deeper the root spreads beneath the surface, the greater the iceberg's tip.
- Similarly, mountainous regions of the Earth have a thicker part of the crust (or a "root") stretching down into the denser mantle in Airy Isostasy.
- This extra "root" serves to balance out the mountain's increased mass above the surface.
- When erosion takes down a mountain's mass over time, the crust beneath rises in reaction, maintaining isostatic balance.

- Airy Isostasy, in essence, defines a "floating" lithosphere in which the thicker sections extend deeper into the mantle, just like larger icebergs sink deeper into the sea.
- This model suggests that the Earth's crust has varying thickness under mountain ranges compared to ocean basins.
- The thicker portions of the crust (mountains) "float" higher on the asthenosphere, similar to how icebergs with larger submerged parts project more above the water surface.

Pratt's View

- With his Pratt Isostasy model, British geologist John Henry Pratt took an alternative method to explain isostatic equilibrium.
- Pratt's hypothesis is based on the density of the **lithospheric blocks** rather than their thickness.
- Consider a similar-sized wooden block and a sponge floating in a tub of water. Despite being the same size as the wooden block, the sponge will float higher since it is less dense.
- Similarly, in Pratt Isostasy, less dense portions of the Earth's crust (such as those made of less dense rock types or those underlain by substantial sedimentary deposits) "float" higher on the denser mantle than denser ones.
- As a result of these density differences within the crust, Pratt's model implies that the varied elevations we see across the Earth's surface, from plains to plateaus, are the result of these density variations within the crust itself.

Pratt	Airy
All blocks have equal depth/thickness with varying density	All blocks have equal density with varying depth/thickness
Based on law of compensation	Based on law of floatation
He believed in contraction of earth in the process of origin of earth	He believed in upstanding position was result of expansion of earth interior after getting heated
His concept was based on local observation	His concept was also based on local observation
Pratt model is used for mid oceanic ridges	Airy model is used for continental topography especially mountain ridges
Pratt has not used word root	Height is proportional to root, higher the elevation thicker the block and root.

- The concept of isostasy is central to our understanding of various geologic processes and phenomena, including mountain building, sedimentation, erosion, and sea-level changes. It provides insight into the dynamic and responsive nature of the Earth's crust in relation to the mantle beneath.

19. Precision medicine in India can't advance without biobank laws

Precision medicine is ushering in a new era of personalized healthcare, with its foundations taking shape during the completion of the Human Genome Project by scientists.

Current legal framework governing biobanks in India

- **Lack of Comprehensive Legislation:** India lacks specific, comprehensive laws governing biobanks. The current framework consists of guidelines rather than enforceable laws, creating gaps in the regulation of biobanking practices.

- **National Ethical Guidelines by ICMR:** The *Indian Council for Medical Research (ICMR)* has issued guidelines on ethical practices in biomedical research involving human participants. However, these guidelines are **not legally binding** and do not address all aspects of biobanking, such as long-term storage and data sharing.
- **Department of Biotechnology (DBT) Standards:** The DBT has certain practices in place for data storage and analysis, but these also lack enforceability and do not fully cover issues such as informed consent and privacy.
- **Absence of a Single Regulatory Authority:** India currently does not have a dedicated regulatory authority to oversee biobanks, which leads to inconsistencies and limited oversight in biobanking activities.

Privacy concerns impact biobank operations and precision medicine

- **Informed Consent Issues:** Participants often give consent without detailed information about how their biological samples and associated data will be used, who will have access, and for how long. This lack of transparency raises privacy concerns.
- **Genetic Data Privacy Risks:** Genetic information can reveal intimate details about an individual's health and predisposition to diseases, potentially affecting their family members. If data privacy is not robustly protected, it may lead to genetic discrimination in insurance or employment.
- **Data Sharing Without Proper Regulation:** In the absence of clear legal provisions, data or samples could be shared without proper consent, risking misuse by pharmaceutical companies or research organizations, including foreign entities.
- **Impact on Public Trust:** Weak data and privacy protections may reduce

public willingness to participate in biobank projects, thus limiting the scale and diversity necessary for effective precision medicine research.

Ethical implications of biobanking practices in India

- **Ownership and Benefit Sharing:** Without legal protections, there is ambiguity regarding the ownership of biological samples. Individuals contributing samples may not receive benefits from commercial applications resulting from their data, raising ethical concerns about fair compensation.
- **Consent Transparency:** Participants may not fully understand the scope of their consent, especially regarding future uses of their samples and data. This lack of clarity can be considered ethically problematic, as it may involve the exploitation of participants' contributions.
- **Risk of Misuse or Mismanagement:** Inconsistent regulations and the absence of penalties for ethical violations create a risk of mishandling samples, unauthorized data access, and exploitation, which may compromise research integrity.
- **Discrimination Risks:** Genetic information obtained from biobanks could be used to discriminate against individuals based on their health risks or genetic traits, which raises concerns about ethical and legal safeguards.

Road ahead

- **Establish Comprehensive Legislation:** Develop and implement a comprehensive legal framework specifically governing biobanks, including clear guidelines on informed consent, data protection, ownership rights, and benefit sharing.
- **Create a Regulatory Authority:** Establish a dedicated regulatory

authority to oversee biobank operations, ensuring compliance with ethical standards and legal requirements.

20. Disinformation, AI and 'cyber chakravayuh'

Emergence of New Security Threats in 2024-

- **Global Concerns:** 2024 began with widespread fears of new security challenges, particularly due to advancements in Artificial Intelligence (AI) and its various forms like Generative AI and Artificial General Intelligence (AGI).
- **Disinformation and Cyber Threats:** The increasing capabilities of AI have made disinformation and cyber threats more prevalent, creating a sense of looming danger across the world.

Security Challenges for the Paris 2024 Olympics

- **High-Risk Target:** The 33rd Summer Olympic Games in France (July-August 2024) were anticipated to be a major target for digital and cyberattacks.
- **Preventive Vigilance:** Despite no major incidents occurring, experts stress the importance of maintaining vigilance as new types of digital threats continue to emerge.

Early Indications of a Threatening Year

- **Taiwan Elections:** The year 2024 saw significant disinformation campaigns during Taiwan's January elections, with fake posts and videos causing widespread confusion. This was largely attributed to AI-driven efforts, potentially linked to Chinese influence.
- **Role of AI in Disinformation:** AI has made it easier to create and

disseminate disinformation, leading to a miasma of confusion and mistrust, especially during politically sensitive periods.

AI-Enabled Disinformation and Its Consequences

- **Deepfakes:** AI-generated deepfakes, which involve digitally manipulated videos, audio, or images, have become a major tool for spreading disinformation.
- **Delayed Truth Revelation:** Often, the truth behind these deepfakes is uncovered only after the damage has been done, highlighting the challenge of countering such disinformation.
- **National Security Risks:** The spread of AI-enabled disinformation poses a significant threat to national security, as seen in ongoing conflicts like Ukraine, where both sides have used such tactics to disrupt critical infrastructure.

The CrowdStrike Outage: A Preview of Potential Cyber Disruptions

- **Global Impact:** In 2024, a software glitch in a Microsoft Windows update caused a massive outage that affected various sectors, including flight operations, air traffic, and stock exchanges across multiple countries.
- **Not a Cyberattack, But a Warning:** While this incident was not a cyberattack, it served as a stark reminder of the potential disruptions that a large-scale cyberattack could cause.

Historical Context of Major Cyberattacks

- **WannaCry Ransomware (2017):** The WannaCry attack infected over 230,000 computers in 150 countries, causing billions of dollars in damage.
- **Shamoon Virus (2017):** Targeted oil companies like Saudi Aramco and

RasGas, labeled as the “biggest hack in history” at the time.

- **Petya Malware (2017):** Severely affected banks, power grids, and institutions across Europe, the UK, the US, and Australia.
- **Stuxnet Attack (2010):** A malicious worm targeting Iran’s nuclear program, Stuxnet highlighted the potential of state-sponsored cyber warfare. Its design could be adapted to target other modern systems.

Growing Cyber Threats to Individuals and Businesses

- **Daily Cyber Threats:** Cyber fraud, hacking, and identity theft have seen exponential growth, threatening the daily lives of individuals.
- **Common Cyber Frauds:**
 1. **Phishing:** Involves stealing personal information like customer IDs, credit/debit card numbers, and PINs.
 2. **Spamming:** Sending unsolicited commercial messages.
 3. **Identity Theft:** A serious and widespread danger, often resulting in significant personal and financial loss.

Response from Governments and Industry

- **Government Measures:** Democratic governments are increasingly trying to implement systems to combat digital threats.
- **Industry Vulnerability:** Despite government efforts, private institutions and businesses are lagging in preparedness, making them vulnerable to attacks.
- **Need for Chief Information Security Officers (CISOs):** Most companies lack adequate leadership to handle digital threats, making the role of CISOs crucial for advising and protecting businesses.

	<p>Necessity for Increased Awareness and Preparedness</p> <ul style="list-style-type: none">• Growing Danger of Digital Threats: Awareness about the increasing digital threats, including unauthorized use of Generative AI content, is the first step toward combating them.• Need for Coordinated Action: The struggle against digital threats requires coordinated efforts across governments, businesses, and society.• Protecting Democracies: Democracies, in particular, need to be vigilant against digital surveillance, disinformation, bullying, and manipulation, as these new threats target the core of democratic systems.
<p>21.</p>	<p>Private participation in India's nuclear energy</p> <ul style="list-style-type: none">• In July 2024, the Government of India, while presenting the Union Budget FY 2024-25, announced plans to expand India's nuclear energy sector.• Proposed partnerships with the private sector for the development of Bharat Small Reactors (BSR) and Bharat Small Modular Reactors (BSMR).• This move is part of India's broader goal of achieving 500 Gigawatts (GW) of non-fossil fuel-based energy by 2030, pledged at the COP26 Summit.• Strengthening nuclear energy infrastructure is critical for India's commitment to decarbonization, ensuring reliable energy supply while reducing reliance on fossil fuels. <p>Existing Legal Framework:</p> <ul style="list-style-type: none">• Atomic Energy Act (AEA), 1962:

- Governs nuclear energy in India, amended in 1987.
- Section 3(a) grants the central government sole control over nuclear energy production, development, and disposal.

- **Private Sector Limitations:**

- **The Act restricts private involvement in critical nuclear activities**, particularly in **research and development (R&D)**, confining private roles to infrastructure development.

- **Supreme Court Verdict (Sept 2024):**

- In the case of **Sandeep T.S. vs Union of India**, the court upheld the AEA provisions, emphasizing stringent safeguards due to the risks of nuclear accidents and misuse.

Civil Liability for Nuclear Damage Act (CLNDA), 2010:

- **Civil Liability Framework:**

- The CLNDA provides for no-fault liability of nuclear operators for nuclear incidents and ensures compensation to victims.

- **Pending Legal Challenge:**

- The constitutionality of the CLNDA is being contested, citing violations of the **absolute liability principle** and the **polluter pays principle**.
- The litigation introduces uncertainty, potentially deterring private sector investment.

The **absolute liability principle** is a legal doctrine that imposes liability on an entity for causing harm, regardless of intent or negligence. This principle holds that if a person or organization engages in hazardous or inherently dangerous activities (such as handling toxic substances, nuclear energy, or chemicals), they are liable for any damage caused, even if all necessary precautions were taken.

- **Judicial Precedent:**

- In **G. Sundarajan vs Union of India (2013)**, the Supreme Court referenced nuclear disasters (Chernobyl and Fukushima) and mandated safety inspections for projects like the Kundankulam Nuclear Plant, reflecting the balance between development and safety.

Role of Private Sector and Public-Private Partnerships (PPP)

- **Current Role:**

- **Historically, private sector involvement has been limited to engineering, procurement, and construction (EPC)** for nuclear infrastructure.

- **New Prospects:**

- The government aims to attract \$26 billion in private investment through partnerships, particularly in developing **Small Modular Reactors (SMRs)**.

- **Challenges in R&D:**

- The AEA currently restricts private involvement in nuclear R&D, a significant barrier to innovation in the nuclear energy sector.

- **PPP Model:**

- **A potential solution could be government-majority ownership (e.g., NPCIL retaining 51% stake), allowing private capital infusion while maintaining state control.**

Regulatory Reforms and the Atomic Energy Regulatory Board (AERB)

- **Regulatory Oversight:**

- The **Atomic Energy Regulatory Board (AERB)** oversees nuclear safety. Concerns about its lack of independence persist.

- **Proposed Reforms:**

- The **Nuclear Safety Regulatory Authority Bill, 2011** aimed to enhance AERB's autonomy but remains unenacted.
- Strengthening AERB's regulatory role is critical for private investment.

- **Future Needs:**

- A revamped AERB structure and legal clarity are essential for creating a conducive environment for private sector participation, ensuring safety, and minimizing regulatory risks.

Liability and Safety Concerns

- **High Liability Standards:**

- Nuclear infrastructure inherently carries high-risk factors, and liability concerns are a significant deterrent for private sector involvement.

- **Past Disasters:**

- Historical nuclear accidents, such as **Chernobyl (1986)** and **Fukushima Daiichi (2011)**, underscore the grave risks of nuclear energy near human settlements.

- **CLNDA Concerns:**

- Critics argue that the **CLNDA does not align with the absolute liability principle**, raising concerns about adequate compensation for nuclear incidents.

- **Public Safety and Transparency:**

- **Ensuring regular inspections, transparency under the Right to Information (RTI) Act, and public accountability is essential in minimizing risks and gaining public trust.**

Economic and Environmental Dimensions

- **Capital-Intensive Expansion:**
 - Nuclear energy is highly capital-intensive, requiring significant investment in skilled labor and advanced technology.
- **Ambitious Nuclear Capacity Growth:**
 - **India aims to increase its nuclear energy production capacity by 32 GWe, as per the World Nuclear Association (September 2024).**
- **Decarbonization Commitment:**
 - Nuclear energy plays a crucial role in meeting India's **net-zero carbon emissions target by 2070**, offering a reliable, low-carbon energy source.

Road ahead

- **Balancing Private Participation and Regulation:**
 - The road ahead requires balancing private sector participation with stringent regulatory oversight, **including legislative reforms to the Atomic Energy Act (AEA) and clarity on the Civil Liability for Nuclear Damage Act (CLNDA).**
- **Public-Private Partnerships (PPP):**
 - Structuring PPPs to allow private investment while retaining government control could provide a **sustainable model for nuclear energy expansion.**
- **Regulatory Strengthening:**
 - Strengthening the AERB, improving transparency, and ensuring high safety standards will be crucial for public acceptance and investor confidence.
- **Achieving Energy Goals:**

- Nuclear energy is vital to India's decarbonization and energy security goals.
- How the government navigates legal, regulatory, and safety challenges will determine the sector's success in contributing to India's long-term energy goals.

India's ambitious expansion of its nuclear energy sector, presents both opportunities and challenges. Strengthening regulatory oversight, addressing liability concerns, and ensuring public safety will be essential for the sustainable growth of nuclear energy in India.

22. Earth's Magnetosphere

The Earth's Magnetosphere, an expansive region **enveloping a planet, is characterized by the dominance of the planet's magnetic field.** Generated by the **convective motion of charged**, molten iron deep within Earth's outer core, the magnetosphere's dynamic nature **responds to solar, planetary, and interstellar influences.** Understanding this intricate system is paramount, offering insights into fundamental space physics and bolstering our ability to forecast and mitigate the impacts of space weather on technology and communication systems.

Earth's Magnetosphere: A Shield Against Solar Forces

- A Earth's Magnetosphere is a region of space surrounding the Earth (or any other planet or star) that is affected by the geomagnetic field (or magnetic field of that body).
- **Earth's Magnetosphere** : Strongest among rocky planets, shielding us

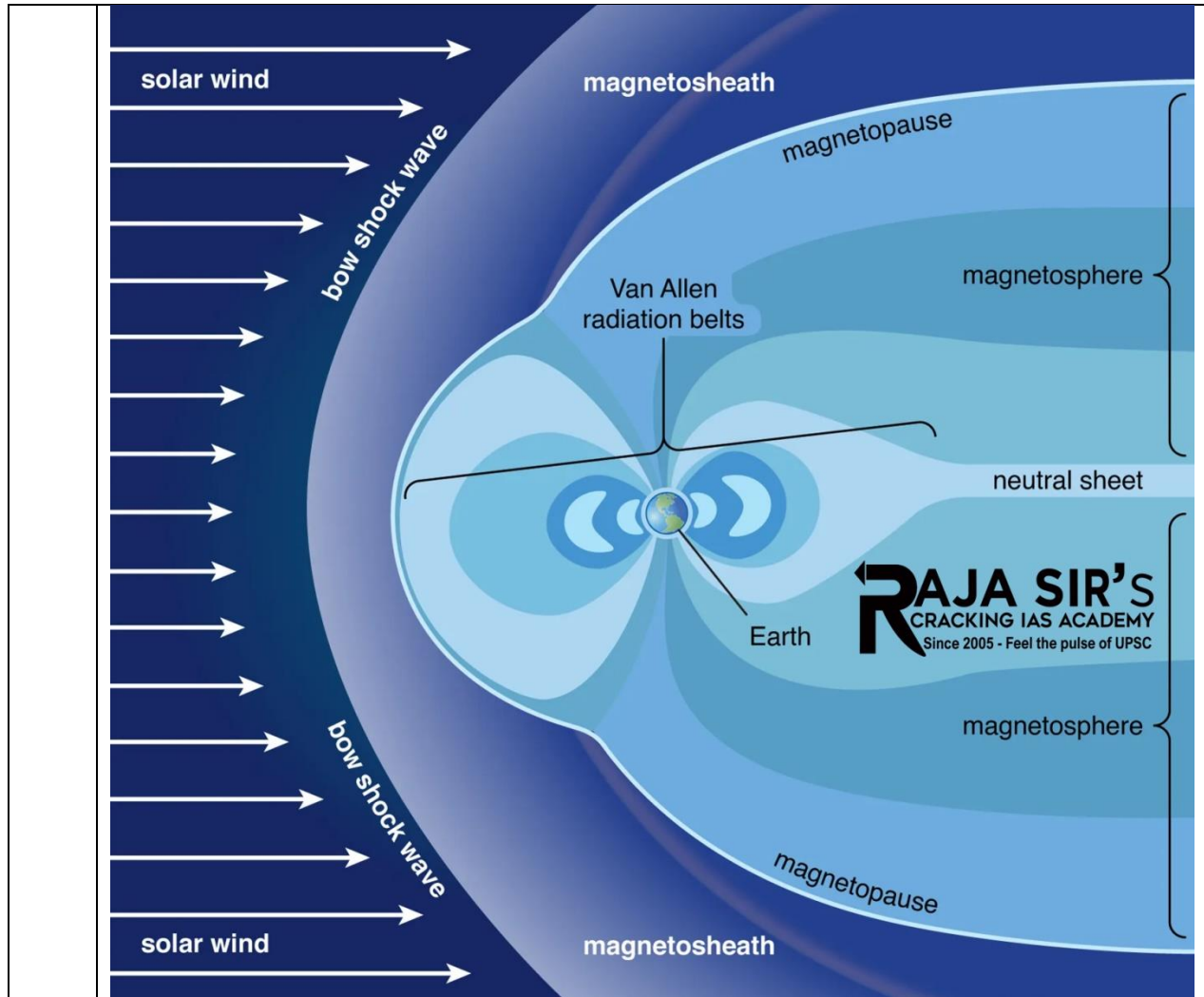
from harmful solar and cosmic radiation and the solar wind erosion.

- **Generation:** Created by charged, molten iron movements deep in Earth's outer core.

- **Solar Wind Impact:** Solar wind compression shapes our magnetosphere, elongating the sun-facing side (dayside) and forming a vast magnetotail on the nightside.
 1. **Dayside Extension:** 6-10 times Earth's radius.
 2. **Nightside Extension:** The magnetotail extends hundreds of Earth radii, surpassing even the moon's orbit at 60 Earth radii.

- **Function:** It traps charged particles from the solar winds (ions and electrons emitted by the Sun) and funnels them into a plasma.
- **Spread:** It **extends up to 60,000 km** on the side **facing the Sun** and to a **greater extent on the opposite side**.
- **Magnetopause:** Its boundary is known as **Magnetopause**, outside which is a turbulent magnetic region known as magneto-sheath.

- **Van Allen Radiation:** It contains the **Van Allen radiation belts**, which contain high energy charged particles.
 - **Lower Belt:** It contains electrons and protons extending from 1000 to 5000 km above the Earth's equator.
 - **Upper Belt:** It has mainly electrons extending from 15000 to 25000 km above the equator.



Impact of Magnetic Storms on Earth's Magnetosphere

- **Origin:** When the **strong gusts of solar wind collide with the magnetosphere of the Earth**, resulting in rapid magnetic field variation, this is known as magnetic storm.
- **Impact:** This results in the generation of **electric currents** in near earth space, which can **harm our artificial satellites** (eg. GPS) and **long-range radio communication**.

	<ul style="list-style-type: none">• Position: Magnetic storms are known as Ring Currents and they are mostly concentrated over the equator. <p>Importance of Magnetosphere Research</p> <ul style="list-style-type: none">• Space's Fundamental Science: Studying the magnetosphere helps us grasp its importance in space.<ul style="list-style-type: none">○ It reveals the basic science of space, which involves complex electromagnetic actions unlike what we deal with on Earth.○ Understanding our nearby space environment also gives us insights into space everywhere else.• Space Weather Preparedness: Studying the magnetosphere can better predict and prepare for space weather, which can mess with our satellites and communication systems.<ul style="list-style-type: none">○ So, learning about the magnetosphere helps us make better space weather forecasts.
<p>23.</p>	<p>Landslides in Wayanad questions about our approach to disaster management</p> <ul style="list-style-type: none">• On July 30, 2024, landslides hit Mundakkai and Chooralmala villages in Wayanad, Kerala.• The disaster is considered one of the deadliest in India, exposing vulnerabilities in disaster management. <p>Changing Disaster Profile of Kerala:</p> <ul style="list-style-type: none">• Historically, Kerala was considered a relatively disaster-free zone, protected by its geography (Western Ghats to the east and the sea to

the west).

- **Over the years, development activities, deforestation, and increasing population density** in hilly areas have led to frequent disasters, including floods, landslides, and coastal erosion.
- The 2018 floods were termed the “floods of the century,” attributed to climate change by the World Meteorological Organization.
- **Increased coastal erosion and rising sea levels** further aggravate the state’s vulnerability.

Vulnerability of Wayanad:

- Wayanad is situated on the eastern slopes of the Western Ghats and is **geologically prone to landslides due to deep gorges and tectonic factors.**
- Tremors often accompany landslides in this region, as evidenced during the July 2024 landslides.
- Recurring landslides call for a more **comprehensive understanding and mapping of the region’s geological characteristics.**

Need for Scientific Reappraisal:

- Current assessments of landslides in Wayanad are oversimplified, focusing on slope, soil thickness, and rainfall.
- A nuanced, **scientific approach is required that includes mapping geological setups, soil characteristics, drainage patterns, human activities like mining, and land use changes.**
- Landslide inventory maps, along with susceptibility maps, are crucial for identifying at-risk zones and issuing timely warnings.

Impact of Climate Change:

- **The warming of the Arabian Sea and rising sea surface temperatures have increased the risk of extreme weather events** in Kerala, including cyclones and heavy monsoons.
- The heat content of the Indian Ocean has rapidly risen, contributing to cyclogenesis in the Arabian Sea.
- Cyclone Ockhi in 2017 was one of the most severe cyclones to hit Kerala in recent memory, underscoring the growing climate-related risks.

Paradigm Shift in Disaster Management:

- **The current disaster management system in Kerala is reactive, focusing on rescue and rehabilitation**, which is insufficient given the growing frequency of disasters.
- There is a need to adopt the **Sendai Framework for Disaster Risk Reduction**, which advocates for a proactive approach encompassing preparedness, resilience, and mitigation.
- **Disaster risk management should be decentralized**, involving local governments, communities, and other stakeholders.

Concerns and Challenges in Addressing Landslides and Disasters in Kerala

- **The average population density in the Western Ghats region of Kerala is above the national average**, leading to greater human exposure to natural disasters.
- There is a **gap in scientific understanding of the geological and environmental factors** contributing to landslides in Kerala.
- **Local communities, who are often the first responders in disasters, are not adequately engaged** in disaster risk management planning.
- Although **technologies** like remote sensing, GIS, and early warning systems are available, their **implementation is limited, especially in**

rural and remote areas.

- **Investments in disaster risk reduction**, particularly in enhancing infrastructure resilience and scientific research, remain inadequate.
- **Development projects, including large-scale infrastructure and mining, are often prioritized** over environmental sustainability, leading to environmental degradation and increased disaster risk.

International Best Practices for Disaster Management and Landslide Mitigation

- **Japan has one of the most advanced early warning systems for landslides, earthquakes, and tsunamis.** The Japan Meteorological Agency uses real-time weather data, geological assessments, and seismic information to issue early warnings to the public.
- **Switzerland implements a range of structural measures to prevent landslides**, including constructing retaining walls, afforestation, terracing, and installing drainage systems to reduce water seepage into slopes.
- **In California, various agencies, including the U.S. Geological Survey (USGS), work together to monitor landslides.** They use geospatial data, satellite imagery, and advanced hydrological models to predict and monitor landslide events.
- **New Zealand has a strong emphasis on community-led disaster risk assessments**, where local communities actively participate in mapping hazards and vulnerabilities.

Key Recommendations:

- **Disaster Risk Zones:** Kerala should create detailed disaster risk zones based on multiple physical and social criteria within a socio-ecological

framework.

- **Community Involvement:** A community-based disaster risk management model should be implemented, engaging local communities in disaster planning and response.
- **Collaborative Approach:** A quadruple helix model involving community organizations, academia, government, and business is suggested to create a robust disaster management framework.
- **Integration in Development:** Disaster risk management should be integrated into local development plans to build resilience and reduce long-term risks.

Road Ahead

- The increasing frequency and intensity of disasters in Kerala necessitate a **shift from reactive disaster management to a more comprehensive, proactive, and community-driven approach.** By adopting scientifically informed practices and engaging local communities, Kerala can better mitigate the risks of future disasters and improve overall resilience.

24. India's AI Landscape

- The world is rapidly adapting to artificial intelligence (AI), and India stands on the cusp of a transformative era.
- The Indian economy is poised to grow at an average rate of 7% over the next five years, outpacing the global growth forecast of 3.2% for 2024.
- **Hosting G20 and the Global Partnership on AI meetings in 2023 has created a favorable geopolitical environment for India to lead in AI**

adoption and innovation.

India's AI Market Growth

- India's AI market is expected to reach \$17 billion by 2027, growing at an annualized rate of 25-35% between 2024 and 2027, according to Nasscom.
- **India leads in generative AI (GenAI) adoption among 13 Asia-Pacific countries**, as highlighted by Deloitte's report.
- The Indian government has committed Rs 10,372 crore over five years to support the India AI Mission, further solidifying its position as a global AI leader.

AI's Potential for Transformative Impact

- Historically, industries like electricity and automobiles witnessed transformation through visionary leadership (e.g., General Electric, Ford).
- Similarly, **India's AI ecosystem can drive sectoral transformations, providing inclusive economic growth and innovation.**
- **Indian industries need a tailored AI strategy, specific to sectoral challenges, to harness AI's full potential.**

Sectoral Example: Logistics Transformation

- The Indian logistics sector, previously riddled with inefficiencies, has witnessed transformations with traditional AI, bringing automation, optimization, and basic forecasting.
- Companies like **PandoAI** consolidated supply chain data to offer valuable analytics to Fortune 500 companies.
- GenAI can take the logistics sector further by uncovering hidden

patterns, predicting disruptions, and designing innovative solutions, potentially reducing logistics costs (which are currently 7.8-8.9% of GDP).

Key to AI Success: Research, Development, and Infrastructure

- **For India to lead in AI, businesses must invest in core compute capabilities, talent, and infrastructure.**
- Despite producing 20% of the world's data, India hosts only 2% of global data centers, limiting its AI computing capacity.
- The Indian government plans to enhance computational capabilities by procuring 10,000 graphics processing units (GPUs) and aims to build a domestic chip industry with over \$10 billion in incentives under the National Semiconductor Mission.

Investment in Talent Development

- Hiring AI talent in India increased by 16.8% in 2023, highlighting the growing focus on AI capabilities.
- While many Indian-origin leaders contribute to global AI developments, a significant number work for international companies.
- **Initiatives like FutureSkills PRIME, a partnership between industry and government, need further support to develop a robust domestic AI workforce.**

Establishing Trustworthy AI Standards

- Building trust in AI systems is crucial. Challenges such as data security, and ethical use, cybersecurity and data privacy concerns in the digital age.
- **Robust governance frameworks are essential for addressing these**

issues, ensuring that AI is widely accepted and operates safely.

- India has the potential to influence global AI standards and policies due to its economic and geopolitical stature.

Key Government Initiatives Supporting AI in India

- **National AI Strategy (NITI Aayog)**
 - **Aim:** To promote the adoption of AI in various sectors and make India a global leader in AI development.
 - **Focus Areas:** Healthcare, agriculture, education, smart cities, and smart mobility.
- **India AI Mission**
 - Aim: To develop an ecosystem that fosters AI innovation and research while ensuring its responsible use.
- **National Programme on AI (Ministry of Electronics and IT – MeitY)**
 - Aim: To establish AI centers of excellence across the country and support AI-driven research and development.
 - **Initiatives under the Program:**
 - **Centre of Excellence (CoEs):** Setting up AI CoEs in major cities to encourage innovation and entrepreneurship.
 - **AI R&D Grants:** The program provides funding for research projects in AI, particularly in areas like language translation, AI for healthcare, and smart cities.
- **FutureSkills PRIME (NASSCOM & Ministry of Electronics and IT)**
 - Aim: To develop digital skills among professionals and students, particularly in AI, machine learning, cloud computing, and cybersecurity.
- **National Supercomputing Mission (NSM)**
 - Aim: To enhance India's computing power by building a network

of high-performance computing systems.

Operationalizing India's AI Ambition

- To fully harness AI's transformative power, companies must take several key steps:
 - Develop robust governance frameworks addressing ethics, data security, and bias.
 - Ensure transparency in AI algorithms and decision-making.
 - Promote inclusive AI development by incorporating diverse perspectives.
 - Invest in ethical AI research through collaborations with academic and research institutions.

Strategic Vision for India's AI Future

- A strategic commitment from the government and industry towards AI development has set the stage for India to emerge as a global leader.
- AI offers India the chance to drive economic growth, innovation, and inclusivity, positioning it at the forefront of global AI advancements.

Road ahead

- **India should deepen collaborations with leading AI nations like the US, Japan, and the EU to share best practices**, access cutting-edge AI research, and jointly develop AI standards.
- **Government-backed AI adoption grants and subsidies can enable SMEs to integrate AI into their business processes**, enhancing their productivity and competitiveness.
- **Industries such as healthcare, agriculture, logistics, and manufacturing should develop customized AI strategies** that address their unique challenges and needs.
- **AI research must become a national priority**, with substantial

	<p>funding for AI R&D, particularly in fundamental research.</p> <p>The convergence of government support, industry involvement, and strategic investments in AI provides India with an unprecedented opportunity to harness the power of AI. This moment represents India's chance to lead in the AI revolution, inspiring a new era of economic prosperity and global leadership in technology.</p>
<p>25. ABC of Earthquakes</p>	<ul style="list-style-type: none">• An earthquake is what happens when two blocks of the earth suddenly slip past one another. The surface where they slip is called the fault or fault plane. The location below the earth's surface where the earthquake starts is called the hypocenter, and the location directly above it on the surface of the earth is called the epicenter.• Sometimes an earthquake has foreshocks. These are smaller earthquakes that happen in the same place as the larger earthquake that follows. Scientists can't tell that an earthquake is a foreshock until the larger earthquake happens. The largest, main earthquake is called the mainshock. Mainshocks always have aftershocks that follow. These are smaller earthquakes that occur afterwards in the same place as the mainshock. Depending on the size of the mainshock, aftershocks can continue for weeks, months, and even years after the mainshock! <p>What causes Earthquakes?</p> <ul style="list-style-type: none">• As we know, the earth's outermost surface, crust, is fragmented into tectonic plates.• The edges of the plates are called plate boundaries, which are made up

of faults.

- The tectonic plates constantly move at a slow pace, sliding past one another and bumping into each other.
- As the edges of the plates are quite rough, they get stuck with one another while the rest of the plate keeps moving.
- Earthquake occurs when the plate has moved far enough and the edges unstuck on one of the faults.
- The location below the earth's surface where the earthquake starts is called the hypocenter, and the location directly above it on the surface of the earth is called the epicentre.

- **Vibrations inside the earth**

Earthquakes are vibrations inside the Earth that follow the release of energy that has built up inside rocks. Rocks fracturing, volcanoes erupting, and man made explosions can all release the energy stored in the rocks creating seismic waves.

- **Faults are cracks in the crust**

Faults are cracks in the crust of the Earth where the earth is moving apart, coming together, or slipping past each other. Each of these movements on the surface of the earth cause earthquakes.

- **Determining the location of an earthquake**

Scientists use difference in the the arrival times of the two sets of seismic waves to determine the location of an earthquake. Using this data scientists can deter what causes earthquakes in the region.

Earthquake Zones

- **Tracking location of earthquakes**

Scientists began tracking and pinpointing the location of earthquakes using data from seismograms. A seismogram is a recording of the ground motion of an earthquake by a seismograph. They found that earthquakes occurred in earthquake zones that outlined the tectonic plates on Earth.

- **Formation of mountain ranges**

When two continental plates collide they form mountain ranges between the plates as the rocks are compressed. The Himalayan Mountains are an example of the Indian Plate and Eurasian Plate colliding.

- **Pacific Ocean is shrinking**

Around the Pacific Ocean are subduction zones where an ocean plate is forced beneath a continental plate or a younger oceanic plate. As the Pacific Plate subducts beneath other tectonic plates it is growing smaller.

- **The Atlantic Ocean is increasing in size**

The Atlantic Ocean is a divergent boundary where new oceanic crust is forming. The Atlantic Ocean is increasing in size as the Pacific Plate decreases in size. All of these plate movements create earthquake zones at plate boundaries.

P waves & S waves-

All earthquakes produce P waves and S waves. P waves compress and expand the rock particles as they travel through solids, liquids and gases. P waves are the first to arrive at reporting stations letting seismologists know an earthquake has occurred. Shortly after the P waves have arrived seismographs record the arrival of S waves.

- **P waves**

P waves are primary waves that are produced by all earthquakes large and small. Rock breaking along a fault line release the energy stored in the rocks when the rocks break due to pressure inside the Earth creating primary waves that are also known as compression waves.

- **S waves**

S waves are also always produced during an earthquake. S waves are transverse waves that move forward in a back and forth motion are also called secondary waves. These waves arrive at reporting stations after P waves. S waves and P waves are known as body waves because they travel through the body of the Earth.

- **P waves expand and contract rock particles**

The focus of an earthquake is the point where the rocks break apart at the start of an earthquake. These waves travel in all directions away from the focus of an earthquake. P waves are energy waves that cause rock particles inside the earth to expand and contract like the slinky in the picture as they move through the body of the Earth.

- **P waves traveling through the body of the Earth**

Compression waves expand rock particles ahead of the waves and compress them as they travel away. They can also compress and expand air. When compression waves reach the Earth's surface they create a

noise often associated with earthquakes. Sometimes people hear a sharp thud while others think the sound is loud and like wind blowing through leaves in a tree. People sleeping are sometimes awakened by the noise as the earthquake arrives at their home.

Seismographs

Seismographs are instruments that record earthquake waves when they arrive at reporting stations on the surface of the Earth. Lines on seismograms show the motion in the Earth as the waves travel to and from the reporting station.

- **P waves are primary waves**

Primary waves are P waves that arrive at recording stations first. They are the fastest waves produced by an earthquake.

- **S waves are secondary waves**

S waves are produced by all earthquakes. S waves arrive a short time after P waves at recording stations. Scientists use the travel time of the two waves to determine the distance between the focus of an earthquake and the reporting station. Scientists use at least three reporting stations to calculate the exact point where the earthquake originated.

- **Discovering the boundary between the crust and mantle of the Earth**

P waves move through solids, liquids and gases. S waves only travel only through solids. The earthquake waves are deflected when the composition of rocks within the Earth change. The scientist who discovered the boundary between the crust and mantle discovered the boundary when he noticed that earthquake waves were deflected at different depths underground. The Moho boundary is deeper under the continents than under the oceanic crust.

- **Beno Gutenberg discovers Earth's core**

Beno Gutenberg discovered the liquid outer core while studying body waves. He found that S waves were stopped at a depth of 2900 km beneath the surface of the Earth. This is the boundary between the mantle and the liquid outer core.

- **Inge Lehmann discovers Earth's inner core**

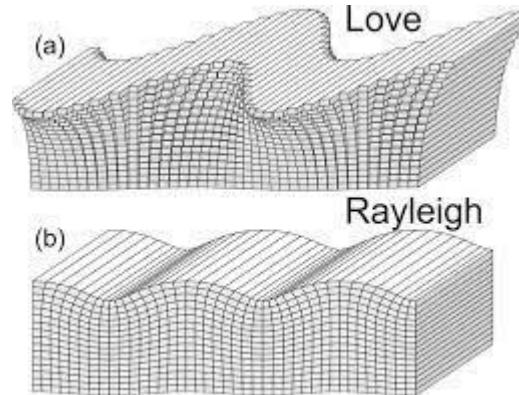
Inge Lehmann in 1936 studying earthquake waves that originated in Japan. She found that P waves sped up inside the core of the Earth for a distance before they slowed down. She used the travel times of these waves through the center of the Earth to prove the existence of a solid inner core of the Earth.

Love Waves

Love waves are a type of **horizontally polarized shear wave**. They move with a **side-to-side motion**, similar to the motion of a **snake or a wriggling rope**. Love waves are the **fastest surface waves** and typically **arrive after the initial body waves (P-waves and S-waves)** during an earthquake. They propagate through the Earth's crust in a horizontal, side-to-side motion that is **perpendicular to the direction of wave travel**.

- They have a **higher frequency and shorter wavelength** compared to Rayleigh waves.
- Love waves are **particularly damaging to structures** because their **side-to-side motion can generate strong shearing forces in the ground**, leading to significant structural damage.
- They are **typically recorded on seismographs** as

the second prominent wave type after the initial P-wave arrival.



Rayleigh Waves

Rayleigh waves, also known as **ground roll** or **rolling waves**, are a type of surface wave that **combines both vertical and horizontal motion**. They create an elliptical, rolling motion as they travel along the Earth's surface. This rolling motion is similar to the motion you might observe in **ocean waves**.

- Rayleigh waves are **slower than Love waves** and arrive after both P-waves and S-waves.
- They have a **circular motion that causes the ground to move both vertically and horizontally** in an elliptical pattern.
- Rayleigh waves are responsible for a significant portion of the shaking experienced during an earthquake.
- The circular motion of Rayleigh waves can lead to a “ground-rolling” effect, causing buildings and structures to sway and **potentially suffer damage**.

Characteristic	Love Waves	Rayleigh Waves
Wave Type	Horizontal shear waves	Combined vertical and horizontal motion
Motion	Side-to-side (horizontal)	Elliptical rolling (circular) motion
Speed	Faster than Rayleigh waves	Slower than Love waves
Arrival Time	Arrive after P-waves and S-waves	Arrive after P-waves and S-waves
Particle Motion	Horizontal motion perpendicular to wave direction	Rolling motion, elliptical ground motion
Frequency	Higher frequency, shorter wavelength	Lower frequency, longer wavelength
Amplitude	Lower amplitude	Higher amplitude
Shearing Forces	Generates significant shearing forces, causing structural damage	Can generate ground-rolling effect, causing swaying and potential damage
Seismic Hazard	Can cause significant damage to structures	Also contributes to seismic hazard and ground shaking
Recorded on Seismographs	Recorded as the second wave type after P-waves	Recorded as the third prominent wave type after P-waves and S-waves

Origin of an Earthquake

- Where is the earthquake focus? The focus of an earthquake is the point where the rocks start to fracture. It is the origin of the earthquake.
- The epicenter is the point on land directly above the focus.

Hypocenter of an earthquake

- The focus is also called the hypocenter of an earthquake. The vibrating waves travel away from the focus of the earthquake in all directions. The waves can be so powerful they will reach all parts of the Earth and

cause it to vibrate like a turning fork.

Epicenter of an earthquake

- Directly above the focus on the Earth's surface is the earthquake epicenter. Earthquake waves start at the focus and travel outward in all directions. Earthquake waves DO NOT originate at the epicenter.

- **Richter scale used for shallow-focus earthquakes**

Shallow-focus earthquakes occur between 0 and 40 miles deep. Shallow-focus earthquakes are much more common than deep-focus earthquakes. Crustal plates moving against each other produce most of the shallow-focus earthquakes here on Earth. These earthquakes are generally smaller and scientists use the Richter scale when measuring these earthquakes.

- **Energy released by shallow focus earthquakes**

Shallow-focus earthquakes are much more dangerous than deep-focus earthquakes. They release 75% of all the energy produced by earthquakes each year. They are crustal earthquakes that are smaller than deep-focus earthquakes.

Deep-Focus Earthquakes Use Moment Magnitude Scale

- Deep-focus earthquakes occur 180 miles or more below the Earth's surface. These earthquakes occur in island arc or deep ocean trenches where one plate is slipping over another in subduction zones. Great earthquakes where one plate is slipping over another plate in a subduction zone trigger deep-focus earthquakes. They are the largest earthquakes and scientists use the moment magnitude scale to measure them.

- Richter Scale and the Mercalli Scale** - The Richter Scale and the Mercalli Scale are both used to measure the intensity of earthquakes, but they do so in different ways. The Richter Scale is a quantitative scale that measures the magnitude of an earthquake based on the seismic waves recorded by seismographs. It is a logarithmic scale, meaning each whole number increase on the scale represents a tenfold increase in measured amplitude and roughly 31.6 times more energy release. On the other hand, the Mercalli Scale is a qualitative scale that measures the intensity of an earthquake based on observed effects and damage. It takes into account people's perceptions and reactions, as well as the physical damage to buildings and other structures. The Mercalli Scale ranges from I (not felt) to XII (total destruction).

Magnitude

- Represents the size of the earthquake but not necessarily the damage or shaking level.
- Only one number (e.g., 6.7) is used represent magnitude.
- Described as “Richter scale”, though “energy” magnitude is now generally used.

Intensity

- Represents the effects of an earthquake: the shaking and damage at different locations.
- The number (Roman Numeral from I to X) varies depending on location.
- Modified Mercalli Intensity Scale is used in U.S. Intensity is also used worldwide.

Seismic Waves and Structure of Earth

- Earthquakes create seismic waves that travel through the Earth. By

analyzing these seismic waves, seismologists can explore the Earth's deep interior. This fact sheet uses data from the 1994 magnitude 6.9 earthquake near Northridge, California to illustrate both this process and Earth's interior structure. The cutaway of Earth on the left shows the paths seismic waves traveled following the quake. The ground motion caused by the seismic waves is shown at the right (seismograms recorded at various locations around the world).

Seismologists study shock, or seismic, waves as they travel through the Earth's interior. These waves originate from natural sources like earthquakes, and from artificial sources like man-made explosions. Knowing how the waves behave as they move through different materials enables us to learn about the layers that make up the Earth. Seismic waves tell us that the Earth's interior consists of a series of concentric shells, with a thin outer crust, a mantle, a liquid outer core, and a solid inner core.

- Seismic waves can tell us a lot about the internal structure of the Earth because these waves travel at different speeds in different materials.
- Reflection causes P and S waves to rebound whereas refraction makes waves move in different directions.
- The variations in the direction of these waves are inferred with the help of their record on seismograph.
- Change in densities greatly varies the wave velocity. By observing the changes in velocity, the density of the earth as a whole can be estimated. By the observing the changes in direction of the waves (emergence of shadow zones), different layers can be identified.
- For both kinds of waves, the speed at which the wave travels also depends on the properties of the material through which it is traveling.
- Scientists are able to learn about Earth's internal structure by measuring the arrival of seismic waves at stations around the world.

- For example, we know that Earth's outer core is liquid because s-waves are not able to pass through it; when an earthquake occurs there is a "shadow zone" on the opposite side of the earth where no s-waves arrive.
- Similarly, we know that the earth has a solid inner core because some p-waves are reflected off the boundary between the inner core and the outer core.
- By measuring the time it takes for seismic waves to travel along many different paths through the earth, we can figure out the velocity structure of the earth.
- Abrupt changes in velocity with depth correspond to boundaries between different layers of the Earth composed of different materials.

Shadow Zone of P-waves and S-waves

- S-waves do not travel through liquids (they are **attenuated**).
- The entire zone beyond 103° does not receive S-waves, and hence this zone is identified as the shadow zone of S-waves. This observation led to the discovery of the **liquid outer core**.
- The shadow zone of P-waves appears as a band around the earth between 103° and 142° away from the epicentre.
- This is because P-waves are refracted when they pass through the transition between the semisolid mantle and the liquid outer core.
- However, the seismographs located beyond 142° from the epicentre, record the arrival of P-waves, but not that of S-waves. This gives clues about the **solid inner core**.
- Thus, a zone between **103° and 142°** from epicentre was identified as the **shadow zone for both the types of waves**.

RAJA SIR'S
Cracking IAS Academy
Since 2005 - Feel The Pulse of UPSC

S-wave shadow zone

Quake

P-wave ray paths

Core

103°

103°

S-wave shadow zone

No direct S-waves received here

The structure of Earth's deep interior cannot be studied directly. But geologists use seismic (earthquake) waves to determine the depths of layers of molten and semi-molten material within Earth. Geologists are now using these records to establish the structure of Earth's interior.

26. Water-soluble fertilisers are key to higher maize fodder yield and quality

- **Water-soluble fertilisers (WSFs) have emerged as a key agro-innovation** to enhance fertiliser use efficiency, restore soil health, and sustain higher yields in fodder crops like maize.
- Traditional fertilisers often lead to uneven nutrient distribution, poor crop response, and environmental harm. In contrast, WSFs provide a balanced nutrient supply, improve soil health, and prevent issues like nitrate accumulation in forage, which can harm livestock.

Importance of Fertiliser Use Efficiency and Soil Health

- Fertiliser application in fodder production is critical, but it comes with challenges. While increasing biomass and crude protein in maize fodder, **nitrogen-heavy fertilisers may result in nitrate accumulation, which can harm livestock.**
- **Effective fertiliser use ensures balanced nutrient supply**, improved crop response, and reduced environmental impacts.
- Indiscriminate fertiliser application can lead to poor crop yields, degradation of soil health, and pollution.

Field Variability and Nutrient Management Challenges

- Field tests reveal substantial variability in nutrient supply, nutrient use efficiency, and crop responses. Such inconsistencies across fields affect overall fodder productivity.
- **To counteract these inefficiencies, precise nutrient and crop management tailored to specific field characteristics is essential.**

- Knowledge-intensive approaches to managing soil and fertiliser distribution can significantly improve outcomes in fodder production.

Role of Water-Soluble Fertilisers (WSFs)

- **Water-soluble fertilisers (WSFs) provide a promising solution by offering better nutrient uptake for plants.** These fertilisers are fully water-soluble and have a low salt index, making them easy to apply either as foliar sprays or through irrigation.
- Available in various NPK formulations (e.g., 19-19-19), **WSFs also contain secondary nutrients like sulphur and zinc.**
- They ensure that nutrients remain available to crops without being affected by environmental factors such as leaching, erosion, or evaporation.

Advantages of WSFs in Maize Fodder Production

- WSFs improve nutrient use efficiency by preventing nutrient wastage. For instance, approximately 25-30% of the recommended fertiliser dose can be saved through WSF use, reducing input costs for farmers.
- **These fertilisers do not contribute to salt accumulation in the soil, maintaining soil health over the long term.**
- WSFs can be used in a variety of field conditions and provide an efficient, balanced nutrient supply, leading to higher fodder yields and improved nutritional quality of the forage.

Potential Drawbacks of Water-Soluble Fertilisers

- While WSFs offer several benefits, there is a **risk of nutrient overload if they are overapplied or improperly diluted**, which can result in phytotoxic injury (plant damage).

- This underlines the need for careful monitoring and management to ensure the correct dosage and application techniques.

On-Farm Testing and Results

- Field trials conducted by **Krishi Vigyan Kendra, Barnala**, assessed the effectiveness of WSF (NPK 19-19-19) in maize fodder production. The study compared three fertiliser management practices: farmer's practice, recommended dose of fertiliser (RDF), and WSF foliar application.
- The trials showed that foliar application of WSF at 1% concentration, combined with 75% RDF, significantly increased maize plant growth (fresh and dry weight) and green fodder yield.
- The nutritional quality of fodder also improved in comparison to traditional practices.

Environmental and Economic Impact

- WSFs reduce leaching, runoff losses of key nutrients (N, P, K), and **nitrogen volatilisation**, which translates into lower production costs and reduced environmental impact.
- The reduced nutrient wastage and improved efficiency result in lower financial burdens for farmers, particularly in terms of fertiliser costs.

International Best Practices in the Use of Water-Soluble Fertilisers

- **Israel, known for its water-efficient agricultural practices, has pioneered the use of fertigation, which integrates irrigation with fertiliser application.** WSFs are dissolved in irrigation water and delivered directly to the root zone through drip irrigation systems.
- **Australian farmers combine the use of WSFs with organic and slow-release fertilisers** to achieve a balanced nutrient profile.

- **Japan has been at the forefront of developing controlled-release WSFs**, which allow nutrients to be gradually released over a longer period.
- **In Europe, especially in countries like the Netherlands, sustainable agriculture certification schemes encourage the use of WSFs** in combination with environmentally-friendly farming practices.

Road ahead

- **Farmers need to be educated** about the benefits and proper application methods of water-soluble fertilisers (WSFs).
- **Precision farming techniques, such as soil testing and nutrient mapping, should be integrated with the use of WSFs.** This ensures that nutrient management is tailored to specific field conditions, reducing wastage and improving crop responses.
- **Ongoing research should focus on developing new WSF formulations** that cater to various crops and environmental conditions.
- **Policies and subsidies** that promote the use of eco-friendly and efficient fertilisers like WSFs should be strengthened.
- **WSFs should be integrated with other sustainable agricultural practices**, such as crop rotation, organic matter incorporation, and water management techniques.

WSFs represent a sustainable and efficient alternative to conventional fertilisers in maize fodder production. They improve fertiliser use efficiency, restore soil health, and ensure higher fodder yields without compromising quality. WSFs offer a balanced, eco-friendly, and cost-effective approach that can help farmers sustain agricultural productivity while mitigating environmental risks.

27. Koppen Climate Classification

- The **Koppen Climate Classification** System is a widely used system for classifying the world's climates based on their **temperature** and **precipitation** patterns. It was first developed by German botanist and climatologist **Wladimir Koppen** in the early 20th century and has since undergone several revisions.
- The Koppen Climate Classification System divides the world's climates into **five major groups**, based on the **average monthly temperature and precipitation** of a location. These groups are further subdivided into smaller categories based on **additional criteria**, such as the presence or **absence of a dry season** or the **amount of annual rainfall**.

Five Primary Koppen Climate Classification

1. **Tropical Climates (A):** These climates are characterized by **high temperatures** and **high levels of precipitation** throughout the year. They are typically found **near the equator**, where the sun's rays are **most direct and intense**.
2. **Dry Climates (B):** These climates are characterized by **low levels of precipitation** and **high temperatures**, and they are often found in regions with a subtropical or desert-like climate. Here, the evaporation exceeds the rainfall and the region is a water deficit.
3. **Temperate Climates (C):** These climates are characterized by **moderate temperatures and precipitation levels**, and they are found in many regions with moderate latitude and moderate oceanic influence.
4. **Continental Climates (D):** These climates are characterized by **extreme temperatures** and highly variable precipitation levels, and they are typically found in regions with a large landmass and a moderate

latitude.

5. **Cold Climates (E):** These climates are characterized by **low temperatures and low levels of precipitation**, and they are typically found in regions with a high latitude and high elevation.

Sub-classification of Koppen Climate

- **m:** The letter “m” is used to denote climates that have a **monsoon season**. Monsoons are **seasonal winds** that bring a shift in the direction of prevailing winds, causing wetter conditions during certain parts of the year. Climates with a monsoon season are typically found in tropical and subtropical regions, where they can cause heavy rainfall and flooding.
- **f:** The letter “f” is used to denote climates that have sufficient **rainfall throughout the year (No Rain Free Month)** to support the growth of a rainforest. These are known as rainforest climates and are typically found in equatorial regions where there is **high rainfall and abundant vegetation**.
- **w:** The letter “w” in the Koppen Climate Classification System refers to a **dry winter season**. This letter is typically added as a suffix to the letters that represent the climate group to which the zone belongs.
- **S:** The letter “S” in the Koppen Climate Classification System is used to denote a **dry summer season**. This letter is typically **added as a suffix** to the letters that represent the climate group to which the zone belongs.

Af Climate

- The Af climate in the Koppen classification is a type of **tropical rainforest climate**. It is typically found **within 10 degrees of the equator**, in regions where **temperatures remain warm to hot throughout the year and rainfall is abundant**. The Af climate is characterized by **average temperatures of 18 °C or higher in every month** of the year, and **annual rainfall totals of at least 60 mm per month**.
- Some examples of areas with an Af climate include the **Amazon rainforest in South America**, the Congo Basin in Africa, and parts of Southeast Asia. The Af climate is often referred to as a “true” rainforest climate because of the consistently high levels of rainfall throughout the year.

Aw Climate

- The Aw climate type, also known as the **tropical savanna climate**, is a climate classification under the Koppen system. It is typically found in areas near the equator with a **distinct wet and dry season**.
- In the Aw climate, the average temperature of the coldest month is greater than 18°C and the average temperature of the warmest month is greater than 22°C (71.6°F). The annual precipitation is typically between 1000-2000 mm (39-79 inches) with a **distinct dry season in winter** lasting 5-7 months.
- This climate type is characterized by **grassy plains** with scattered trees and shrubs and is home to many large herbivores such as zebras, giraffes, and elephants. The dry season can be harsh and vegetation can die back, but the rainy season brings new growth and replenishes water sources.

Am Climate

- The Am climate, also known as the **tropical monsoon climate**, is a climate classification under the Koppen system. It is typically found in **areas near the equator with a distinct wet and dry season**, similar to the Aw climate.
- In the Am climate, the average temperature of the coldest month is greater than 18°C (64.4°F) and the average temperature of the warmest month is greater than 22°C (71.6°F). The annual precipitation is typically between 1000-2000 mm (39-79 inches), with a **distinct wet season lasting at least 7 months and a dry season lasting less than 5 months**.
- This climate type is characterized by heavy rainfall and high humidity during the wet season, often leading to flooding and landslides. The dry season can be hot and humid, with water sources becoming scarce. This climate type is often found in Southeast Asia, parts of Africa, and northern South America.

As Climate

- Here the summer is dry and the region is located in the tropical region. It is rarely found.
- In addition to the above classification scheme, Koppen selected certain letters and symbols specifically for the sub-categorization of the tropical region.

s: Summer Dry

i: The difference between the coldest and the warmest month is less than 5 degrees C.

g: The hottest season preceding precipitation.

w': Maximum Precipitation in winter.

w”: Two Seasons of Maximum Precipitation and two dry seasons.

BWh Climate

- The BWh climate, also known as the **hot desert climate**, is a climate classification under the Koppen system. It is characterized by **high temperatures and low precipitation**, with most areas receiving less than 250mm (10 inches) of rainfall per year.
- In the BWh climate, the average temperature of the warmest month is greater than 22°C (71.6°F) and the annual precipitation is typically less than 200mm (7.9 inches). The **temperature range in this climate type can be extreme**, with **hot temperatures during the day and cold temperatures at night**.
- This climate type is found in the **subtropical and tropical regions of the world**, including parts of **North Africa**, the **Middle East**, and the southwestern United States. The lack of precipitation in these areas leads to a **scarcity of vegetation**, and the landscape is often dominated by barren deserts and rocky outcrops.

BSh Climate

- The BSh climate, also known as the **hot semi-arid climate**, is a climate classification under the Koppen system. It is characterized by **high temperatures and low to moderate rainfall**, with most areas receiving between 250-500mm (10-20 inches) of rainfall per year.
- In the BSh climate, the average temperature of the warmest month is greater than 22°C (71.6°F), and the annual precipitation is typically less than the potential evapotranspiration. The temperature range in this climate type can be large, with hot summers and cool to mild winters.
- This climate type is found in the subtropical and tropical regions of the

world, including parts of Africa, Asia, Australia, and the Americas. The vegetation in these areas is often characterized by **drought-resistant shrubs and grasses**, with some scattered trees in areas where water is more readily available.

- The BSh climate is often associated with dry and arid landscapes and is sometimes referred to as a desert climate. However, unlike true desert climates (such as the BWh climate), the BSh climate receives **some rainfall throughout the year**, albeit in low amounts.

BWk Climate

- The BWk climate, also known as the **cold desert climate**, is a climate classification under the Koppen system. It is characterized by **low precipitation** and large temperature ranges, with hot summers and **cold winters**.
- In the BWk climate, the average temperature of the warmest month is greater than 22°C (71.6°F), while the average temperature of the coldest month is below 0°C (32°F). The annual precipitation is typically less than 250mm (10 inches) and is often in the form of snow.
- This climate type is found in the **mid-latitude deserts of the world**, including parts of North America, Asia, and Europe. The vegetation in these areas is often sparse, consisting of drought-resistant plants such as cacti and succulents.
- The BWk climate is often associated with arid and barren landscapes and is characterized by **extreme temperature fluctuations between day and night**, as well as between seasons. During the day, temperatures can be very hot, but they can drop dramatically at night due to the lack of moisture in the air.

Bsk Climate

- The BSk climate, also known as the **cold steppe climate**, is a climate classification under the Koppen system. It is characterized by **low precipitation** and large temperature ranges, with hot summers and cold winters.
- In the BSk climate, the average temperature of the warmest month is greater than 22°C (71.6°F), while the average temperature of the coldest month is below 0°C (32°F). The annual precipitation is typically between 250-500mm (10-20 inches), with most of the precipitation occurring in the form of rain.
- This climate type is found in the mid-latitude steppes of the world, including parts of North America, Asia, and Europe. The vegetation in these areas is often characterized by grasslands, with some scattered trees and shrubs in areas where water is more readily available.
- The BSk climate is often associated with **dry and arid landscapes**, and is similar to the nearby BWk climate, except that it **receives slightly more precipitation**. This climate type is characterized by extreme temperature fluctuations between day and night, as well as between seasons. During the day, temperatures can be very hot, but they can drop dramatically at night due to the lack of moisture in the air.

Terms Used by Koppen for Sub-classification of B-Type Climate

k: Mean Annual Temperature below 18 degrees Centigrade.

h: Mean Annual Temperature above 18 degrees Centigrade.

a: Summer is dry.

w: Winter is dry.

n: Minimum Fog

Cf Climate

- The Cf climate, also known as the **humid subtropical climate**, is a climate classification under the Koppen system. It is characterized by hot and humid summers, mild winters, and ample precipitation throughout the year.
- In the Cf climate, the average temperature of the warmest month is greater than 22°C (71.6°F), while the average temperature of the coldest month is above -3°C (26.6°F). The annual precipitation is typically between 1,000-1,500mm (39-59 inches), with rainfall occurring throughout the year.
- This climate type is found in the **subtropical regions of the world, including parts of eastern and southeastern Asia**, the southeastern United States, and eastern Australia. The vegetation in these areas is often characterized by lush forests and grasslands, with a wide variety of plant and animal life.
- The Cf climate is often associated with **hot and humid summers**, which can lead to thunderstorms and occasional tropical cyclones. The winters in this climate type are generally mild, with occasional cold snaps and frost. The ample rainfall in this climate type supports a wide range of agricultural activities, including the cultivation of crops such as rice, sugarcane, and tea.

Cw Climate

- The Cw climate, also known as the **warm temperate climate with dry winters**, is a climate classification under the Koppen system. It is characterized by mild to warm summers, cool to cold winters, and low to moderate precipitation throughout the year.
- In the Cw climate, the average temperature of the warmest month is

greater than 10°C (50°F), while the average temperature of the coldest month is below 18°C (64.4°F). The annual precipitation is typically between 500-1,000mm (20-39 inches), with most of the precipitation occurring in the summer months.

- This climate type is found in the mid-latitude regions of the world, including parts of North America, Europe, and Asia. The vegetation in these areas is often characterized by deciduous forests and grasslands, with a variety of plant and animal life.
- The Cw climate is often associated with dry and sunny winters, which can lead to drought conditions in some areas. The summers in this climate type are generally warm and pleasant, with occasional thunderstorms and rain. The moderate precipitation and mild temperatures make this climate type suitable for a variety of agricultural activities, including the cultivation of grains, fruits, and vegetables.

Ca Climate

- The Ca climate, also known as the **hot-summer Mediterranean climate**, is a climate classification under the Köppen system. It is characterized by hot, dry summers and mild, wet winters.
- In the Ca climate, the average temperature of the **warmest month is greater than 22°C (71.6°F)**, while the **average temperature of the coldest month is above 0°C (32°F)**. The annual precipitation is typically between 500-1,000mm (20-39 inches), with most of the precipitation occurring in the winter months.
- This climate type is found in the Mediterranean regions of the world, including parts of Europe, North Africa, and California. The vegetation in these areas is often characterized by scrubland, evergreen trees, and grasses.

- The Ca climate is often associated with hot and dry summers, which can lead to wildfires and drought conditions. The winters in this climate type are generally mild, with occasional rain and snow. The moderate precipitation and mild temperatures make this climate type suitable for a variety of agricultural activities, including the cultivation of citrus fruits, grapes, and olives.

Df Climate

- The Df climate, also known as the **humid continental climate** with hot summers, is characterized by warm to hot summers, cold winters, and moderate precipitation throughout the year. The average temperature of the warmest month is greater than 10°C (50°F), while the average temperature of the coldest month is below -3°C (26.6°F). The annual precipitation is typically between 500-1,000mm (20-39 inches).

Dw Climate

- The Dw climate, also known as the **humid continental climate with mild winters**, is characterized by warm to hot summers, cold winters, and moderate precipitation throughout the year. The average temperature of the warmest month is greater than 10°C (50°F), while the average temperature of the coldest month is above -3°C (26.6°F). The annual precipitation is typically between 500-1,000mm (20-39 inches).

ET Climate

- The ET climate, also known as the **polar tundra climate**, is characterized by extremely cold temperatures and low precipitation throughout the year. The average temperature of the warmest month is below 10°C (50°F), while the average temperature of the coldest month is

below -38°C (-36.4°F). The annual precipitation is typically less than 250mm (10 inches), with most of it falling as snow.

EF Climate

- The EF climate, also known as the polar ice cap climate, is characterized by year-round freezing temperatures and extremely low precipitation. The average temperature of the warmest month is below 0°C (32°F), while the average temperature of the coldest month is below -38°C (-36.4°F). The annual precipitation is typically less than 250mm (10 inches), with most of it falling as snow.

Evaluation of Köppen Climate Classification

- The Köppen Climate Classification System is widely regarded as one of the most comprehensive and useful schemes for classifying and understanding the world's climate patterns. The system is based on a **combination of temperature, precipitation, and vegetation characteristics**, and provides a simple and effective way to describe and compare the different types of climates found in various regions around the world.
- One of the main advantages of the Köppen Climate Classification System is its ability to capture the major climatic trends and patterns of the world, while also allowing for regional variation and subtleties. The system provides a framework for identifying and categorizing different climate zones, which can be used for a wide range of applications, including agriculture, land-use planning, and climate modeling.
- However, there are also some limitations and criticisms of the Köppen Climate Classification System. Some argue that the system

oversimplifies the complexity and diversity of climate patterns and that the use of broad categories and thresholds can mask important regional differences and nuances. Additionally, the system was developed over 100 years ago and does not take into account recent changes in the climate due to human activities, such as global warming.

- Overall, while the Köppen Climate Classification System has some limitations, it remains a valuable tool for understanding and comparing the world's climate patterns, and is widely used and accepted by scientists, policymakers, and other stakeholders.

The Importance of the Köppen Climate Classification System

The Köppen Climate Classification System is an essential tool for geographers and climatologists, as it provides a standardized and comprehensive understanding of the Earth's climatic regions. This understanding is crucial for a variety of applications, including:

- Planning and management of land and natural resources
- Agriculture and food production
- Urban and regional planning
- Disaster response and risk assessment
- Climate modeling and prediction

In conclusion, the Köppen Climate Classification System is a widely recognized and essential tool for understanding the Earth's climatic regions. It provides a standardized and comprehensive understanding of the world's climates, which is crucial for a variety of applications in geography, climatology, and related fields. Understanding the characteristics of the Earth's climatic regions, and how they are classified by the Köppen Climate Classification System, is an important aspect of the study of geography and the natural world.

28. Temperature Distribution on Earth

- Temperature differs from one part of the world to the other. Since Insolation is the basic source of energy for the atmosphere, the distribution of insolation would determine the temperature of the earth. Thus **latitude, altitude, distance from sea, features of the surface, nature of the landscape** are some important factors that affect the distribution of temperature.
- Since, the insolation is highest at equator; temperature should be highest at the equator and lowest near the poles, however actually it is not. Highest temperature on earth is recorded at a few degrees north of equator. Altitude is the second major control of temperature of a place. The temperature depends upon albedo of the surface also.
- One major factor affecting the distribution of the temperature of Earth is distribution of Land and Oceans. Since there is more land in Northern Hemisphere and more waters in Southern hemisphere and *there is a big difference between the specific heat of land and water*; the **loss of heat from the continents is bigger than the oceans.** The continents get heated faster and get cooled faster in comparison to the Oceans. This is the reason that the *temperatures of the Oceans are moderate while that of continents is extreme.* The moderating effect on temperature of the land due to proximity of the seas is called **Maritime influence.** The increasing effect on temperature of the land at interior of the continents is called **Continental Influence.**

Three Broad Temperature Zones

The earth can be generally divided into three broad temperature zones viz.

1. Torrid Zone
2. Temperate Zone
3. Frigid zone.

Torrid Zone

- Torrid Zone is the tropical region. The temperature remains high. Sun is directly overhead at least once during the year. In the Northern Hemisphere, the overhead Sun moves north from the equator until it reaches 23.5 °North (Tropic of Cancer) for the June solstice after which it moves back south to the equator. The year is consequently divided nearly into four equal parts by the two times at which the sun crosses the equator (Equinoxes) and those two at which it attains greatest declinations (Solstices). The Torrid Zone forms the hottest region of the world with ***two annual seasons namely a dry and a wet season***. This zone includes most of Africa, southern Asia, Indonesia, New Guinea, northern Australia, southern Mexico, Central America and northern South America.

Temperate Zones

- Temperate zones are the mid latitudinal areas, where the temperature is moderate. There are two temperate areas viz. North and South. In the two Temperate Zones, consisting of the tepid latitudes, the **Sun is never directly overhead**, and the climate is mild, generally ranging from warm to cool. The **four annual seasons, Spring, Summer, Autumn and Winter occur in these areas**. The North Temperate Zone includes Great Britain, Europe, northern Asia, North America and northern Mexico. The

South Temperate Zone includes southern Australia, New Zealand, southern South America and South Africa.

Frigid Zones

- The two Frigid Zones, or polar regions, experience the midnight sun and the polar night for part of the year – the cliff of the zone experiences one day at the solstice when the Sun doesn't rise or set for 24 hours, while in the centre of the zone (the pole), the day is literally one year long, with six months of daylight and six months of night. Please note that the Frigid Zones are not the coldest parts of the earth, and are covered with ice and snow. The coldest temperature on earth has been recorded a few degrees below the 90°N.

Patterns of Global Isotherms

- The global distribution of temperature can be represented with the help of isotherms. Isotherms are the lines that join the places with the identical temperatures. Please note that isotherms are drawn after correcting the temperature of a *place to the sea level so that the differences due to altitude can be minimized*. The Isotherms on the earth run parallel to the latitudes.
- Due to the difference between the specific heat between water and land, at any latitude, the temperature over the landmass is higher in summer and lower in winter in comparison to the seas. Here we discuss about the global isotherms drawn in the month of January and July. As shown in the picture, Isotherms for the month of July bend towards Northward while moving from Sea to Land.
- For the Month of January, the isotherms bend towards south while moving from sea to land. The only thing you have to note about

Isotherms is that water in the South Atlantic and Pacific is absorbing greater amounts of energy during January and the land is rapidly heating and reradiating energy. Please also note that due to difference in the specific heat, both highest and lowest temperatures are observed in the interiors of the continents.

Vertical Distribution of Temperature

- The vertical distribution of temperature on earth is also unequal. As we studied above in detail that in troposphere, the temperature falls uniformly with height as per the Environmental Lapse Rate. The normal value of this Lapse Rate is 6.4°C per kilometers. When a parcel of air rises upwards and cools this is known as adiabatic cooling. This adiabatic cooling is the result of the expansion of air as it is lifted upwards. When the air descends, it gets warmed and this is called adiabatic warming.

Inversion of the Temperature

- In the mountain valleys, the temperature of the air is **found increasing with increasing altitude**. Thus there is an inversion of the temperature. This is because during the night, the quick radiation from the upper exposed slopes of the mountains causes the surface and air over it to cool rapidly. This cooler air is denser and gets drained by the valley slopes and displaces the warmer air toward up. So, when we go up in a valley, the temperature seems to getting increased. This phenomenon is also called **drainage inversion**.

Mean Thermal Equator

- Thermal equator is a global isotherm having the highest mean annual

temperature at each longitude around the globe. Thermal equator does not coincide with the geographical equator. The *highest absolute temperatures are recorded in the Tropics* but the *highest mean annual temperatures are recorded at equator*. But because local temperatures are sensitive to the geography of a region, and mountain ranges and ocean currents ensure that smooth temperature gradients (such as might be found if the Earth were uniform in composition and devoid of surface irregularities) are impossible, the location of the thermal equator is not identical to that of the geographic Equator.

- Further, we know that the Earth reaches perihelion (the minimum distance from the Sun in its orbit) in early January and is at aphelion (maximum distance) in early July. During winter season of the respective hemispheres, the angle of incidence of the sun's rays is low in tropics. The average annual temperature of the tropical regions is therefore lower than the observed near the equator, as the change in the angle of incidence is minimum at equator.
- The thermal equator shifts towards north and south with north south shift in the position of vertical rays of the sun. *However, annual average position of the Thermal equator is 5° N latitude*. The reason is that highest mean annual temperature shifts towards northwards during the summer solstice to a much greater extent than it does towards south at the time of winter solstice.

Daily variation of Temperature

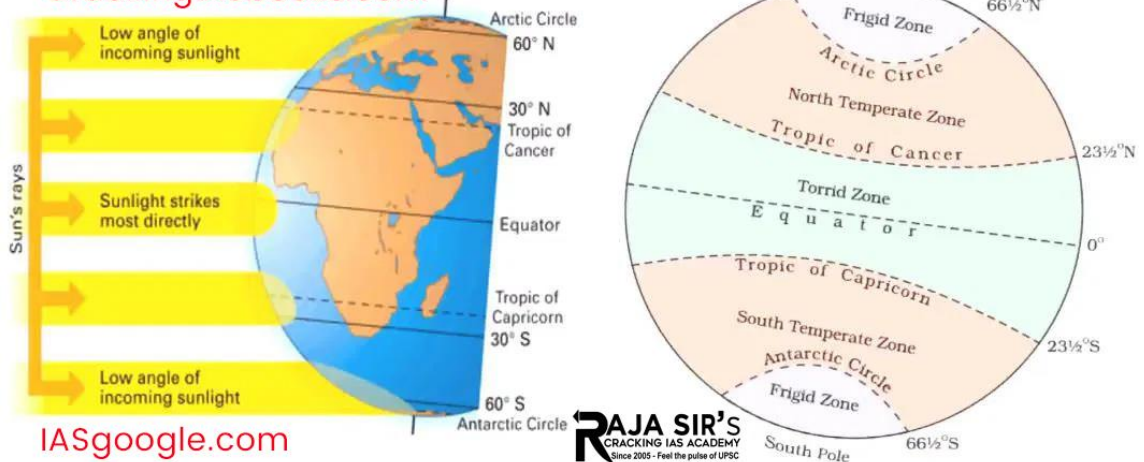
- Sun is at the highest point at noon but the highest temperature does not occur at 1200 hours because the **atmosphere does not get the heat directly from the Sun**. It receives heat from the earth's surface slowly and that is why maximum temperature is generally attained by

1400 hours (2.00p.m.). The daily minimum temperature at a place does not occur at about 0400 hours (4.00 p.m.) in the morning because radiation of heat continues upto the sun rise.

Here are some notable observations on daily temperature ranges:

- Daily temperature range is **low in clouded areas** because the clouds obstruct the receipt and loss of insolation.
- The sky is clear in hot desert's areas. Insolation is received without obstruction in the day and lost without obstruction in the night. This causes **high temperature range in deserts.**
- Ice or snow absorbs less and reflects the insolation more. Hence, the daily temperature range is low in snow bound areas.
- The air is thin in areas of high altitude. There is great loss of insolation in the night. There is no obstruction in the receipt of insolation in the day. Such places have a high temperature range.
- There is a higher temperature range in than interior areas of continents than at seas because the sea heats and cools slowly but the land heats and cools rapidly.
- Warm and cool winds also disturb the temperature range.

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Annual temperature range

1. On Equator

- The duration of the day or night is the same in equatorial countries. The sun's rays are vertical all through the year. Hence, there is no worthwhile difference between the summer and winter seasons. This is the reason that the ***lowest annual temperature range is found in equatorial areas.***

2. On Poles

- Towards the poles, the duration of the day and the inclination of the sun rays go on increasing. It causes a lot of difference between the temperatures of the two seasons. Hence, towards the poles, the annual temperature range goes on increasing.

3. Near Oceans

- Near the seas and oceans, the equalizing effect of sea water makes the winter less cold and the summer less hot. This reduces the annual range of temperature near the seas. The equalizing effect of the sea water cannot reach land areas, away from the seas. The countries like Mongolia and Tibet which are situated far into the interior of the continent have a high annual range of temperature. The ocean currents near the coasts also affected the temperature range. Due to the warm gulf stream, the winter of western Europe is less cold than what it should have been without the gulf stream. This reduces the annual temperature range.
- The shifting attitude of ocean currents has a lot of effect on the annual temperature range. For example, the weather and seasons have to undergo greater changes on the eastern coasts of Indian and Australia

due to the shifting of ocean currents. It increases the annual temperature range on these coasts as compared to that on the opposite side coasts.

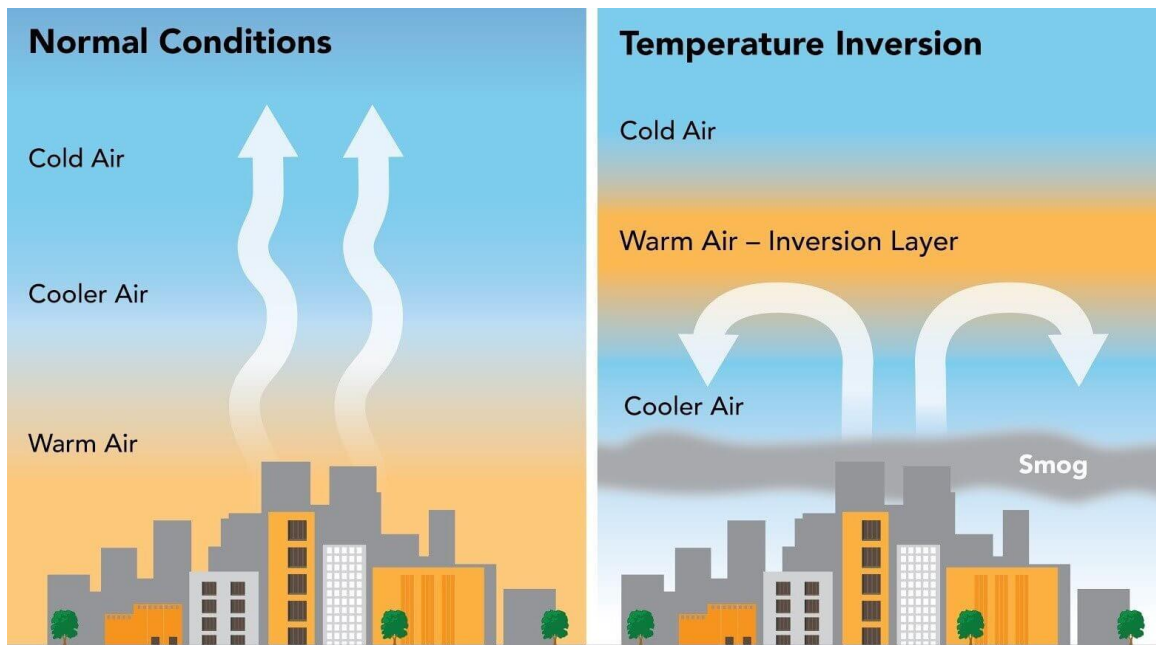
Impact of Winds

- The prevailing winds also have a greater effect on the annual temperature range. Winds from the land blow in Arabian countries and therefore increase the annual range of temperature. Winds from the oceans and seas blow into Western Europe and reduce the annual temperature range. The variation in the annual temperature range in west and east European countries is due to land and sea winds. The effect of winds from the ocean has a far smaller effect in Eastern Europe than in Western Europe. It is why the annual temperature range is higher in eastern than in Western Europe.

29. Temperature Inversion

- Under normal conditions, temperature usually decreases with increase in altitude in the troposphere at a rate of 1 degree for every 165 metres. This is called **normal lapse rate**.
 - But on some occasions, the situations get reversed and temperature starts increasing with height rather than decreasing. This is called **temperature inversion**.
- **Temperature inversion:** It is a reversal of the normal behavior of temperature in the troposphere. Under this meteorological phenomenon a layer of warm air lies over the cold air layer. It is caused in stac atmospheric conditions while some times, it occurs due to **horizontal or vertical movement of air**.

- Temperature inversion is usually of short duration but quite common nonetheless.



Favourable Conditions for Temperature Inversion

- **Long winter nights:** Loss of heat by terrestrial radiation from the ground surface during night may exceed the amount of incoming solar radiation.
- **Cloudless and clear sky:** Loss of heat through terrestrial radiation proceeds more rapidly without any obstruction.
- **Dry air near the ground surface:** It limits the absorption of the radiated heat from the Earth's surface.

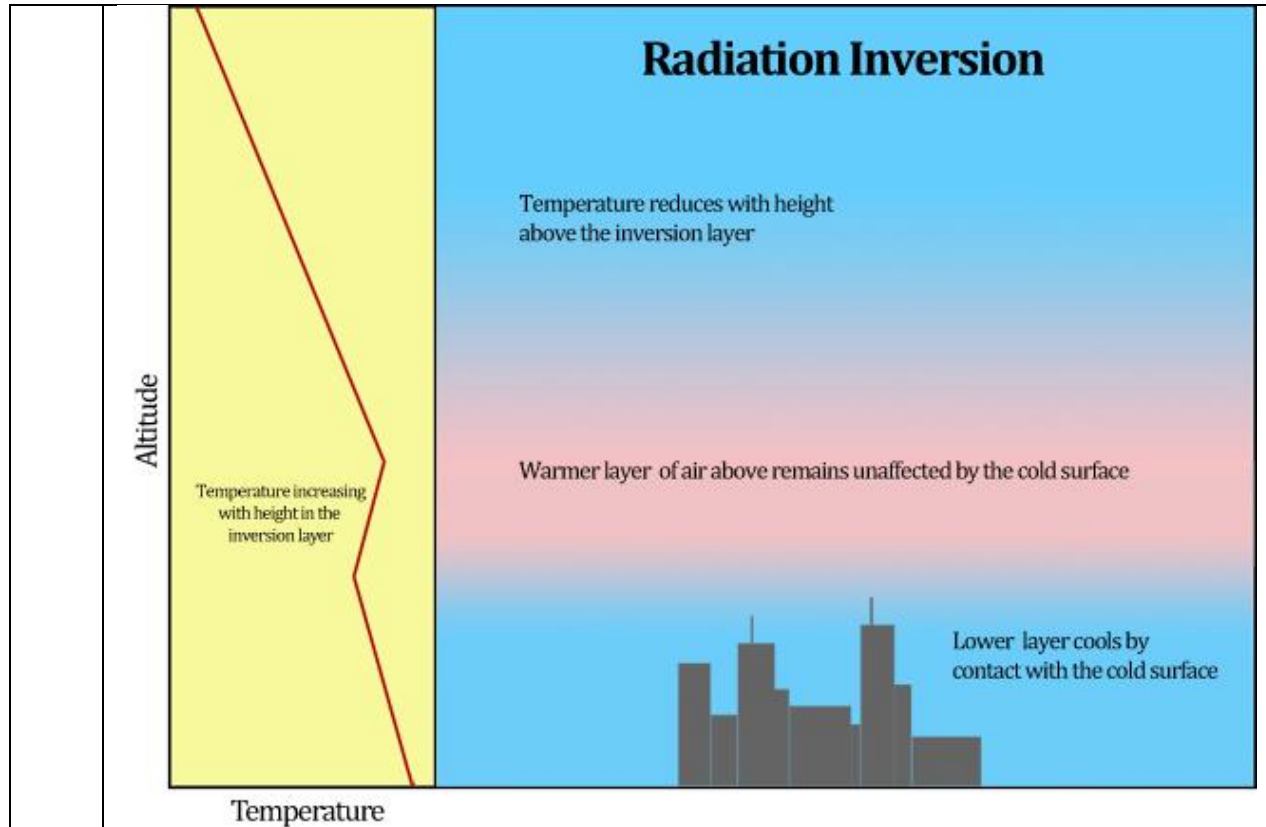
- **Slow movement of air:** It results in no transfer or mixing of heat in the lower layers of the atmosphere.
- **Snow covered ground surface:** It results in maximum loss of heat through reflection of incoming solar radiation.

Types of Temperature Inversion

- Temperature inversion occurs in several conditions ranging from ground surface to great heights. Thus there are several kinds of temperature inversions.
- The following are classified on the basis of relative heights from the earth's surface at which it occurs and the type of air circulation:

Non-Advectional

- **Radiation Inversion (Surface Temperature Inversion)**
 - Surface temperature inversion develops when air is cooled by contact with a colder surface until it becomes cooler than the overlying atmosphere; this occurs most often on clear nights, when the ground cools off rapidly by radiation. If the temperature of surface air drops below its dew point, fog may result.
 - It is very common in the higher latitudes. In lower and middle latitudes, it occurs during cold nights and gets destroyed during day time.



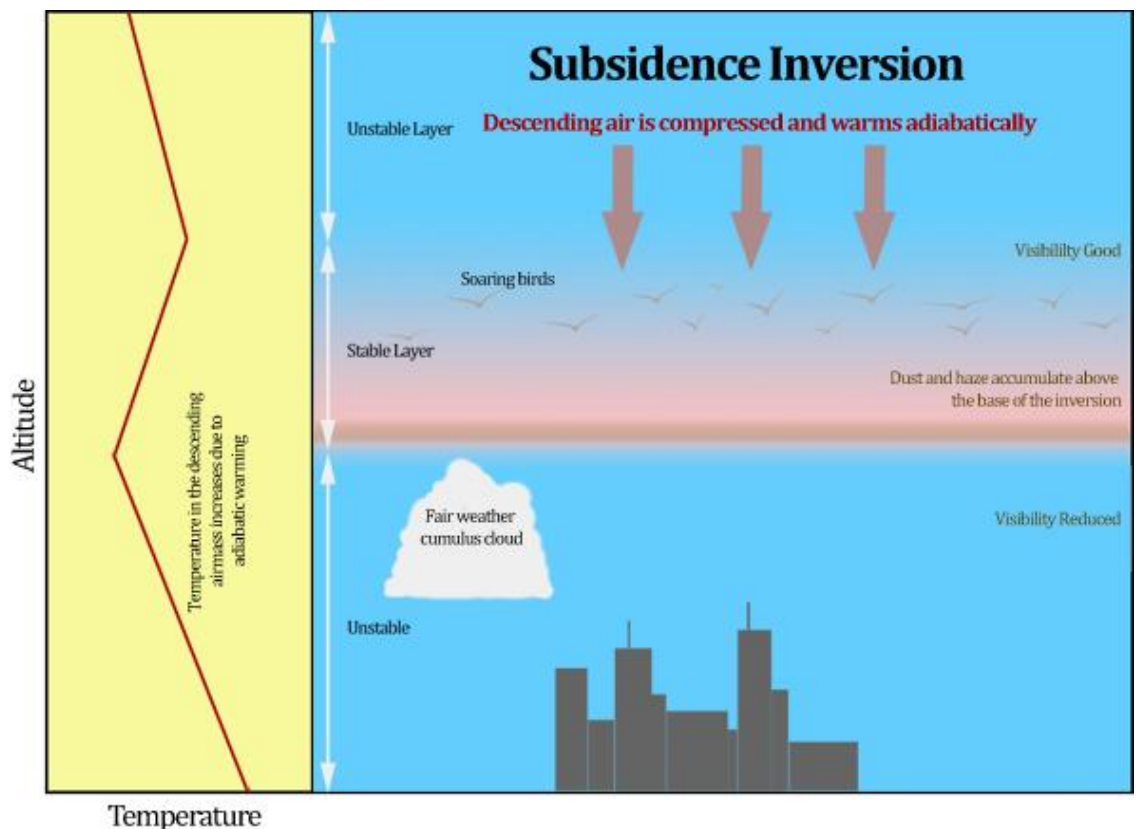
Ground or surface inversion, also called as **radiation inversion**, occurs near the earth's surface due to radiation mechanism. This is also called as non-advectional inversion because it occurs in stable atmospheric condition characterized by almost no movement of horizontal or vertical air.

- **Subsidence Inversion (Upper Surface Temperature Inversion)**

- When a widespread layer of air descends, it is compressed and heated by the resulting increase in atmospheric pressure, and as a result the lapse rate of temperature is reduced.
- The air at higher altitudes becomes warmer than at lower

altitudes, producing a temperature inversion. This type of temperature inversion is called subsidence inversion.

- It is very common over the northern continents in winter (dry atmosphere) and over the subtropical oceans; these regions generally have subsiding air because they are located under large high-pressure centers.
- It is also called upper surface temperature inversion because it takes place in the upper parts of the atmosphere.



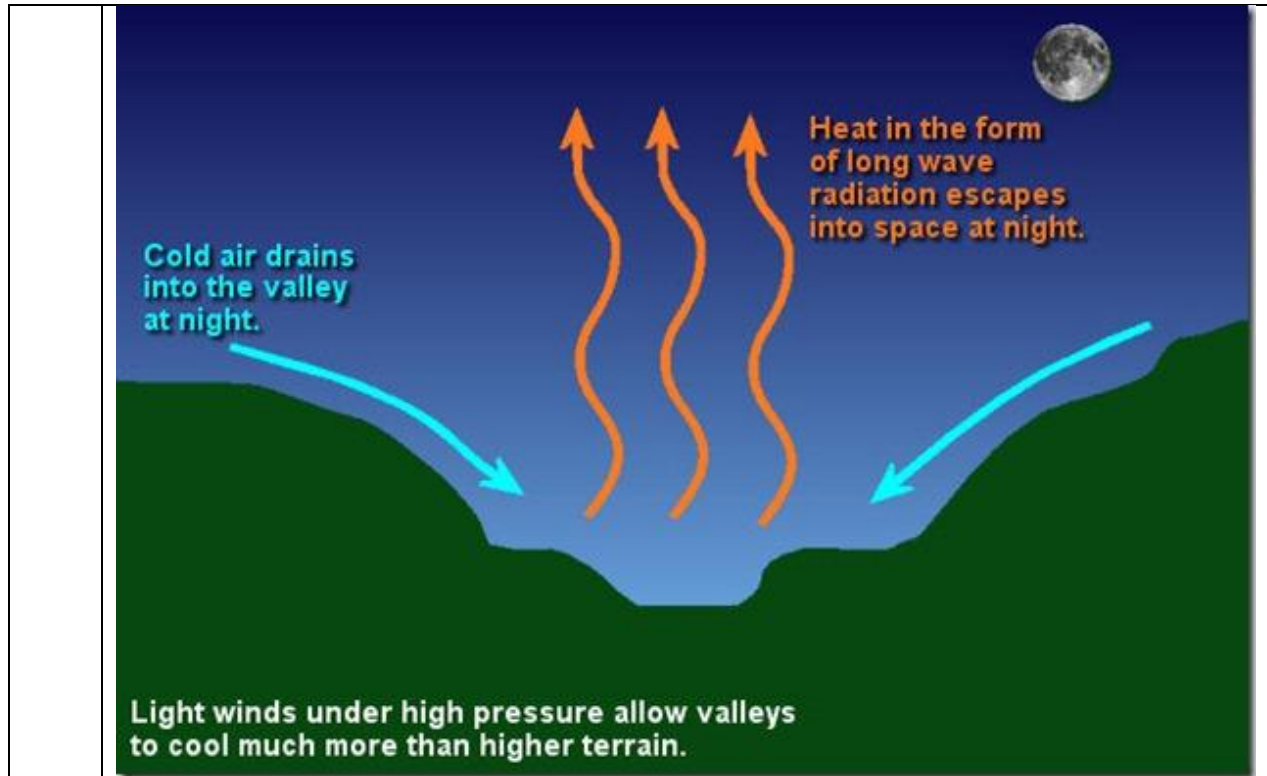
• **Advectional**

Advection Inversions: They develop when there is a horizontal inflow of cold air

into an area. This is common to cool maritime air blowing into a coastal locale. Advection inversions are usually short-lived (typically overnight) and shallow. They can happen at any time of year, depending on the location of the relatively cold surface and the direction of the wind.

- **Valley inversion in intermontane valley**

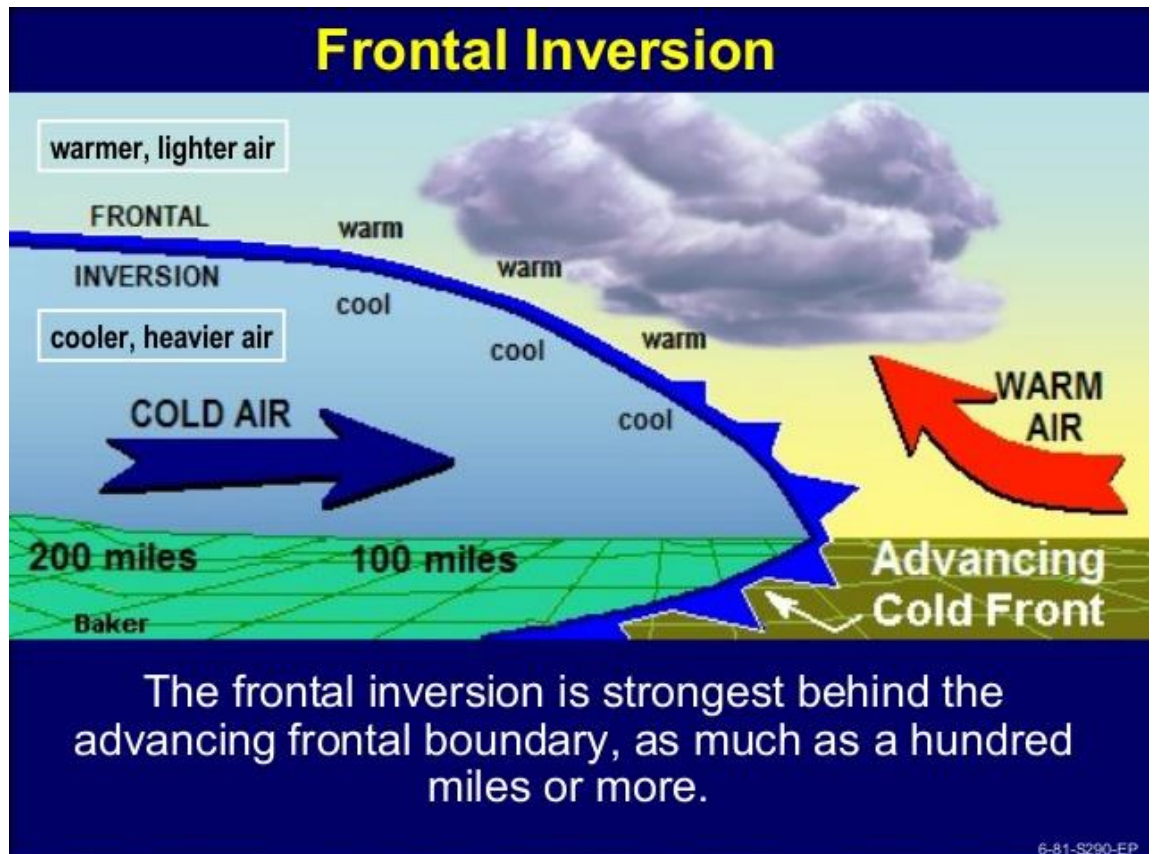
- In high mountains or deep valleys, sometimes, the temperature of the lower layers of air increases instead of decreasing with elevation along a sloping surface.
- Here, the surface radiates heat back to space rapidly and cools down at a faster rate than the upper layers. As a result the lower cold layers get condensed and become heavy.
- The sloping surface underneath makes them move towards the bottom where the cold layer settles down as a zone of low temperature while the upper layers are relatively warmer.
- This condition, opposite to normal vertical distribution of temperature, is known as Temperature Inversion.



Frontal or Cyclonic inversion

- When the warm and cold fronts meet, then the warm front rises up and being heavier the cold front sinks down. It results in formation of Frontal Inversion.
- It has considerable slope, whereas other inversions are nearly horizontal. It often takes place in the temperate zone and causes cyclonic conditions which result in the precipitation in different forms.
- A frontal inversion is unstable and is destroyed as

the weather changes.



Effects of Inversion of temperature

- Temperature inversion determines the precipitation, forms of clouds, and also causes frost due to condensation of warm air due to its cooling.
 - **Dust particles hanging in the air:** Due to inversion of temperature, air pollutants such as dust particles and smoke do not disperse on the surface.
 - **Stops the movement of air:** It causes the stability of the atmosphere that stops the downward and upward movement of

	<p>air.</p> <ul style="list-style-type: none">○ Less rainfall: Convection clouds can not move high upwards so there is less rainfall and no showers. So, it causes a problem for agricultural productivity.○ Lower visibility: Fog is formed due to the situation of warm air above and cold air below, and hence visibility is reduced which causes disturbance in transportation.○ Thunderstorms and tornadoes: Intense thunderstorms and tornadoes are also associated with inversion of temperature because of the intense energy that is released after an inversion blocks an area's normal convection patterns.○ Diurnal variations in temperature tend to be very small.
<p>30.</p>	<p>Sir Creek Dispute</p> <ul style="list-style-type: none">• Sir Creek {local name <i>Baan Ganga</i>} is a 96 kilometres long estuary in the marshes of the Rann of Katch where Arabian Sea joins the land mass. It's basically a fluctuating tidal channel, not truly a flowing creek. It currently lies on the border of India's Gujarat and Pakistan's Sindh province. In marshy areas like the Rann, landmasses emerge and slip back into water. The joint survey held by India and Pakistan held in 2007 claimed Sir Creek had shifted nearly 1.5 km eastwards.• At the time of partition, boundary here was not demarcated and since then, Pakistan has claimed the entire creek. <p>Background</p> <ul style="list-style-type: none">• Out of the total 7417 kilometres of total coastline of India shared by

nine states, Gujarat with 1663 kilometres is the state with largest coastline. The Gujarat coast is characterised by two major gulfs viz. Gulf of Katch and Gulf of Cambay. A part of Pakistan's coastline is adjacent to that of the India's Gujarat coast. But there are no bilateral agreements defining the maritime boundaries. Not only these boundaries are unsettled but also there is absence of clear fishing laws. The Maritime Zones Acts of both India and Pakistan are almost twins but none of them is said to be corresponding to the United Nations Convention of Law of Sea (UNCLOS).

The marshlands of Sir Creek became first disputed between the **Rao of princely state of Katch and the Chief Commissioner of Sindh Province** of British India due to different perceptions of the boundaries. The case was taken up by then Government of Bombay, which conducted a survey and mandated its verdict in 1914. This verdict has two contradictory paragraphs, which make the India and Pakistan contenders on the same issue.

- Paragraph 9 of this verdict says that the boundary between Kutch and Sindh lies 'to the east of the Creek,' which effectively implied that the creek belonged to Sindh and, therefore, to Pakistan.
- On the other hand, Paragraph 10 says Sir Creek is navigable most of the year and quotes the chief commissioner of Sindh to buttress the point.

According to international law, a boundary can only be fixed in the middle of the navigable channel, which meant that it has be divided between Sindh and Kutch, and thereby India and Pakistan. India has used this para to consistently argue that the boundary needs to be fixed in the middle of the creek.

Sir Creek Issue: A Cartographic Dilemma

The map of the region was chalked out in 1925 and in this map, a **'green riband'** was shown to the east of the Creek'. Pakistan says that this **'Green Line'** is the marked boundary between Sindh and Kutch, and argued that the Creek belonged to Sindh.

India countered, saying the depiction was part of 'normal cartographic practice' and *should not be used to make any territorial claims*. Thus, this dispute is a classic example of cartographic dilemma. Till 1954, the borders around Sir Creek were virtually open and there was a free movement of people and material from both sides. After 1954, the countries started rigid stances on borders and a controversy evolved around Sir Creek. Till 1968, India and Pakistan were competing each other to provide historical evidence that it belonged to them.



Importance of Sir Creek

- The strategic or military importance of Sir Creek is little. The core importance of the Sir Creek is because of the fishing resources. Sir Creek is considered to be one of the largest Fishing grounds in Asia. Further, immense potential economic benefits as the marshlands are estimated to be rich in hydrocarbons and shale gas, is another importance of Sir Creek.

Stands of India and Pakistan

- In arguments made at the UN tribunal, India claimed that Kutch was a well-defined entity and the Raos of Kutch paid tribute to imperial powers, first Mughals, then British. Pakistan uses different colonial sources to say the Kutch never had an existence of its own, that the rulers of Sindh had invaded and occupied parts of the Rann in the 18th century, and that the whole breadth of the Rann was the boundary between Kutch and Sindh.
- In spite of this historical nebulosity, the tribunal supported India's claim to 90 per cent of the Rann, fixed the land border up to a point called the **Western Terminus**, but left the westernmost part of the border fluid. This includes the stretch of water now under dispute.

Current Position

The dispute between India and Pakistan is on 3 issues:

- The actual demarcation "from the mouth of Sir Creek to the top of Sir Creek"
- The actual demarcation "from the top of Sir Creek eastward to a point on the line designated on the Western Terminus".

	<ul style="list-style-type: none">• Demarcation of maritime boundary between India and Pakistan in Arabian Sea. <p>India and have held the talks in earlier {latest 2012} on Sir Creek Dispute. Neither has changed its claims on the creek since then. In 2007, the two sides had exchanged maps that matched. But the process was derailed by the Mumbai attacks.</p> <p>Road ahead</p> <p>If Sir Creek is to be treated as a water border, it must be divided according to international laws that govern such boundaries. Further, if India gives up control of the Creek, there is no guarantee that Pakistan would not claim any new territory in the sector, particularly when some oil or gas resource is discovered. Thus, despite being a small issue, it does not solve due to trust deficit.</p>
<p>31.</p>	<p>Supreme Court cracks down child pornography</p> <ul style="list-style-type: none">• The Supreme Court's historic judgment against online child sexual abuse marks a significant milestone in combating child exploitation.• It expands the scope of criminal liability for downloading and storing Child Sexual Exploitative and Abuse Material (CSEAM), which addresses the core issue of demand for such content.• In January 2024, the Madras High Court ruled that merely downloading or watching child pornography was not a crime, sparking widespread concern.

- The ruling undermined the **Protection of Children from Sexual Offences (POCSO) Act, 2012**, and could normalize the consumption of child sexual abuse material.
- The Supreme Court reversed this decision in September 2024, expanding the legal definition of child abuse and reframing the issue as a grave crime.

Key Takeaways from the Supreme Court Judgment:

- **Reframing the issue:**
 - The court shifted the language from “child porn” to **Child Sexual Exploitative and Abuse Material (CSEAM)**, emphasizing the crime’s severe nature.
- **Criminalization of Downloading and Storing:**
 - The judgment holds that merely downloading or storing such material constitutes an offense, **creating a strong deterrent against the demand for child abuse content.**
- **Accountability of Social Media Intermediaries:**
 - The court mandated social media platforms to report CSEAM in real-time to law enforcement authorities, holding them accountable for content on their platforms.
- **Long-term impact:**
 - The judgment highlighted the perpetuity of online abuse, where victims continue to suffer re-victimization as images remain available online.
- The recent Supreme Court judgment aligns with **India’s commitment under the United Nations Convention on the Rights of the Child (UNCRC)** to protect children from harm, including online sexual abuse.

Constitutional Provisions

- **Article 21 (Right to Life and Personal Liberty):**
 - The Constitution of India guarantees the Right to Life under Article 21, which has been interpreted to include the right to live with dignity, protection from exploitation, and personal safety.
 - Child sexual abuse and exploitation directly violate this fundamental right.
- **Article 15(3):**
 - This article empowers the State to make special provisions for the protection and welfare of children.
 - The Protection of Children from Sexual Offences (POCSO) Act, 2012, and other child protection laws derive their legitimacy from this constitutional mandate.
- **Article 39(e) and (f) (Directive Principles of State Policy):**
 - The State is directed to ensure that children are not abused and are provided opportunities to grow in a healthy manner.
 - Article 39 emphasizes the responsibility of the State to protect children from exploitation, ensuring their rights are safeguarded.

Legal Provisions

- **POCSO Act, 2012** is the cornerstone legislation that addresses child sexual abuse in India. It criminalizes various forms of sexual exploitation of children, including the use of children in pornographic content.
- **The Information Technology (IT) Act, 2000** governs cybercrimes and electronic offenses, including child pornography. It complements POCSO by targeting online sexual exploitation and content distribution over digital platforms.

- **Juvenile Justice (Care and Protection of Children) Act, 2015** emphasizes child-friendly approaches and includes special provisions for children involved in or victims of crimes such as trafficking and sexual exploitation.

Concerns / Challenges

- **Many social media platforms and messaging apps use end-to-end encryption**, making it difficult for law enforcement agencies to monitor or intercept harmful content, including CSEAM.
- **The use of Artificial Intelligence (AI) to create synthetic child abuse material (deepfakes) complicates detection.** Distinguishing between real and AI-generated images presents significant challenges for law enforcement and forensic experts.
- CSEAM can spread quickly across multiple platforms and jurisdictions, making it challenging to track, remove, and prevent further dissemination.
- Many social media platforms are headquartered outside India, making **cross-border cooperation difficult.**
- **The shortage of skilled personnel**, including forensic experts and cybercrime investigators, hampers the effective implementation of the judgment.
- Most legal frameworks focus on prosecuting offenders, but there is insufficient attention given to the **rehabilitation and psychological support of child victims.**

Way Forward:

- **Defining Cybercrime:**
 - Indian laws must explicitly define cybercrime and include CSEAM

under its scope as an organized crime.

- Emerging crimes such as **AI-generated child abuse material** should also be criminalized.

- **Accountability of Social Media Platforms:**

- Social media companies must be held responsible for flagging and reporting CSEAM to law enforcement in real-time.

- **Forensic Lab for CSEAM:**

- India should establish a forensic lab equipped with the latest technology to analyze CSEAM data and provide timely intervention.

- **National Database on Sexual Offenders:**

- Individuals prosecuted for downloading CSEAM should be added to the **National Database on Sexual Offenders**, barring them from jobs involving children.

Global Impact and Border-less Response:

- **CSEAM as a Global Industry:**

- The global CSEAM industry is worth billions, fueled by technological advancements, and requires international cooperation for dismantling.

- **Global Convention:**

- A legally binding **international convention** is needed to streamline cooperation between governments, law enforcement, and stakeholders to combat CSEAM.

- **International Database of Sex Offenders:**

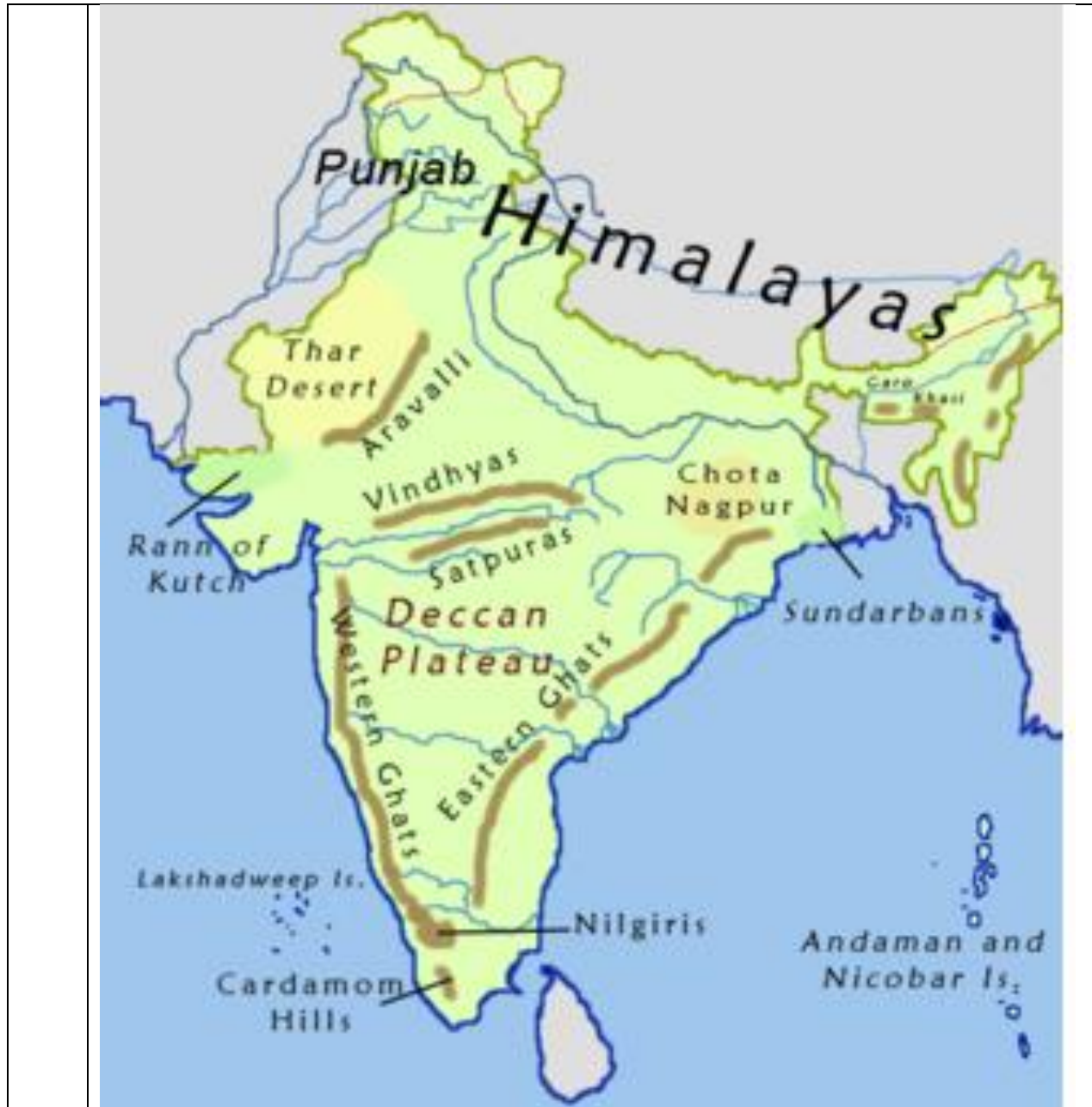
- Establishing a global database would ensure better tracking and cross-border action against offenders.

	<p>This judgment sets a precedent not only for India but for global efforts in combating child exploitation. A coordinated, multi-layered approach involving legal reforms, technological advancements, and international cooperation is necessary to dismantle the CSEAM industry and protect vulnerable children worldwide.</p>
<p>32.</p>	<p>Aravalli Ranges</p> <ul style="list-style-type: none">• The Aravalli Range is a mountain range located in Northern-Western India. The length of the range is approximately 670 km which runs in south-west direction. The range starts near Delhi and passes through Haryana, Rajasthan and finally ends in Gujarat. The Aravalli Range is a significant ecological hotspot due to its rich geological history, diverse flora and fauna. It provides significant fresh water to neighbouring states and act as a natural buffer from adjoining desert. The range faces concerns from unorganised urbanization, overexploitation of natural resources, mining, loss of forest cover and wildlife habitat. Centre and state governments along with the Supreme Court has stepped in to conserve it and the Aravalli Green Wall project is a welcome and holistic move.• Historically, the Aravalli Range has significantly determined the region's cultural and economic development. The range is one of the oldest mountain ranges of the world that was formed by orogenic process of folding and dates earlier than the formation of the Himalayan ranges. The approximate age of Aravallis is around 670 million years and belong to Pre-Cambrian era. The Aravalli were higher in ancient times but due to many years of weathering they have worn down

considerably. The Aravallis and its geography have played a major role in shaping the region's history and will keep on shaping its future too. The Aravalli Range has its own **spiritual significance** coupled with its **natural beauty** as it is adorned with sites which are sacred in nature such as **Dilwara Jain Temples**. Many wildlife sanctuaries, national parks and reserves such as **Sariska tiger Reserve** and **Mount Abu Wildlife Sanctuary** are located within the Aravalli Range. The Aravalli mountains are not just geological marvels; they are an integral part of India's cultural and natural heritage. These majestic ranges are a recognized global biodiversity hotspot, showcasing India's commitment to preserving its natural splendour.

Features of Aravalli Range

- The Aravallis are located in the **North-western of India**, stretching from **Delhi to Gujarat through Haryana and Rajasthan**, with a length close to **670 Km** and having an average elevation of **600-900** metres.
- The northern part of the Range is **isolated with rocky hills and ridges** in between Delhi and Haryana.
- **Climate:** The **Northern** part of Aravalli range has humid **subtropical climate and hot semi-arid continental climate**. The **Central** Aravalli range has an arid and dry climate. The **Southern** Aravalli range in Gujarat has a tropical wet and dry climate.
- **Rivers:** The major rivers flowing from Aravalli are **Banas** and **Sahibi** rivers which are tributaries of Yamuna. **Luni River**, which flows into the Rann of Kutch also originates from the range. Other rivers include **Chambal, Sabarmati, Dohan, Sota and Krishnavati** river.



Ecology: The Aravalli Range is known for its **rich biodiversity**. It hosts diverse plants and wildlife, including species like the Indian wolf, Bengal fox, caracal, leopards, striped hyena, golden jackal, nilgai, wild pig, peafowl and many

species of reptiles.

- The Aravalli mountains are divided into two main ranges: the **Sambhar-Sirohi Range** and the **Sambhar-Khetri Range** in Rajasthan.
- The highest peak of the Aravalli Range is **Guru Shikhar Peak (1722m) on Mount Abu**.
- The region is an **essential supply of water** for the states of Delhi, Haryana, Rajasthan, and Gujarat.
- There are various hill forts, temples, and other historical structures in the Aravalli Range.
- The range is also **rich in minerals** such as copper, lead and zinc.
- The range also helps to **regulate the local temperature**, with its peaks and slopes giving relief.

Significance of Aravallis

- **Stop Desertification:** Aravalli range serves as a **barrier** to prevent **desertification** from spreading further eastward into Rajasthan and then to Gangetic plains. **Dust storms** might occur frequently with greater intensity if the Aravallis were not there acting as a natural barrier.
- **Water Regulation:** Rivers of the range are key water providers. Aravalli hills cause adequate rainfall hence being responsible for **rich biodiversity, livelihood and agriculture in the constituent states**. They also facilitate ground water recharge.
- **Climate Regulation:** The Aravalli shields the **plains** from the effects of **westerly winds** coming from the **Central Asian region** and prevents clouds from moving eastward to the lower Himalayas, which also **influences the climate of north India**.
- **Tackling Pollution:** Despite the shrinking forests of the Aravalli, they

serve as a **cushion to reduce the impact and shock of pollution** and **human activity** on the metropolitan environment.

- The availability of commercially **viable quantities of minerals** such as **copper, rock phosphate, lead-zinc-silver deposits at Zawar, marble, kyanite, asbestos** etc.

Issues concerning Aravalli Range

- **Deforestation:** Timber extraction is leading to deforestation which causes loss of habitat for wildlife, soil erosion and water scarcity.
- Aravallis have been breached due to human activity and there is threat of desertification of the area.
- **Illegal Mining:** mining is done **without permission** and has caused extensive damage to the environment.
- **Human-Wildlife Conflict:** As the human population in the Aravalli ranges increases, there is an **increasing conflict between humans and wildlife.**
- **Unplanned Urbanization:** Unplanned urbanization has been a major issue in the Aravalli ranges. The unchecked growth of urban areas has adversely affected the environment and wildlife.
- **Loss of Water Resources:** The Aravalli ranges are the source of many rivers and streams in the region. However, due to unchecked development activities, the water resources in the area have been severely depleted.
- **Unstable Geology:** **The geology of the Aravalli ranges is very unstable** due to the presence of various faults and fractures. This has led to an increased risk of landslides and earthquakes in the area.
- **Overgrazing:** The Aravalli range has been **facing overgrazing** due to an increase in the number of livestock.

- **Climate Change:** The Aravalli range is facing **an increase in temperatures**, which endangers water security and can lead to land degradation.

Judicial Pronouncements and Initiatives

- **Aravallis a National Asset:** The **Supreme court** had **suspended all mining activities in the Aravalli hills in Haryana**, and termed environment and ecology as **national assets**.
- **Plan:** The top court had also directed the **Forest Department** to frame a **comprehensive conservation strategy** for the Aravalli.
- **Demolished Human Housing:** In 2021 **Supreme Court** ordered for the **demolition of large enclaves of the housing complex**, built in violation of the environmental laws, encroaching fragile ecosystems.
- The **National Green Tribunal** ordered the **Haryana government to remove all illegal development projects in the Aravalli in 2018**.

The Green Wall of India (Aravalli Green Wall Project)

A 1400 km long Green Wall of India from Porbandar to Panipat will help in restoring degraded land through **afforestation along the Aravali hill range**.

- Increase the green cover and biodiversity of the Aravalli through afforestation, reforestation and restoration of water bodies, but also improve the **soil fertility, water availability and climate resilience** of the region.
- The project will **benefit the local communities** by providing them with employment opportunities, income generation and ecosystem services.
- **Stop Desertification:** It will also act as a barrier for dust coming from the deserts in western India and Pakistan.

Conserving Aravallis

- **Scientifically mapping** the degradation and overall change in the topography, soil of the Aravallis, for **a comprehensive strategy to restore its greenery.**
- There is need for redundancy of outdated laws and streamlining **the difference in land legislations. The outlook towards conservation** of the Aravalli among the constituent states must be addressed.
- **The Union and State Governments** must evolve and adopt a **robust common mechanism for smooth implementation of conservation measures** to restore the ecological state of the Aravallis.
- **Sustainable, responsible mining** should replace the exploitative practices adopted at present.
- **Eco-sensitive zones** and potential animal movement corridors must be protected at all costs.
- There is a need for evolving **Soil Moisture conservation** measures, integrating them with **traditional water harvesting and ground aquifer recharge technologies.**
- **Alternative economic avenues**, livelihood measures, steps strengthening the rural economy of the region must be accorded priority.

Road ahead-

- The Aravallis play a vital role in **regional ecology.** They act as a **barrier against Thar Desert** expansion, regulate climate, and provide water sources for millions. They are an **ecological hotspot** in northwest India. However, decades of deforestation, mining, and urbanization have degraded its **natural resources and threatened biodiversity.** Water scarcity, desertification, and human-wildlife conflict are major concerns.

	<ul style="list-style-type: none">• Positive strides have been made towards conservation. The Supreme Court has recognized the Aravallis as a national asset and ordered demolition of illegal structures. The ambitious Aravalli Green Wall project aims to restore degraded lands through afforestation. By addressing the challenges and implementing effective conservation measures, we can ensure a healthy future for this vital ecosystem and its surrounding communities. This requires a concerted effort from all stakeholders - government, NGOs, and local communities - to work together for the long-term sustainability of the Aravalli Range.
<p>33.</p>	<p>Can Universal Basic Income tackle India's poverty?</p> <ul style="list-style-type: none">• The International Labour Organization (ILO) has highlighted global issues of jobless growth, worsened by automation and Artificial Intelligence (AI).• Rising inequality and youth unemployment, particularly in India, have reignited debates around UBI as a tool to provide a social safety net. <p>UBI gained momentum in India after the 2016-17 Economic Survey, which proposed considering UBI to replace inefficient welfare schemes.</p> <ul style="list-style-type: none">• The development of JAM (Jan-Dhan, Aadhaar, Mobile) infrastructure has enhanced the feasibility of implementing Direct Benefit Transfers (DBTs) for UBI.

UBI as a Safety Net Policy

- **UBI should be viewed as a social safety net policy rather than a solution to employment growth or economic development.** It helps individuals manage the consequences of unemployment and poverty.
- Policies need to be evaluated based on their objectives. UBI is designed to provide **basic income support, not directly solve structural economic issues like job creation.**

Benefits of Universal Basic Income (UBI)

- **UBI provides a direct cash transfer to all citizens, ensuring a minimum income floor.** This can lift people out of poverty, particularly in regions with high poverty rates, by providing basic financial security.
- Universal transfers ensure fewer intermediaries, reducing administrative costs and **minimizing exclusion errors.**
- With **basic income support**, individuals, especially in lower-income groups, will have **more purchasing power.** This can stimulate **aggregate demand**, boosting consumption and potentially driving economic growth, especially in times of economic downturn.
- UBI can provide essential financial support to **vulnerable populations** like the elderly, disabled, and unemployed, who may not benefit from work-based welfare programs like MGNREGS.
- With guaranteed financial support, families are more likely to invest in **better healthcare** and **education** for their children, improving overall human development indicators in the long run.
- A guaranteed basic income can reduce the **stress** and **mental health issues** associated with financial insecurity. It can also reduce **crime rates**, as people with stable income are less likely to resort to criminal activities out of desperation.

Feasibility vs. Desirability

- **Feasibility:** UBI may not be financially viable for India, given budgetary constraints.
- **Desirability:** UBI is desirable as it can provide universal income support, reducing inequality and offering a minimal consumption guarantee.
- **A key question is whether a modified UBI that is less ambitious but financially feasible can be explored.**

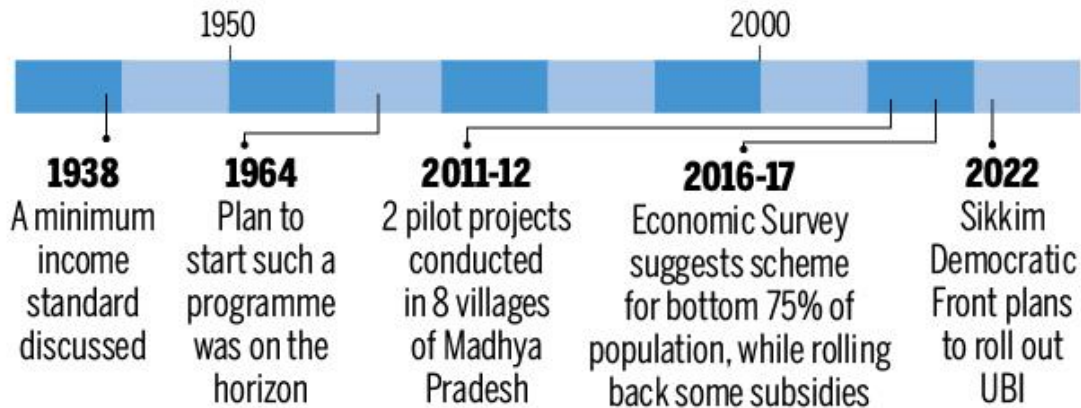
State and Central Government Schemes:

- **Rythu Bandhu (Telangana)** and **KALIA (Odisha)** are state-level schemes providing unconditional payments to farmers. The national-level **PM-KISAN** scheme offers ₹6,000 per year to farmers, aiming to cover 10 crore farming households.
- **Challenges:** These programs face issues like **inclusion and exclusion errors** due to logistical challenges (Aadhaar verification, bank rejections).

Financial Feasibility of UBI in India:

- Large-scale UBI proposals range from 3.5% to 11% of GDP, requiring significant budgetary resources or cutting other anti-poverty programs.
- A more feasible approach is a **limited UBI**, pegged at **1% of GDP**, providing around ₹144 per month to every citizen (or ₹500 per household). This amount, while small, can be scaled up gradually, building on programs like **PM-KISAN**.

INDIA'S TRYST WITH INCOME SUPPORT



UBI ACROSS THE WORLD

US | Alaska Permanent Fund distributes part of the state's oil revenues to all residents on per-capita basis

Stockton, California | Secured funding from private non-profits to launch a small project with about 100 participants receiving \$500 a month for about 18 months

Finland | Scheme started in 2017 to pay 2,000 jobless people assistance of €560 a month stopped last year

Kenya | Largest experiment underway with some villages receiving \$0.50-1 a day

Brazil | Has run experiments

Canada | Ontario plans to test a basic income scheme

France | A senate committee has recommended an experiment

UK & Germany | Studies have been conducted

Scotland | Committed funds to conduct an experiment

Barcelona, British Columbia | Plans to start experiments

Switzerland | Plan to give everyone right to basic income defeated in 2016



Concerns and challenges associated with implementing a Universal Basic

Income (UBI)

- One of the primary concerns about UBI is the significant financial burden it places on the government.
- If UBI is implemented by replacing current welfare schemes, **there's a risk that targeted programs that are crucial for vulnerable populations** (such as food distribution via the Public Distribution System or MGNREGS) might be eliminated, leaving certain groups worse off.
- Providing a universal cash transfer **could potentially lead to inflation**, particularly in rural or underdeveloped areas where an increase in demand for basic goods might outpace supply.
- There is concern that UBI could **create a disincentive to work**, as individuals receiving guaranteed income may opt out of the labor force.
- **Biometric failures and network issues have already plagued existing welfare schemes in India**, such as PM-KISAN, leading to exclusion errors.
- While UBI may provide short-term financial relief, it **does not address the structural issues related to unemployment, education, healthcare, or inequality in the long run.**

Road ahead

- Implementing a full-scale UBI may not be feasible in India due to financial constraints. Therefore, a **modified UBI, starting with specific vulnerable groups (such as women, the elderly, the disabled, and landless laborers), could be an effective compromise.**
- **UBI can be integrated into existing frameworks like MGNREGS (Mahatma Gandhi National Rural Employment Guarantee Scheme)**

and Public Distribution System (PDS) to ensure comprehensive coverage.

- The JAM (Jan-Dhan, Aadhaar, Mobile) infrastructure is crucial for the smooth rollout of UBI. The government must continue improving banking access in remote areas, addressing issues with Aadhaar-based verification, and ensuring stable internet and mobile connectivity.
- UBI is not a solution to structural unemployment; hence, it must be paired with policies that promote job creation and boost economic growth.

UBI has merit as a tool to address poverty and inequality, but its large-scale implementation faces budgetary challenges. A **modified UBI**, gradually rolled out and combined with existing programs, offers a viable strategy for India, ensuring a **balanced and comprehensive social safety net** for all citizens.

34. Haber-Bosch Process and Food Supply

- The **Haber-Bosch process**, developed in the early 20th century, revolutionized global agriculture and food production by enabling the industrial synthesis of **ammonia (NH₃)** from atmospheric nitrogen (N₂) and hydrogen (H₂).
- This innovation, which allowed for the mass production of nitrogen-based fertilizers, has had a profound impact on feeding the world's growing population and supporting modern agriculture.

Understanding Nitrogen and Its Role in Nature

- **Nitrogen (N₂)** is a critical element for life, as it is a key component of

proteins, enzymes, and amino acids in both plants and animals.

- Although nitrogen is abundant in the atmosphere, making up about **78% of the air**, it is mostly present in an inert form (N₂) that cannot be directly utilized by plants.
- Plants require **reactive nitrogen**, such as **ammonia (NH₃)** or **nitrates (NO₃-)**, to grow and thrive.
- In nature, reactive nitrogen is produced through two primary methods:
 - **Lightning**: The immense energy from lightning breaks nitrogen molecules, allowing them to combine with oxygen to form nitrogen oxides, which later become **nitrates** in the soil.
 - **Nitrogen-Fixing Bacteria**: Certain bacteria, such as **Rhizobia**, form symbiotic relationships with plants like **legumes**, helping convert atmospheric nitrogen into forms usable by plants.
- However, these natural processes provide limited amounts of nitrogen, insufficient to support the world's growing demand for food.

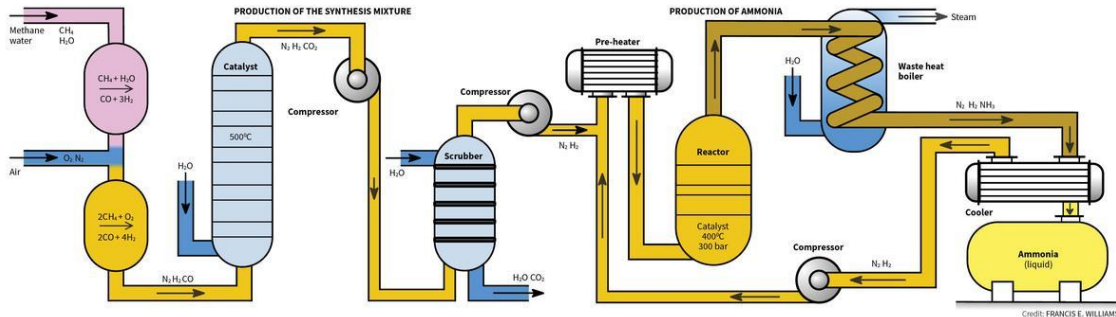
The Haber-Bosch Process

- The **Haber-Bosch process**, developed by **Fritz Haber** and later industrialized by **Carl Bosch**, provided a solution to this problem by creating an artificial method for nitrogen fixation.
- The process involves combining nitrogen (N₂) and hydrogen (H₂) under high pressure (around 200 atmospheres) and temperatures of about 400-500°C, in the presence of a catalyst, to produce **ammonia**.
- **Ammonia** produced through this process is a critical ingredient in synthetic fertilizers, which are used to enrich soil and promote plant growth.
- The availability of ammonia-based fertilizers has enabled the world's agricultural productivity to grow exponentially, contributing to a

sevenfold increase in the global food supply during the 20th century.

How ammonia is made on an industrial scale

Ammonia is made of nitrogen and hydrogen. Under extreme heat, the molecules separate and form a compound, but it is short-lived because of the heat. The German chemist Fritz Haber heated the N₂-H₂ combination to various temperatures in a platinum cylinder and applied pressure to create ammonia. This graphic demonstrates the Haber-Bosch process



Environmental Impact & Concerns

- While the Haber-Bosch process has been instrumental in solving global food shortages, it also presents significant environmental challenges.
- **Excessive Nitrogen Use:** The widespread use of nitrogen fertilizers has led to the accumulation of reactive nitrogen in the environment, which can cause **soil degradation**, **water pollution**, and **air contamination**. Excess nitrogen seeps into waterways through runoff, leading to problems like **eutrophication**—the excessive growth of algae that depletes oxygen in water bodies, killing aquatic life.
- **Nitrogen Pollution:** Reactive nitrogen released into the atmosphere can combine with water vapor, leading to **acid rain**, which damages ecosystems and erodes infrastructure.
- **Greenhouse Gas Emissions:** The production of ammonia through the Haber-Bosch process requires substantial amounts of energy, primarily from fossil fuels, contributing to the emission of **greenhouse gases** like carbon dioxide (CO₂).

Global Food Security and the Haber-Bosch Process

- Despite its environmental drawbacks, the Haber-Bosch process remains essential for **global food security**.
- It is estimated that without synthetic fertilizers, about one-third of the world's population—nearly **2 billion people**—would face food shortages.
- The availability of nitrogen fertilizers has enabled countries to increase crop yields and sustain larger populations.
- For instance, in the early 20th century, India had an average life expectancy of only 19 years.
- By enabling the mass production of fertilizers, the Haber-Bosch process helped boost food production, contributing to improved health outcomes and increasing life expectancy to over **67 years** today.

Technological Innovation and the Future

- While the Haber-Bosch process has been a crucial technological breakthrough, it is clear that **technological solutions alone cannot solve the challenges of feeding a growing population**.
- Experts suggest that along with continued innovation in fertilizer production, addressing these challenges requires **political action**, **sustainable farming practices**, and **social mobilization** to minimize environmental damage and ensure equitable food distribution.
- The lessons from the Haber-Bosch process underscore the importance of balancing **technological progress** with **environmental stewardship** and **social responsibility**.

Conclusion

- The **Haber-Bosch process** revolutionized agriculture by providing an artificial method to produce nitrogen fertilizers, enabling the world to

meet its growing demand for food.

- However, its environmental impacts cannot be ignored, as excess nitrogen contributes to pollution, soil degradation, and climate change.
- Moving forward, the challenge lies in balancing the benefits of this technology with sustainable practices and innovation to ensure a healthier and more equitable future for all.

35. Volcanism

- **Volcanism** or volcanic activity is the phenomenon where solids, liquids, gases, and their **mixtures erupt to the surface** of a **solid-surface astronomical body**, for example, planets like Earth, moons, asteroids and comets.
- It is caused by the presence of a **natural heat source** inside the body. This **internal heat partially melts solid material** in the body or turns material into gas. The mobilized material rises through the body's interior resulting in formation of various **intrusive and extrusive landforms**.

Volcano

- A volcano is **an opening in the earth's crust** through which gases, molten rock materials (lava), ash, steam etc. are emitted outward in the course of an eruption. Such vents or openings occur in those parts of the earth's crust where the rock strata are relatively weak.
- Volcanic activity is an example of **endogenic process**. Depending upon the explosive nature of the volcano, different **extrusive**

landforms can be formed such as a **plateau** (if the volcano is not explosive) or a **mountain** (if the volcano is explosive in nature) or **intrusive landforms** like baccolith, laccoliths etc.

- **Magma vs Lava:**

- **Magma** is the term used to denote the **molten rocks** and related materials seen **inside the earth**. A weaker zone of the mantle called **asthenosphere**, usually is the source of **magma**.
- **Lava** is nothing but the **magma above the earth surface**. Once this magma came out to the earth surface through the vent of a volcano, it is called as the **Lava**.

Tools and Methods to Predict Volcanic Eruptions:

- **Seismic Data:**

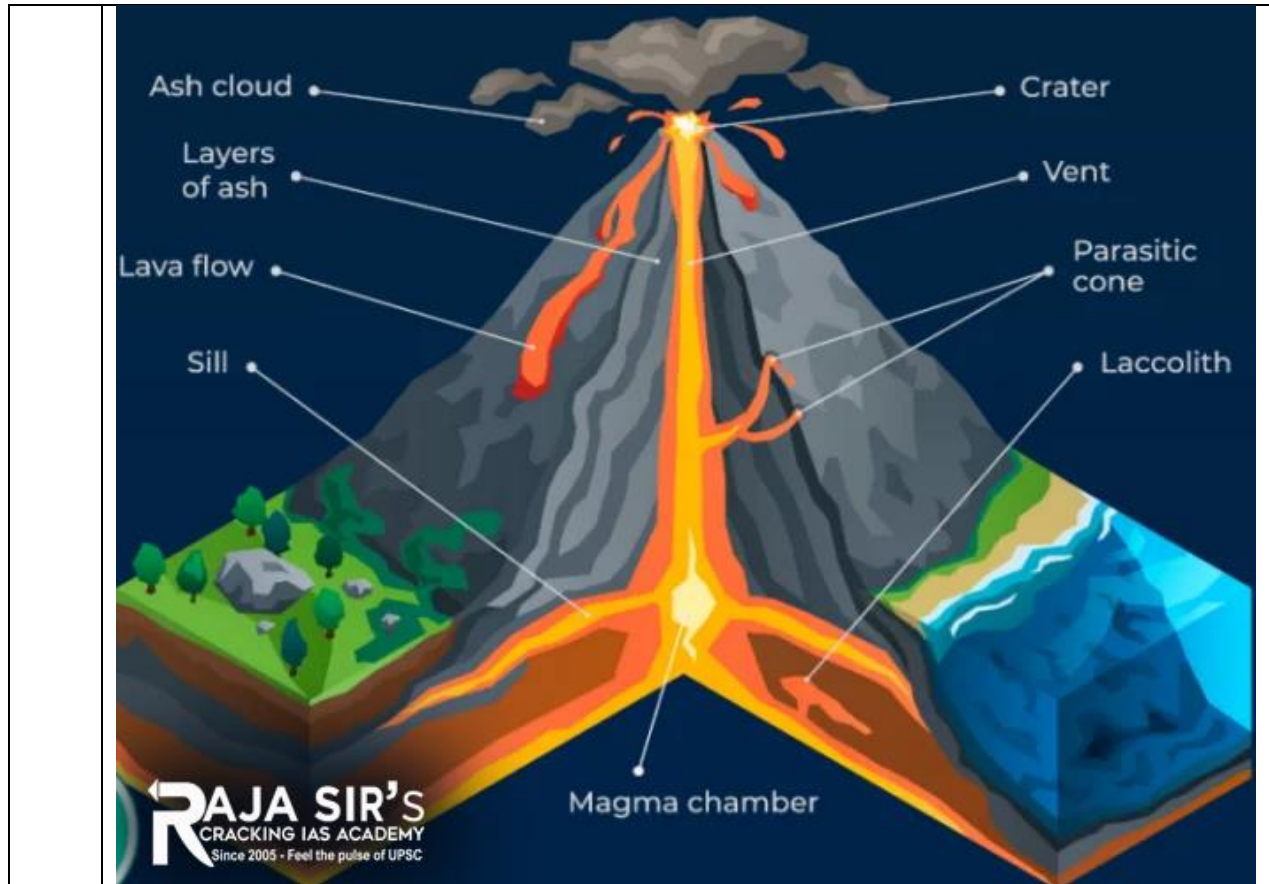
- Monitoring earthquakes and tremors as potential precursors to volcanic eruptions.

- **Ground Deformation:**

- Observing changes in the ground, indicating magma movement.

- **Gas Emissions and Gravity Changes:**

- Analyzing volcanic gas emissions, gravity, and magnetic field alterations.



Different Types of Volcanoes

- **Based on the frequency of Eruption:**

- **Active volcanoes:**

- They erupt frequently and are mostly located in the **Pacific Ring of Fire**, which includes New Zealand, Southeast Asia, Japan and the western coast of the Americas.
- About 90% of all earthquakes worldwide strike within this region.
- Volcanic activity is linked to the movement and collision of **tectonic plates**. **Examples** include Kilauea in Hawaii and

Santa Maria in Guatemala.

○ **Dormant Volcano:**

- These are not extinct but have not erupted in recent history. The dormant volcanoes may erupt in future. Example: **Mount Kilimanjaro**, located in Tanzania, also the highest mountain in Africa, is known to be a dormant Volcano.

○ **Extinct or inactive volcanoes:**

- These have not worked in the distant geological past. Example: Dhinodhar Hill, Gujarat.

• **Based on the Nature of Eruption:**

○ **Shield Volcanoes:**

- These are the **largest and gentlest volcanoes** on Earth, formed primarily from basalt lava.
- They erupt with **low explosivity** unless water interacts with the vent. The lava flows in a fountain-like manner, building a cinder cone around the vent before spreading out.
- **Hawaiian volcanoes** are classic examples of shield volcanoes.

○ **Composite Volcanoes:**

- These volcanoes erupt cooler, **thicker lava compared to shield volcanoes.**
- They are built up over time through numerous explosive eruptions, layering ash, and pyroclastic material with lava flows.
- **Mayon Volcano (Philippines), Mount Fuji (Japan), and Mount Rainier (Washington)** are some prominent

composite volcanoes. The Pacific Ring of Fire is home to many composite volcanoes.

○ **Calderas:**

- These are the **most explosive volcanoes**, prone to **collapsing inward** during eruptions rather than building upwards. The resulting depressions are called calderas.

○ **Flood Basalt Provinces:**

- These volcanoes erupt **highly fluid lava** that travels long distances, covering vast areas with thick basalt flows.

○ **Mid-Ocean Ridge Volcanoes:**

- They are found underwater along the **mid-ocean ridge** system that stretches for over 65,000 kilometers across the ocean basins, these volcanoes erupt frequently along the central ridge.

Distribution of volcanoes

- Most of the volcanoes in the world are found in three well-defined belts:
 - The Circum-Pacific Belt (**Pacific Ring of Fire**).
 - The Mid-World Mountain Belt.
 - The African Rift Valley Belt.

Types of Volcanic Landforms

• **Intrusive Volcanic Landforms:**

- Sometimes, **magma cools and solidifies beneath the Earth's crust**, creating different landforms. These are called intrusive volcanic features.
 - **Batholiths:** These are massive, irregularly shaped masses of **igneous rock** that form when large bodies of magma

cool deep underground.

- **Sills and Dikes:** Sills are **flat, sheet-like intrusions of magma** that fill the cracks of Earth's crust horizontally, pushing the rock layers above them further apart. **Dikes**, on the other hand, are vertical intrusions that cut through the rock layers like walls.
- **Laccoliths:** These are **dome-shaped intrusions** that form when magma pushes up on layers of rock, doming them like a blister.
- **Phacoliths:** These are **lens-shaped intrusions** that squeeze into the folds of existing **rock layers**.
- **Monadnocks (Inselbergs):** These are **isolated hills or mountains** that stand out from the surrounding landscape. They form when **resistant rock** (often intruded by magma) **remains after erosion** has worn away softer rock around it.
- **Extrusive Volcanic Landforms:**
 - These are created when magma erupts and cools above the Earth's surface.
 - **Fissure Vents:** These are **long cracks in the Earth's crust** that allow lava to flow out in a continuous stream, with minimal explosions.
 - **Conical Vents:** These are the classic volcano shapes with a central vent. Violent eruptions of ash and lava build up around the vent, creating the cone-like form..
 - **Mid-Ocean Ridges:** These **underwater mountain ranges** erupt frequently due to the constant seafloor spreading. The lava here is **less viscous and flows easily**, creating vast plains of basalt rock.

- **Shield Volcanoes:** These are **broad, gently sloping volcanoes** formed by fluid basaltic lava flows. They erupt less explosively than other types.
- **Lava Plateaus:** When large volumes of lava erupt and spread out over vast areas, they solidify to form **extensive, flat plateaus**. **Colombia Plateau in the United States** and the **Deccan Plateau in India** are examples of lava plateaus.
- **Calderas:** These are large, cauldron-shaped depressions that form when the roof of a magma chamber collapses after a powerful eruption.
- **Lava Domes:** As the name suggests, these are dome-shaped protrusions formed by the slow extrusion of viscous lava that cools and hardens around the vent.

Impacts of Volcanic Eruptions

- **Destructive Effects of Volcanism:**
 - **Earthquakes:** Magma movement beneath a volcano can trigger **earthquakes**. These **tremors** can cause **significant ground cracks, leading to widespread destruction** and loss of life, particularly in densely populated areas near volcanoes.
 - **Climate Impacts:** Volcanic eruptions **release a massive amount of gas** into the atmosphere. These gases can **disrupt weather patterns** and lead to unpredictable climate changes.
 - **Pyroclastic Flows:** Eruptions often generate scorching hot clouds of gas and debris known as pyroclastic flows. These flows move at **incredibly high speeds and temperatures**, incinerating anything in their path.

LAVA AND VOLCANIC GASES

Volcanic eruptions can be unpredictable and destructive. Here, we investigate the types of lava produced in volcanoes and the gases ejected during eruptions.

TYPES OF LAVA

Lava is made up primarily of silicate minerals. Two main classifications of lava are mafic (or basaltic) lavas and felsic (or silicic) lavas. Some lavas are in between these two.

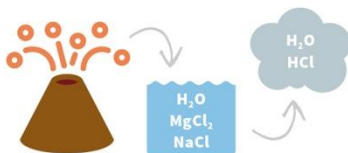
	MAFIC	FELSIC
SiO₂ CONTENT	LOW (~55% by mass)	HIGH (~70% by mass)

	HOTTER	COOLER
ERUPTION TEMP. (°C)	(~1,100-1,200° C)	(~700-800° C)

	LOW	HIGH
VISCOSITY	(flows quickly)	(flows slowly)

	LOWER	HIGHER
GAS CONTENT	(0.5-2.0%)	(4.0-6.0%)

If lava meets the sea, its high temperature creates clouds of steam and hydrochloric acid known as "laze." The acid forms from the reaction of steam with chloride salts.



LAVA & PYROCLASTIC FLOWS

There are two main types of mafic lava flow common to Hawaiian volcanoes: pahoehoe and aa.

PAHOEHOE



Smooth surface

Lower viscosity

Slow moving

AA



Rough surface

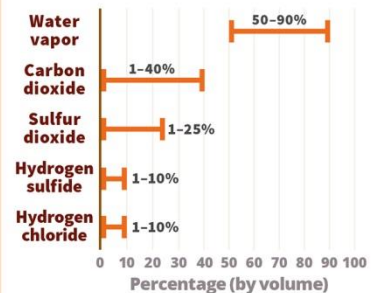
Higher viscosity

Fast moving

Highly explosive eruptions, like that of the Fuego volcano in Guatemala, yield pyroclastic flows. These are clouds of hot lava blocks, ash, pumice, and gas, with deadly high temperatures.

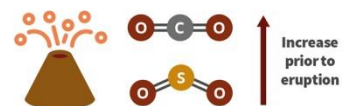
VOLCANIC EMISSIONS

The composition of gases given off by volcanoes can vary depending on magma type and volcanic activity.



Source: "Advances in Global Change Research" 2004, DOI: 10.1007/978-1-4020-2167-1

Other gases found in lower amounts include carbon disulfide, carbonyl sulfide, and hydrogen fluoride.



Monitoring CO₂ and SO₂ emissions from volcanoes helps scientists predict if eruptions are imminent.

- **Volcanic Ash:** Volcanic ash, composed of **tiny rock and mineral fragments**, can pose a serious health threat when inhaled. It **can irritate the lungs, cause respiratory problems**, and even be fatal in high concentrations.
- **Constructive Effects of Volcanism:**
 - **Fertile Soil:** Volcanic ash, **rich in minerals** like silica, oxygen, magnesium, potassium, and iron, gets deposited near eruption

sites. This ash breaks down over time, creating highly **fertile soil ideal for agriculture**.

- **Land Formation:** Repeated eruptions in the same spot can **build entirely new landforms**, like the Hawaiian Islands.
- **Contact Metamorphism:** When hot magma comes in contact with existing rock formations, it alters their structure through a process called contact metamorphism. This can **create valuable new rock types** like marble and hornfels.
- **Volcanic Lakes:** Large craters formed by eruptions can fill with water over time, creating crater lakes. These **scenic lakes** can become important sources of **freshwater and support unique ecosystems**.
- **Volcanic Geysers:** It's formation is a consequence of **geothermal heating**. This process occurs when **groundwater interacts with either the high temperatures** of igneous rock located at relatively shallow depths within the Earth's crust, or with the even more extreme temperatures associated with **molten magma** situated deeper within the Earth.

Volcanism is a powerful and multifaceted geological phenomenon. As we continue to advance our understanding of volcanic processes, we should strive to not only mitigate the associated hazards but also appreciate the constructive contributions of volcanoes to the ever-evolving geological landscape of our planet. Its effects range from devastating earthquakes and climate disruptions to the creation of fertile soils and unique geological features. Understanding its complexities is essential for both managing its hazards and harnessing its benefits sustainably.

36. Piedmont Plains

A piedmont plain is a low-lying area of land that lies at the foot of a mountain range. It is typically characterized by gentle slopes, fertile soil, and abundant water resources, and is often used for agriculture and other forms of land use. The term “piedmont” comes from the Italian word “piede,” meaning “foot,” and “mont,” meaning “mountain.” In geography, a piedmont plain refers to a region at the base of a mountain range that has been shaped by the erosion and sedimentation of nearby mountain streams and rivers.

Examples of Piedmont Plains

1. **Deccan Plateau in Southern India:** This region covers several states, including Maharashtra, Karnataka, and Andhra Pradesh, and is known for its rich cultural heritage and diverse communities.
2. **Punjab Plains in Northern India:** Located in the state of Punjab and extending into parts of Haryana and Himachal Pradesh, this region is known for its rich history, cultural heritage, and agricultural productivity.
3. **Indo-Gangetic Plains:** This region extends across several states in northern and eastern India, including Uttar Pradesh, Bihar, and West Bengal. The Indo-Gangetic Plains are one of the most fertile regions in India and are known for their agriculture, particularly in the cultivation of rice and wheat.
4. **Assam Valley:** This region is located in the northeastern state of Assam and is known for its fertile soil, tea plantations, and diverse wildlife.
5. **Kathiawar Peninsula in Western India:** This region is located in the state of Gujarat and is known for its rich cultural heritage, including several historic temples and palaces, as well as its agriculture and trade.

Piedmont Glacier

- The term “Piedmont Glacier” refers to a type of glacier that is located at the foot of a mountain range, typically along the edges of a large alluvial plain or piedmont. This type of glacier is formed by the accumulation and compaction of snow and ice along the base of a mountain range and is fed by the high snowfall in the mountains.
- Piedmont glaciers in India are most commonly found in the Himalayan mountain range, where they are an important source of water for the region’s rivers, lakes, and wetlands. These glaciers are also an important source of hydroelectric power, as they feed the large rivers that flow from the mountains and provide a reliable source of water for irrigation and other purposes.
- However, Piedmont glaciers in India are facing increasing threats due to climate change and other factors, which are causing them to shrink in size and in some cases disappear altogether. This has significant implications for the water security and livelihoods of the communities that rely on them and highlights the importance of protecting and preserving these important resources for future generations.

Piedmont Lakes

- “Piedmont Lakes” refers to large, shallow lakes that have formed in the low-lying areas surrounding the Himalayan mountain range. These lakes are typically located in the Piedmont Zone, which is an area at the foot of the Himalayas characterized by its gently rolling hills, fertile soil, and abundant water resources.
- Piedmont Lakes are an important source of water for irrigation and hydropower and are also home to a diverse array of plant and animal life. Some examples of Piedmont Lakes in India include the **Dal Lake in**

Jammu and Kashmir, the **Wular Lake** in the Kashmir Valley, and the **Tso Moriri Lake** in Ladakh.

- These lakes are popular tourist destinations and are known for their scenic beauty and recreational opportunities. They are also of cultural and spiritual significance to local communities, who have lived in the area for centuries and have developed close ties with the lakes and their ecosystems.

Piedmont Zone

- In the context of India, the term “Piedmont Zone” refers to a region located at the foot of the Himalayan mountain range. The Piedmont Zone is characterized by its gently rolling hills, fertile soil, and abundant water resources. It is an important agricultural area and is home to several large rivers and lakes, including the Ganges and Indus rivers.
- This region is known for its diverse geography, including forests, hills, and plains, and is also rich in natural resources such as minerals, forests, and wildlife. The Piedmont Zone supports a large population, including farmers, herders, and fishermen, who are heavily dependent on its natural resources for their livelihoods.
- In addition to its agricultural importance, the Piedmont Zone is also an important transportation corridor, connecting the Himalayas with the rest of India. Major roads, railways, and airports pass through the region, making it an important hub for trade and commerce.

Features of Piedmont Plains

The Piedmont plain is a geographic region characterized by the following features:

1. **Rolling Hills:** The Piedmont plain is characterized by gently rolling hills,

with an elevation that is higher than the coastal plain but lower than the surrounding mountains.

2. **Low Mountains:** The Piedmont plain is bounded by low mountains, which form the eastern edge of the Appalachian Mountains.
3. **Fertile Soils:** The Piedmont plain has fertile soils, which are a result of the weathering of the underlying rock formations and the deposition of sediment from the mountains.
4. **Mild Climate:** The Piedmont plain has a mild climate, with warm summers and cool winters. This makes it an ideal region for agriculture and forestry.
5. **Diverse Plant and Animal Life:** The Piedmont plain is home to a diverse range of plant and animal species, including hardwood forests, grasslands, and wetlands.
6. **Agriculture and Forestry:** The Piedmont plain is an important agricultural region, with crops such as cotton, tobacco, and corn grown in the area. The region is also known for its forestry industry, with a variety of tree species grown for lumber and paper products.
7. **Urban Development:** The Piedmont plain is also an important area for urban development, with many cities and suburbs located in the region.

Significance of Piedmont Plains

The Piedmont plain is significant for several reasons:

1. **Agricultural Production:** The fertile soils and mild climate of the Piedmont plain make it an ideal region for agriculture. It is known for producing a variety of crops, including cotton, tobacco, corn, and soybeans.
2. **Forestry:** The Piedmont plain is also an important region for forestry, with a variety of tree species grown for lumber and paper products.

	<ol style="list-style-type: none">3. Urbanization: The Piedmont plain is an important area for urban development, with many cities and suburbs located in the region. This makes it a significant center of population and commerce.4. Natural Resources: The Piedmont plain is a rich source of natural resources, including minerals such as iron, gold, and silver. It is also an important source of fresh water, with numerous lakes and rivers located in the region.5. Biodiversity: The Piedmont plain is home to a diverse range of plant and animal species, including hardwood forests, grasslands, and wetlands. This makes it an important area for the conservation and preservation of biodiversity.6. Cultural Significance: The Piedmont plain has a rich cultural heritage, with a long history of settlement and development. It is also home to numerous historic sites, including battlefields, homes of famous Americans, and cultural landmarks.
<p>37.</p>	<p>Great Indian Bustards</p> <ul style="list-style-type: none">• The Great Indian Bustard (<i>Ardeotis nigriceps</i>), the State bird of Rajasthan, is considered India's most critically endangered bird.• It is considered the flagship grassland species, representing the health of the grassland ecology.• Its population is confined mostly to Rajasthan and Gujarat. Small populations occur in Maharashtra, Karnataka and Andhra Pradesh.

Vulnerability:

- The bird is under constant threats due to collision/electrocution with power transmission lines, hunting (still prevalent in Pakistan), habitat loss and alteration as a result of widespread agricultural expansion, etc.
- GIBs are a **slow-reproducing species**. They lay a few eggs and have almost a **year-long parental care of chicks**. The GIB achieves maturity in around 3-4 years.

• **Protection Status:**

- **IUCN Red List:** Critically Endangered
- **Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES):** Appendix 1
- **Convention on Migratory Species (CMS):** Appendix I
- **Wildlife (Protection) Act, 1972:** Schedule I

Conserving the GIB-

• **Species Recovery Programme:**

- It is kept under the species recovery programme under the **Integrated Development of Wildlife Habitats** of the Ministry of Environment, Forests and Climate Change (MoEFCC).

• **Firefly Bird Diverters:**

- **Firefly bird diverters** are flaps installed on power lines. They work as **reflectors for bird species like the GIB**.
- Birds can spot them from a distance of about 50 meters and change their path of flight to avoid collision with power lines.

(Ardeotis nigriceps)

Weight: 15-18 kg
(Heaviest flying bird in India)

Height: 100 cms or 1 m

Wingspan: on 210-250 cm

Lifespan: 15-16 Years

Breeding:
Monsoon Season (MAR-SEP)

Female **Male**

Male: During the breeding season, the male Great Indian bustard showcases a **deep sandy buff hue with a black breast band**, complemented by a **black crested head** that can be inflated during displays, along with a **prominent gular pouch used for producing resonant calls** which can be heard up to a distance of 500 metres.

Female: In the female which is **smaller than the male**, the head and neck are not pure white and the **breast band is either rudimentary, broken, or absent**. It **lay one egg** and incubate it for 25-30 days.

GIBs have **Poor Frontal Vision**

Voice: A bark when alarmed

Food: Grass seeds, insects like Grasshoppers and Beetles, and sometimes even **small rodents and reptiles**.

They generally **favour flat open landscapes** with minimal visual obstruction and disturbance, therefore **adapt well in grasslands**.

Black cap contrasting with the pale head and neck.

Spends most of the time on Ground but is a **excellent Flyer**.

The body is brownish with a black patch spotted in white.

Population: **100-250**

Schedule-I of Wildlife Protection Act, 1972

IUCN Status
GREAT INDIAN BUSTARD

The GIB is a large bird with a horizontal body and **long bare legs**, giving it an **ostrich-like appearance**.


Illustration of Great Indian Bustard.
By: Thomas Hardwicke

Habitat


The great Indian bustard **historically inhabited Western India** across 11 states and parts of Pakistan.

Mostly found in **Rajasthan** with small fragmented populations in **Gujarat, Madhya Pradesh, Andhra Pradesh, Maharashtra and Karnataka**.


Threats




Habitat Destruction and Fragmentation, Conversion of Grassland



Power Lines and other development disturbance (due to Poor Frontal Vision)



Overgrazing



Hunting (Still prevalent in Pakistan)

- **Artificial Hatching:**

- The conservation breeding programme started in 2019 by collecting eggs from the wild and **artificially hatching them**. The first chick hatched on 21st June 2019, and was **named 'Uno'**. Eight more chicks were hatched that year and raised and monitored.
- A total of **29 GIBs have been housed** in the two breeding centres in Rajasthan.

- **National Bustard Recovery Plans:**

- It is currently being implemented by conservation agencies.

- **Conservation Breeding Facility:**

- MoEF&CC, the Rajasthan government and the **Wildlife Institute of India (WII)** have also established a conservation breeding facility in **Desert National Park at Jaisalmer in June 2019**.

- **Project Great Indian Bustard:**

- It has been **launched by the Rajasthan government** to construct breeding enclosures for the species and develop infrastructure to reduce human pressure on its habitats.

Desert National Park:

- It is situated on the western border of India **within the Jaisalmer & Barmer Districts of Rajasthan**.
- Great Indian Bustards, Rajasthan State animal (Chinkara), State tree (khejri) and State flower (Rohida) are found naturally at this park.
- It was declared a **UNESCO World Heritage Site in 1980** and National Park in 1992.

Kutch Bustard Sanctuary:

	<ul style="list-style-type: none">• The Kutch Bustard Sanctuary is located near Nalia in the Kutch district of Gujarat, India.• It is the smallest sanctuary in the country, spread over just two square kilometres. The sanctuary, also known as the Lala-Parijan sanctuary, was declared in July 1992 primarily to safeguard the endangered Great Indian bustard.• The sanctuary is home to three species of Bustards: the Great Indian bustard, lesser floricans, and the Macqueen bustard.
38.	<p>Tardigrades</p> <p>Researchers in China identified a new tardigrade species, Hypsibius henanensis, from moss samples collected in Funiu Mountain, Henan province with the ability to withstand Radiation.</p> <p>Key highlights of the study</p> <ul style="list-style-type: none">• Genome Sequencing: Scientists sequenced the genome of <i>Hypsibius henanensis</i>, revealing 14,701 genes, with around 30% unique to tardigrades.• Radiation Exposure: The team subjected this tardigrade species to high doses of gamma radiation, far exceeding human survivability limits, to study its response. <p>Tardigrades' radiation resistance reasons</p> <ul style="list-style-type: none">• Genetic Adaptation: The researchers have identified the genetic mechanisms that help a newly discovered species of tardigrades

(*Hypsibius henanensis*) withstand high levels of radiation.

- **DNA Repair Genes:** They identified 2,801 genes involved in DNA repair processes. Key elements include:
- **TRID1 Protein:** Aids in rapid repair of DNA double-strand breaks resulting from radiation.
- **Mitochondrial Proteins:** Two proteins, generated from a radiation-activated gene, are crucial for mitochondrial synthesis and DNA repair.
- **Betalain Pigments:** These **antioxidant pigments** help neutralise reactive chemicals caused by radiation exposure, protecting cellular structures.

Tardigrades (*Hypsibius henanensis*)

- **Tardigrades are resilient Creatures** also known as water bears or moss piglets.
- They are microscopic, eight-legged animals, typically about 1 mm (0.04 inch) or smaller.
- Classified as **free-living invertebrates** in the **phylum Tardigrada**.
- Their tiny, boneless bodies are supported by a hydrostatic skeleton filled with **hemolymph** (a fluid-filled compartment).
- Equipped with a specialised mouthpart called a **buccal pharyngeal apparatus**, enabling them to suck nutrients from plants and other microorganisms.
- Known as **extremophiles**, capable of surviving extreme environmental conditions.

TARDIGRADES

WATER BEARS
MOSS PIGLETS

Mouth
8 Legs
Claws
Algae

WATER DROPLET

Most tardigrades are phytophagous (plant eaters) or bacteriophagous (bacteria eaters)

Water-dwelling Eight-legged Segmented Micro-animals

SMALLEST BELOW 0.1 mm BIGGEST 1.5 mm

- Tardigrades are classified as extremophiles
- Tardigrades have been around for 530 million years
- Tardigrades can live in boiling water and solid ice
- Tardigrades can survive up to 10 days in space
- Tardigrades can repair their DNA after radiation damage

- Require a thin layer of water around their bodies to prevent dehydration, making them effectively aquatic.
- Found globally across terrestrial, marine, and freshwater environments from the Arctic to the Antarctic, including high altitudes and deep-sea regions.

	<p>Potential Application of Tardigrades</p> <ul style="list-style-type: none"> • Space Exploration: Protecting astronauts from cosmic radiation. • Nuclear Clean-up: Enhancing radiation tolerance for workers in radioactive environments. • Cancer Treatment: Potentially improving radiation therapy for cancer patients by enhancing human cell stress resistance. • Testing on Human Cells: Tardigrade-derived betalain pigments improved the survival rate of human cells exposed to radiation, suggesting promising applications for human health.
<p>39.</p>	<p>Metaverse and AI - Future perfect or imperfect</p> <p>The metaverse is a virtual world where people interact using avatars, usually in 3D. It's a digital universe that combines physical and digital reality, and is expected to be the next evolution of social connection.</p> <p>Metaverse can</p> <ul style="list-style-type: none"> • Socialize: Meet friends and family, or build virtual communities • Work: Collaborate with others in virtual offices • Learn: Participate in activities and attend events • Play: Dive into gaming worlds, sports, and multiplayer contests • Shop: Interact with content created by others • Experience films: Watch films in a new way, or catch live events from anywhere in the world <p>As the Metaverse continues to gain popularity, it is important to consider the challenges posed by the rise of this technology and AI. The</p>

following are some of the major challenges posed by them are as follows:

- **Societal and Economic impacts:**
 - AI and the Metaverse have the potential to disrupt traditional industries and change the way people work and interact, which could lead to job loss and income inequality.
- **Ethical concerns:**
 - AI systems and the Metaverse raise questions about bias, transparency, and accountability. There is also a risk that these technologies could be used to perpetuate or amplify societal problems such as discrimination and inequality.
- **Dependence on technology:**
 - As people increasingly rely on AI and the Metaverse for daily activities, there is a risk of people becoming too dependent on technology, which could lead to a loss of important life skills.
- **Governance:**
 - The Metaverse and AI are global and borderless, which makes it difficult to govern and regulate them. This may lead to lack of oversight and accountability.
- **Psychological and emotional effects:**
 - Spending excessive time in the Metaverse and interacting with AI systems may have negative effects on people's mental and emotional well-being.
- **Technical challenges:**
 - Building and maintaining the Metaverse and AI systems requires significant technical expertise and resources, which can be a challenge for both developers and users.
- **Impact on physical health and well-being:**
 - As the Metaverse becomes more immersive, there is a risk that

users will spend increasing amounts of time in virtual worlds, potentially at the expense of their physical health and well-being.

- **Data privacy and security:**

- With the increasing amount of personal data being shared within the Metaverse, there is a risk of data breaches and other security threats.

Further, to curb the challenges posed by metaverse and AI we need to implement the following measures like:

- **Reduce Digital Divide:** Governance mechanisms for virtual worlds would need to be supported with strengthening and scaling efforts to promote digital literacy, safety and wellbeing so that participants can engage meaningfully in online communities while consciously navigating harmful content and behaviors.
- **Policy Backing:** It is the right time for the government to create the right policy background for its operation and leverage the metaverse for public services.
 - The government needs to focus on information accessibility, information utilization and information receptiveness.
- **Promote Safe and Secure Metaverse Ecosystem:** There is a strong need to develop and regulate effective ecosystems to address the distinct elements of safety, privacy, and security within the DNA of this technology.
 - Building a citizen-friendly meta-governance infrastructure will need a collaboration by experts from various disciplines, including designers, business model experts and lawyers, to mitigate any potential legal hurdles. Private sector intervention may be required as well.

- **Meta Help Desk:** In e-governance, essential information is released to a targeted audience through ICT. Meta-help desks or meta-divisions in a particular ministry/ other government agency can help in providing the critical data required.
- **Transparent and Consent-based Applications:** Technology companies will need to be more responsible and transparent in their data processing and safety practices.
 - Fostering an informed consent-based model while collecting personal data and abiding by the principles of data minimization and purpose limitation will be critical to prevent unchecked data processing and collection for commercial gains.
- **Global Cooperation:** As the metaverse continues to develop, we are seeing a glimpse of a more digitally advanced borderless world that is full of promise.
 - While this new world continues to expand, we have to be aware of the set of challenges it brings with every new development and to look forward towards uniform regulations across the globe.

Future Challenges and Opportunities of Meta-AI

- **More Pervasive AI:**
 - **ChatGPT** has shown the world that **conversational artificial intelligence is an idea whose time has come.**
 - The ChatGPT can answer “follow-up questions”, and can also “admit its mistakes, challenge incorrect premises, and reject inappropriate requests.” but most such AI elements are now in standalone products, which is more play than work.
 - In 2023, this intelligence will be seen coming into **more products that we use every day** —for instance Gmail that will not just

auto-suggest but also write next mail to the boss.

- **Beyond Social Media:**

- Twitter and **Facebook are struggling to remain relevant amid** an increasingly younger and digital native audience. Their concepts of social engagement are very **different, often sans text and notice-board behaviors.**
- Meta, for instance, knows that it will have to **think beyond its present social media platforms** and wants to be the social link when users move to the Metaverse, if at all.
- But that might not be something that will shift soon. Till then, there seems to be a vacuum emerging in the social media space, **for now plugged by users sticking to short videos.** But that fad too shall pass and not all platforms are good in that segment.

- **More Regional, Darker Social Bubbles:**

- As the Internet spreads to new users, especially in countries like India, it is also becoming more localized and multilingual.
- Across the world, the English language internet seems to have plateaued, making platforms like **Google focus more on opportunities to serve smaller, regional languages.**
- This is a tech challenge in more ways than one, but also **presents an opportunity to test out new technologies that can convert the content of the internet for these new users** without much human intervention.

- **Future of Metaverse:**

- As hybrid workforces become the norm and with travel still not as easy as earlier, **extended reality (XR)** could become the answer to collaborate and communicate virtually.
 - XR is an emerging umbrella term **for all the immersive technologies, including augmented reality (AR), virtual**

reality (VR), and mixed reality (MR) plus those that are still to be created.

- All immersive technologies extend the reality we experience by either blending the virtual and “real” worlds or by creating a fully immersive experience.
- Since the headsets and other paraphernalia to facilitate these virtual interactions are still very expensive, it **might be up to companies to make these available to their employees for regular XR meetings**. The first experience of this could end up looking like an upgraded version of video conferencing, but with the ability to interact with objects in the virtual space.
- A few more commercial versions of the Metaverse is expected to be accessible to regular users during the year. However, the **challenge will be with the hardware that lets people access these virtual worlds without making people bankrupt in the real world**. The big disruptor could be an affordable device that logs users into the Metaverse easily — maybe it will just be a smartphone.

Ethical Concerns related to AI

- The legal and ethical issues **that confront society due to AI include privacy and surveillance**, bias or discrimination, and potentially the philosophical challenge is the role of human judgment. Concerns about newer digital technologies becoming a new source of inaccuracy and data breaches have arisen as a result of its use.
- The other side of this technological revolution is a growing apprehension on the **socio-political and economic implications of AI**, specifically, the concerns about co-existence of these emerging technologies and core

principles of modern democracies.

- Consequently, **AI ethics and the safe and responsible application of AI** are becoming front and centre of the technology revolution.
- **Constitutional morality was envisioned as the cornerstone for AI ethics' principles** in India, thus, propelling our constitutional rights and ethos to the paramount consideration for deploying AI in a responsible manner.

Principles of a Responsible AI

- **Safety and Reliability:** AI systems must ensure **reliability regarding their intended functions** and must have **built-in safeguards** to ensure the **safety of stakeholders**.
- **Equality:** AI systems must be built keeping in mind that **similar people in similar circumstances are treated equally**.
- **Inclusivity and Non-Discrimination:** AI systems must be developed to be inclusive of all stakeholders, and must not discriminate through bias between stakeholders on **religion, race, caste, sex, descent, place of birth or residence in matters of education, employment, access to public spaces etc.**
- **Privacy and Security:** AI systems must ensure that the **personal data of data subjects must be safe** and secure, such that **only authorised persons must access personal data** for specified and necessary purposes, within a framework of sufficient safeguards to ensure this process.
- **Principle of Transparency:** The design and training of AI systems is key for its functioning. The **system must be audited and be capable of external scrutiny** to ensure that the **deployment of the AI system is impartial**, accountable and free from bias or inaccuracies.

- **Principle of Accountability:** Since there are various actors in the process of developing, deploying and operationalizing an AI system, the **accountability structures for any effects, harms or damages** by the AI system **must be clearly set out in a publicly accessible and understandable manner.**
- **Protection and Reinforcement of Positive Human Values:** This principle focuses on the **possible deleterious effects of AI systems** through collection of personal data for profiling, the **use of AI systems in manners contrary to fundamental rights** guaranteed by the Constitution of India.

Road ahead

- **Reducing the Digital Divide:** In order for participants to engage meaningfully in online communities while consciously navigating harmful content and behaviors, governance mechanisms for virtual worlds would need to be supported with strengthening and scaling efforts to promote digital literacy, safety, and wellbeing.
- **Policy Support:** The government should now develop the best possible policy framework to support its operations and use the metaverse to provide public services.
- **Information accessibility,** information use, and information receptivity must be the government's main concerns.
- **Secure and Safe Metaverse Ecosystem:** To handle the unique features of safety, privacy, and security inside the DNA of this technology, effective ecosystems must be developed and regulated.
 - To overcome any potential legal obstacles, the development of a citizen-friendly meta-governance infrastructure will require the cooperation of specialists from diverse fields, including designers,

business model experts, and attorneys. It can also be necessary to include the private sector.

- **Global Cooperation:** We are catching a glimpse of a more technologically advanced, borderless society full of promise as the metaverse continues to grow.
 - While this new world is still expanding, we need to be mindful of the issues it poses with each new development and anticipate universally enforceable laws.
 - ICT is used in e-governance to distribute critical information to a specific audience. The necessary vital data can be supplied by meta-help desks or meta-divisions within a certain ministry or by other government organizations.
- **Applications with open and informed consent:** The data processing and safety practices used by technology corporations will need to be more accountable and open.
 - To avoid unregulated data processing and collection for commercial advantage, it will be crucial to promote an informed consent-based approach while collecting personal data and adhere to the principles of data minimization and purpose limitation.

The Metaverse and AI are emerging concepts in technology that presents a new way for people to interact and engage in a virtual world. However, this technology also poses a number of challenges but with proper set of governance and regulation, this technology could help humanity in unimaginable ways.

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Per and polyfluoroalkyl substances are used in 1. Water...2. Stain...

Which of the above statements is/are correct?

Explan...**Given with source link**

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With reference to **perfluoroalkyl and polyfluoroalkyl substances (PFAS)**

1. PFAS are found to be widespread in ..
2. PFAS are not easily degraded ...
3. Persistent exposure to PFAS

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- * Explanation pdf with source links
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