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Editor's Note

Dear Students,

Let's be absolutely clear: **current affairs are not just important; they are the bedrock of success for the UPSC CSE exam!** To conquer this challenge, you need more than just knowledge; you need **unwavering analytical prowess, razor-sharp cognitive ability, a laser-focused approach, and the undeniable power of Logic, Examples, and Data (LED)** to back every point. And let's not forget the crucial flair for writing in the mains and the gift of gab that shines in the interview – none of this is achievable without a current affairs resource that cuts through the noise.

That's precisely why **Nitin Sir Classes** proudly presents our monthly magazine. Under our auspices, this magazine **doesn't just meet; it EXCEEDS** every one of these vital parameters. We've stripped away the frills to deliver the **absolute nitty-gritty**, meticulously crafted to sharpen every skill you need.

This isn't just our hope; it's our **firm, personal conviction** that this magazine will be your constant companion, propelling you forward on every single step of your journey toward realizing your cherished dream. **Success isn't accidental; it's the relentless effort.** Remember the timeless truth: "The last stroke of the hammer breaks a stone. This does not mean the first stroke is useless." Every single effort counts!

Stay relentlessly focused on your goal, armed with the right endeavour.

Warm greetings!

Nitin Kumar
Director
Nitin Sir Classes

Long Articles

Israel-Iran Conflict: Regional Tension in West Asia Creating Havoc Globally

Though a fragile ceasefire is finalised between **Israel** and **Iran**, there is no doubt that **currently, the West Asian regional order** is sitting on the **hotbed of geopolitical instability**. This led us to a series of questions that are necessary to answer, and let my students understand why this conflict has surged recently and how it is affecting the global order and India's national interest.

Why did the Israel-Iran conflict start now?

The Israel-Iran conflict has escalated recently due to several key reasons. ***Firstly***, the **Iran Nuclear Deal negotiations** (also known as **JCPOA**) stalled after a report from the **International Atomic Energy Agency** (**IAEA**) revealed that Iran's current uranium enrichment capabilities could allow it to build nuclear weapons. This has raised serious concerns about **nuclear instability in West Asia**, as **Iran's possession of nuclear arms** could shift the **balance of power** in the region. Iran aims to assert its dominance and reduce the influence of **Saudi Arabia** and **Israel**. **Israel**, in particular, has been very vocal about its fears regarding **Iran's nuclear programme** and has previously launched attacks on Iranian nuclear sites, such as those in **Natanz**, **Bushehr**, **Isfahan**, and **Fordow**, to prevent Iran from advancing its nuclear capabilities.

Why is it difficult to attack Iran from land?

Iran's defence is bolstered by its rugged topography, dominated by the **Zagros** and **Elborz mountain ranges**, which act as formidable natural barriers against invasions. These mountains hinder large-scale troop movements and conceal critical military sites. Additionally, vast deserts like the **Dasht-e Kavir** and **Dasht-e Lut** create harsh, inhospitable conditions that **complicate logistics** and **sustainment for any attacking force**, making invasion extremely difficult.

How is it affecting regional order and global stability?

This conflict is affecting both regional order and global stability in several ways. On the geopolitical front, different global powers have taken sides: **China** and **Russia** support **Iran's retaliation against Israeli attacks**, while the **G7 countries**, led by the **USA**, back Israel and condemn Iran's actions. Israel's aggressive approach, known as the **Daliyeh doctrine**, which involves **destroying hostile threats**, has caused **radiation leaks near Iranian nuclear sites**. In response, **Iran** has attacked **Israeli hospitals**, escalating the conflict further. The warfare between the two countries now involves **advanced technology** such as **drones**, **air defence systems**, and **cyber attacks** on critical infrastructure, showing how modern conflicts have evolved beyond traditional battlefields.

The conflict also threatens **global trade** and **energy security**. The **Strait of Hormuz**, a crucial passage for global oil supply that runs through Iran, is one of the world's top chokepoints. Any disruption here could severely **impact global energy markets**. Additionally, the region includes vital trade routes like the **Suez Canal** and the **Red Sea**, which connect **Asia** and **Europe**. Escalation in the conflict could disrupt these routes and affect global economics. The ambitious **India-Middle East-Europe Economic Corridor** (**IMEC**), launched during **India's G20 presidency** to boost trade between India, the **UAE**, and **Israel**, might also face delays similar to previous projects like the **International North-South Transport Corridor**. There is also concern that if **Iran** and the **Taliban** support each other, the conflict could spill over into **Afghanistan** and **Central Asia**, causing wider instability.

How is this conflict going to affect India's interests?

For India, this conflict poses multiple challenges. India has consistently called for **dialogue and de-escalation**, reflecting its long-standing foreign policy and **Prime Minister Narendra Modi's** view that "***this is not the era of war***." India's "**Look West**" **policy** prioritises national interests without getting deeply involved in West Asian regional politics. Protecting the **large Indian diaspora** in the region is also a priority, especially given risks like piracy and hostage situations. **West Asia is a major source of remittances for India**, so instability there could harm India's economy and foreign exchange reserves. **Energy security** is another concern; although **India** has diversified its **oil imports**, ongoing conflict may force further adjustments. Lastly, India must prepare for potential internal security threats by strengthening border forces to prevent any militant or terrorist infiltration resulting from regional instability.

Fuel for the Future: Thorium, Technology, and a Green Viksit Bharat

India has big dreams for its future. By 2047, the 100th year of its independence, the country hopes to become a "Viksit Bharat" — a fully developed nation. To achieve this, India must ensure a high quality of life for all its people while also keeping its promise of reaching net zero carbon emissions by 2070. This is a difficult goal because around 96% of the country's current energy — about 9,800 terawatt-hours (TWh) — comes from burning fossil fuels, which harm the environment. Scientists say that to reach a

Human Development Index of 0.95, like many advanced nations, India needs about 28,000 TWh of clean energy every year (Anil Kakodkar, "Fuel for a Green Viksit Bharat" published in *The Indian Express* on June 12, 2025). To solve this energy puzzle, India is turning to nuclear power, especially using thorium — a special metal found in large amounts in the country. Kakodkar believes nearly 70% of this clean energy must come from nuclear sources, which means increasing India's nuclear energy output by 70 times over the next 45 years (Kakodkar, 2025). This essay explores how thorium-based nuclear technology, guided by India's three-stage programme, can play a vital role in building a clean, secure, and energy-rich future for a green Viksit Bharat.

Homi Bhabha's Three-Stage Plan

After Independence, Dr. Homi Bhabha, a pioneer in Indian science, created a three-stage nuclear programme. The idea was simple: start with uranium and eventually shift to thorium. Thorium is safer, more abundant, and creates less radioactive waste. However, the journey has not been smooth. India's second stage — using fast breeder reactors — is still facing delays.

But there is hope. India has already built and run successful Pressurised Heavy Water Reactors (PHWRs), a type of reactor that can be used to test thorium as fuel. These reactors meet global standards and are safe and efficient. Kakodkar believes we must treat PHWR technology as a national asset and share it with more domestic agencies so we can build reactors faster (Kakodkar, 2025).

Why Thorium is Special

Thorium has many qualities that make it better than uranium. It is about three times more abundant in the Earth's crust than uranium. Thorium-based fuels produce fewer dangerous by-products and are harder to use for making weapons. Also, thorium reacts better under high temperatures and produces more energy for every neutron absorbed compared to uranium.

In fact, thorium oxide has better heat conduction and a higher melting point than uranium dioxide. This makes reactors using thorium safer because they are less likely to overheat. Thorium also creates fewer neutron poisons, which are particles that slow down or stop nuclear reactions.

Problems and Possibilities

Despite these benefits, India has not been able to use thorium on a large scale. One major reason is the delay in fast breeder reactors, which are essential for turning thorium into usable fuel (India's Nuclear Fuel Cycle, 2024). Another issue is the high cost of building large nuclear power plants.

Some experts suggest using Small Modular Reactors (SMRs). These are tiny versions of traditional nuclear reactors. They can be built in factories and shipped to power stations. SMRs cost less, are safer, and can be used for things beyond electricity, like heating homes or purifying water (Thorium 1_JA, p. 424). However, many SMR designs are not yet ready for use. Dr. Kakodkar warns that betting too much on SMRs now could delay our progress (Kakodkar, 2025).

Instead, he suggests focusing on Molten Salt Reactors (MSRs), which are a good match for thorium fuel. MSRs can use thorium to create energy safely and efficiently. These reactors use liquid fuel, so they operate at lower pressure and have natural safety features (IAEA TECDOC-1450, p. 32).

Recycling and Saving Uranium

India currently depends a lot on imported uranium. But this is risky. Geopolitical issues could cut off uranium supply. To avoid this, scientists suggest recycling spent fuel from reactors. This method lets us use the same uranium again, along with plutonium, to make more energy. This recycling can give us 60–70 times more energy from the same amount of uranium (Kakodkar, 2025).

Recycling can also help us begin the third stage of the nuclear programme earlier by using thorium in PHWRs and reusing the spent fuel in MSRs. This plan would also reduce our need to mine more uranium, which is both costly and harmful to the environment.

India's Energy Mix and the Role of Renewables

Some people ask: why not just use solar and wind energy instead? These are clean and renewable, after all. The answer lies in scale and stability. According to a study on India's energy future, renewable energy alone cannot meet the total demand because it is intermittent. Solar and wind energy depend heavily on weather and need large areas of land.

Nuclear power, on the other hand, can run non-stop and does not depend on sunshine or wind. A well-balanced mix of renewable and nuclear energy is the best way forward. While hydro and solar can provide around 8,000 TWh, nuclear energy must cover the remaining 20,000 TWh needed to make India a developed, low-carbon nation (Kakodkar, 2025).

International Cooperation and Fuel Innovations

India must also work with other countries to build new technologies. One area is High Assay Low Enriched Uranium (HALEU), which can help reactors use thorium more efficiently. Another is ANEEL fuel, a type of fuel that mixes thorium and uranium. This fuel is designed to be safer and more efficient while reducing radioactive waste.

Researchers are developing new fuel designs to make nuclear energy more efficient. One such design is the "seed and blanket" model. In this setup, uranium is placed at the centre (the seed) to start the reaction, while thorium surrounds it (the blan-

ket) and slowly turns into usable fuel. This method allows for better use of thorium by gradually converting it into fissile material, making it a sustainable option. It performed well in the Shippingport reactor in the United States, where the seed-and-blanket design successfully demonstrated high fuel efficiency and safety. This proven success shows that such designs could be an important part of future clean energy systems, especially in countries like India that have large thorium reserves and are looking for reliable alternatives to fossil fuels.

Small Reactors for Tomorrow, Not Today

This proven success shows that such designs could be an important part of future clean energy systems, especially in countries like India that have large thorium reserves and are looking for reliable alternatives to fossil fuels. Alongside innovative fuel assemblies, new reactor types are also being explored to meet India's growing energy needs. Small Modular Reactors (SMRs) hold promise for the future, especially in remote areas or for industrial uses. They are flexible, safer by design, and can be built faster than traditional reactors. However, India should not treat them as an immediate solution. Most SMR designs are still under testing or in early stages of development. Relying too heavily on them now could slow down progress on proven technologies like PHWRs and MSRs. As Kakodkar notes, "the overemphasis on SMRs at this stage may delay the actual deployment of large-scale clean energy" (Kakodkar, 2025). SMRs should be developed steadily, but only as part of India's longer-term nuclear strategy.

Looking Ahead: What Must Be Done

To achieve its clean energy dream, India must do the following:

1. Build more PHWRs and Light Water Reactors using Indian technology.
2. Speed up the development of fast breeder and molten salt reactors.
3. Begin using thorium in existing reactors as soon as possible.
4. Recycle spent nuclear fuel to get more energy and reduce waste.
5. Work with other nations on HALEU and ANEEL fuel development.
6. Include SMRs only as a part of the long-term plan, not the immediate one.

A comprehensive strategy using all available tools, especially thorium-based nuclear systems, will be critical for India to meet its energy needs without harming the planet.

Conclusion: A Safer, Cleaner India

India stands at a crossroads. The road to becoming a Viksit Bharat will not be easy. But it is possible. Thorium can be our secret weapon — safe, clean, and efficient. With wise policies, steady investment, and international cooperation, India can build a future where every home has power, every child breathes clean air, and every citizen lives a life of dignity.

India must stay focused on the bigger picture: building an India that is environmentally clean, economically strong, and independent in its energy needs. This vision guides all efforts in developing sustainable nuclear power solutions.

Tariffs, Power, and Peril: India's Trade Test in the Trump Era

International trade is often governed by well-planned rules, agreed upon by many countries, to create peace and fairness in business. For years, these rules provided stability to businesses that trade across borders. However, when Donald Trump became the President of the United States, he brought with him a style of governing that preferred acting alone. This is known as ***unilateralism***. He used tariffs—special taxes on imported goods—not only to fix trade issues, but also to pressure other countries. While his actions were said to protect America, they caused great disturbance across the world, especially for countries like India.

Trump's tariffs reached levels between 10% and 135% and were applied to more than one hundred countries, even to faraway places like the Heard and McDonald Islands that do not have people living on them. These drastic actions shook the very foundation of international trade and caused trouble for America's own democratic values. This essay tries to understand the legal problems caused by these tariffs, examines the logic behind them, and explores how India is handling the situation carefully to protect its own economic future.

The Constitution in Danger: How Tariffs Shook American Democracy

In democratic countries, there is a balance of power between the different branches of government. In the United States, the President, the lawmakers (Congress), and the judges (the courts) all have their roles. They are supposed to check each other's powers so that no one becomes too powerful. But when President Trump imposed massive tariffs using executive orders—without asking Congress or following trade agreements—it caused a major worry.

Surprisingly, it was not another country but five small American businesses that stood up against these tariffs. These companies made products like fishing equipment, musical circuits, and bicycles. They filed a case in the U.S. Court of International Trade (CIT), saying the tariffs were illegal and were harming their ability to survive. The court agreed and declared on 28 May 2025 that Trump's actions had gone beyond what the law allows. The judges reminded the nation that calling something a "national emergency" does not allow a president to rewrite trade laws as he pleases.

Yet, this strong ruling was put on hold the very next day by an appeals court. This delay showed how difficult it is for the legal system to stop unfair actions quickly. Worse still, the Trump administration introduced a bill called the One Big Beautiful Bill (OBBB), which aimed to protect the president from being challenged by the courts. This bill, if passed, would weaken the basic structure of democracy by removing important checks and balances.

False Alarm: Were the Tariffs Even Needed?

President Trump said that America's trade deficit—a situation where the country imports more than it exports—was a national emergency. But experts, including R.V. Anuradha ("Trump's Tariffs and a U.S.-India Trade Agreement" published in *The Hindu* on 13 June 2025),, show that this is not entirely true. Trade deficits are not always bad. They can simply mean that people in a country are buying more because they have more money. More importantly, Trump's figures are wrong because they ignore America's big advantage in services. These include digital services, education, and finance, where the U.S. earns a lot more than it spends.

For example, Trump said the U.S. had a $44.4 billion trade deficit with India. But this did not count services or the arms trade. When all factors are considered, the U.S. actually has a $35–40 billion trade surplus with India. This means that America earns more from India than it loses.

Furthermore, Trump used "national security" as a reason for placing tariffs on steel and aluminium. But in 2022, the World Trade Organisation (WTO) ruled that this reason was not valid. Other countries like Switzerland, Norway, and Türkiye also opposed these claims. Despite this, the U.S. raised the tariffs on Indian steel and aluminium to 50%, ignoring both international rulings and previous agreements.

Tariffs as Weapons: Turning Trade into a Threat

Normally, trade agreements are meant to build friendly relations between countries. But Trump used tariffs as a weapon to force other countries to make deals on his terms. He even told the court that these tariffs gave him more power in negotiations, especially with India. However, the court clearly said that using tariffs as a bargaining tool was not legally acceptable.

Trump's administration went further by planning more extreme actions through the OBBB, which aimed to protect such unfair decisions from being overturned by the courts. This kind of behaviour is dangerous because it damages the trust between nations. It also sends the wrong message—that rules can be broken if someone powerful decides to do so.

India's Position: Trapped Between Pressure and Caution

India has found itself in a difficult spot because of Trump's aggressive tariff policies. Even though both countries were trying to finalise a trade agreement, the U.S. kept increasing tariffs on Indian goods. Steel and aluminium faced 50% duties, making it harder for Indian businesses to compete. India even withdrew its case from the WTO after reaching a "mutually agreed solution" with the U.S. in 2023, but this agreement did not stop further tariffs from being placed.

There are also fears that American companies investing in India, such as Apple, might face punishment from their own government. The Trump administration even threatened to tax Apple if it moved production to India. This makes India's economic relationship with the U.S. seem uncertain and risky.

Moreover, India is concerned about a proposed 3.5% tax on money sent from the U.S. to other countries. This would hurt Indian workers living in America who send money home to support their families. Another problem is the H-1B visa program, which helps skilled Indian workers get jobs in the U.S., especially in technology. Under Trump, visa rules became stricter, affecting the careers of many Indians.

Digital services are another area where India and the U.S. disagree. India wants to tax big American tech companies, but the U.S. has threatened to retaliate. All of these issues show that India must be very careful while dealing with the U.S. and must protect its own interests firmly.

India's Strategy: A Path of Balance and Strength

R.V. Anuradha suggests that India should take a wise and careful approach while negotiating any trade deal with the United States. There are several important goals India must focus on:

1. **Ending Extra Tariffs**: India should demand the complete removal of all unfair tariffs on its exports, especially in key industries like steel and aluminium.
2. **Protecting Investments**: The deal should prevent the U.S. from punishing its own companies for investing in India.
3. **Saving Remittances**: The 3.5% tax on remittances must not apply to money sent by Indian workers, as it would hurt millions of families.
4. **Respecting Digital Taxes**: India should keep its right to tax digital services fairly without facing revenge tariffs.
5. **Ensuring Visa Access**: Indian professionals should continue to have access to jobs in the U.S. through the H-1B visa program.
6. **Aligning with WTO Rules**: India must make sure that any trade deal it signs does not break international rules under the WTO.

Most importantly, India must keep the option of walking away from the deal if it is not good. Signing a weak agreement could damage India's economy for many years. The pain caused by Trump's tariffs may not last forever, but the effects of a bad deal could be long-lasting.

The Need for Multilateralism: Choosing Fairness Over Force

Multilateralism means many countries working together under common rules. Institutions like the WTO help make trade fair by solving disputes peacefully and making sure no country is too powerful. Trump's tariffs have shown what happens when these systems are ignored. Countries like India are left confused and vulnerable.

India, during its G-20 presidency, said that multilateralism must be protected. This is more than just a promise. It is a practical way to make sure smaller or developing countries are not bullied by bigger powers. Relying only on bilateral deals with strong countries like the U.S. puts India at risk. A better way is to strengthen international rules and make trade agreements that are fair to all.

Bigger Picture: Lessons for India and the World

Trump's behaviour in trade policy tells a bigger story about the changes happening in global politics. Instead of working with others, some leaders now prefer to use pressure and threats to get what they want. This kind of behaviour creates fear and instability. The old system of trade, built after World War II through GATT and later the WTO, is now facing one of its biggest challenges.

India must learn from this. As a rising power, India needs strong partners, fair rules, and global respect. It must build ties with many countries, not just one. Depending too much on the U.S. or any single country could lead to disappointment. India must also protect its growing services industry and make sure its digital economy has room to develop freely.

The U.S.-India relationship has often been described as a friendship between two democracies. But friendship in diplomacy must be based on trust and fairness. India should not accept a relationship where it is treated unequally. At the same time, India must continue to act responsibly, respect international laws, and encourage others to do the same.

Conclusion: Walking the Tightrope with Wisdom

The story of Trump's tariffs and India's response shows how complicated global trade has become. It is not just about money or goods, but also about power, fairness, and the future of democracy. The use of executive power without checks, the ignoring of global rules, and the use of trade as a weapon have made the world a more uncertain place.

For India, the journey ahead is difficult but not impossible. It must stay true to its values, protect its people's interests, and not be afraid to say "no" to unfair deals. The world is watching, and how India responds will shape not just its own future, but also the future of global trade.

By holding onto the principles of justice, balance, and cooperation, India can help build a world where no country is too strong to ignore others and where every voice, big or small, matters. This is the true lesson from the crisis caused by Trump's tariffs. And this is the path India must walk—with care, courage, and confidence.

India's Quantum Future: A Guide to Secure Communication for Tomorrow

Introduction: The Quantum Leap

Quantum physics, once seen as too mysterious and complex for everyday use, is now beginning to reshape the world around us. It is revolutionising communication and cybersecurity and is expected to lead the next major scientific shift. India, like many other nations, is in a race to understand and apply this powerful new technology. Quantum communication, in particular, is poised to redefine how we protect and transmit information across the globe. As Prateek Tripathi explains in "Quantum Communication and Encryption: Significance, Global Progress, and Implications" (ORF Occasional Paper No. 480, June 2025), "Quantum communication will fundamentally alter the landscape of digital communication once it becomes a practical reality." However, he cautions that India "will need to address a number of challenges, including investment and talent shortage, supply chain constraints, and export controls."

This essay seeks to explain the key ideas of quantum communication and encryption in simple terms, explore their importance for India, and examine the steps the country is taking to prepare. The central thesis is that India must adopt a careful and balanced strategy, focusing on both Post-Quantum Cryptography (PQC) and Quantum Key Distribution (QKD), to ensure secure communication in the years ahead.

Quantum Basics: What Makes It Special?

To understand quantum communication, we need to understand a few key ideas in quantum physics. Unlike classical physics, where things behave predictably, quantum physics deals with particles so tiny that they behave in surprising ways. For example, particles like photons (light particles) can exist in more than one state at a time—a principle known as superposition. They can also become entangled, meaning their states are linked even when separated by large distances.

These unusual properties are not just fun facts—they are powerful tools. In communication, they allow us to send information in new ways that are far more secure than what current technology allows.

The Quantum Threat: Why We Need New Security

Today, we use encryption to keep our online data safe. This includes messages, bank details, and government secrets. Most of this protection is based on mathematical problems that are very hard for normal computers to solve. But quantum computers, which are being developed now, could solve these problems much faster. This means they could break today's encryption and steal sensitive data.

There is also something called the "store now, decrypt later" threat. Hackers could collect encrypted data today and wait for quantum computers to become powerful enough to unlock it later. So even if the data is safe now, it may not be safe in the future.

Post-Quantum Cryptography: The First Line of Defence

One solution is Post-Quantum Cryptography, or PQC. This involves creating new encryption methods that even quantum computers cannot break easily. The best part about PQC is that it can be used with today's technology. Since it is software-based, it can be added to current systems without changing the hardware.

India is already working on this. According to Tripathi (2025), "PQC is generally hardware-agnostic and can be embedded into existing communication systems with minor upgrades." For example, India's Centre for Development of Telematics (C-DOT) has built PQC-based products like the Quantum-safe IP Encryptor.

However, PQC is not perfect. Some of its algorithms could be broken in the future, and it requires more computing power. Still, it is the best immediate solution to protect our data.

Quantum Key Distribution: The Vault of the Future

Quantum Key Distribution (QKD) is a more advanced and futuristic approach. It uses the strange behaviour of quantum particles to send secret keys for encryption. If anyone tries to spy on the communication, the particles change their state, and the system can detect the intrusion. QKD remains the only known method to provide unconditional security guaranteed by the laws of quantum mechanics.

But QKD has many challenges. The particles used are very delicate and easily disturbed. The technology needs special hardware that is expensive and hard to produce. Transmission is also difficult over long distances, especially without using satellites or special repeaters.

That is why experts suggest using QKD only for very important communications, such as military or government messages, while continuing to improve the technology for wider use later.

India's Progress: Walking Two Roads at Once

India has realised that it must work on both PQC and QKD at the same time. This is what experts call a "dual-track" approach. In April 2023, India approved the National Quantum Mission (NQM), which aims to promote research and build practical tools for quantum communication. The mission supports projects like satellite-based quantum communication over 2,000 km and long-distance QKD trials.

One important achievement is a test by DRDO and IIT Delhi, where they achieved QKD over 380 km with very low error. At the same time, C-DOT is pushing forward with PQC tools that use algorithms approved by the United States, like CRYSTALS-Kyber and Dilithium.

The mission also includes setting up four Thematic Hubs involving top institutions across India. These hubs are focusing on different aspects of quantum research, including communication and encryption.

Learning from Global Leaders

India is not alone in this race. Countries like the United States and China are far ahead. The US started its National Quantum Initiative in 2018 and has invested over US$500 million in quantum communication projects. Agencies like NIST have already finalised standards for PQC.

China has built a huge quantum communication network, including a satellite called Micius that can send quantum keys between Asia and Europe. China has also made QKD part of its national five-year plans.

India can learn from these examples. The country needs to increase its investment, build strong partnerships between government and private companies, and train more scientists and engineers in this field.

Challenges: From Hardware to Human Talent

India faces several challenges in its quantum journey. One big problem is the lack of experts. India currently has fewer than 200 researchers in the field of quantum communication. To solve this, India needs to create special university courses, sponsor PhD programmes, and offer international fellowships.

Another challenge is the shortage of materials and equipment. Much of the hardware for quantum technology, like single-photon detectors, is imported. Export controls and global politics make this harder. Building a local supply chain is essential for long-term success.

Solutions: Practical and Strategic Steps

Experts suggest several ways India can succeed:

1. **Focus on PQC first:** Since it is easier to apply and works with existing systems, PQC should be used widely in the short term.

2. **Reserve QKD for critical areas:** Use QKD for defence and key government projects while continuing research.
3. **Support start-ups:** Encourage small companies to work on PQC software.
4. **Build hardware locally:** Develop labs to make quantum components within India.
5. **Train talent:** Create university programmes, online courses, and fellowships.
6. **Join global efforts:** Work with international groups like NIST and Quad to share knowledge and set standards.

Conclusion: The Future is Now

Quantum communication is no longer science fiction. It is real, and it is coming fast. India stands at a crossroads. By adopting a balanced approach that uses PQC today and builds toward QKD for tomorrow, the country can protect its digital future. This will require investment, training, innovation, and international cooperation.

India should use Post-Quantum Cryptography (PQC) now as a "firewall" to guard data today, while working toward using Quantum Key Distribution (QKD) later as a secure "vault." This means starting with tools we already have and building stronger systems over time to protect India's digital future from growing threats in a quantum world.

If India succeeds in this mission, it will not only secure its communication networks but also emerge as a leader in the next great scientific revolution. With careful planning and determined action, India can unlock a safer, smarter, and more sovereign digital future.

India's Data Protection Challenge: The Road to Global Trust

In a world driven by digital technologies, personal data has emerged as one of the most valuable resources. Whether for commercial purposes, governance, or national security, control over personal data has significant implications. Recognising this, India passed the **Digital Personal Data Protection Act** (**DPDPA**) in 2023. While this law marks an important step forward for India, questions remain about its compatibility with global standards, especially the **European Union's General Data Protection Regulation** (**GDPR**).

India aspires to be recognised as an "adequate" jurisdiction by the European Union, which would allow personal data to flow freely from Europe to India. However, a recent refusal by the **European Data Protection Supervisor** (**EDPS**) to allow the European Investment Bank to transfer contact data to India shows that this goal remains distant. This essay explores the strengths and weaknesses of the DPDPA, compares it with the GDPR, and suggests how India can bridge the gap to become a globally trusted digital economy.

The EDPS Decision: A Cautionary Signal

The EDPS's decision not to allow the European Investment Bank to transfer data to India was not a full rejection of the DPDPA. Rather, it was a procedural refusal that highlighted gaps in India's current system. The decision pointed out that India had not yet operationalised the necessary infrastructure to ensure compliance with the DPDPA. There was no Data Protection Board in place. The rules and regulations to support the law were not finalised. As a result, the EDPS could not confirm that India's system offered protection equivalent to the GDPR (EDPS, 2024).

This episode shows that even though India now has a formal data protection law, it is not enough. Laws must also be implemented with clarity, independence, and accountability. Without these, international confidence cannot be built.

Government Powers and the Need for Limits

One major concern with the DPDPA is the broad exemptions it grants to the Indian government. **Section 17**(**2**) allows the government to exempt any of its agencies from following the rules of the law on grounds like national security, public order, or the prevention of crime. These exemptions do not require approval from an independent body. They are not subject to judicial review. There is also no requirement to prove that such actions are necessary and proportionate.

In contrast, **Article 23** of the **GDPR** allows governments to **restrict some rights for specific reasons**, but such restrictions must always be necessary, proportionate, and based on laws that include safeguards (GDPR, 2018). This difference is important. While the GDPR seeks to balance state interests with personal rights, the DPDPA gives more power to the state, often at the expense of individual privacy.

This is not just a theoretical issue. Without clear limits, government agencies could misuse personal data, leading to surveillance or political targeting. This would damage trust in the system and make it harder for India to be recognised as a safe country for data storage or processing.

Lack of Independence: The Problem with the Data Protection Board

The GDPR makes it very clear that its data protection authorities must be independent. Article 52 of the GDPR says that national supervisory authorities must be completely independent from the government and must be free from any external influence (GDPR, 2018).

The DPDPA, however, allows the central government to control the composition and rules of the Data Protection Board. This means the same authority that collects and uses data also appoints the body responsible for oversight. True independence and competence are essential if such a Board is to inspire domestic and international trust.

Without an independent regulator, it is difficult to expect unbiased enforcement of rules, especially when powerful state agencies are involved. This lack of credibility was likely one reason the EDPS hesitated to trust India's system.

User Rights: On Paper but Not in Practice

The DPDPA includes rights like access to data, correction of errors, and the right to erase data. However, these rights are often subject to conditions like "as may be prescribed," meaning their actual implementation depends on future rules. Moreover, individuals may be required to submit specific identification details, such as customer IDs, to make a request. These steps make it difficult for ordinary people to use their rights.

By comparison, the GDPR puts the burden on companies (data controllers) to respond to user requests. Users are not expected to jump through unnecessary hoops. The GDPR also sets strict time limits for replies and allows complaints to be filed easily with an independent authority.

A law that gives rights but does not make them easy to use cannot truly protect privacy. As the ORF report points out, if the DPDPA's rights are "weakly framed or difficult to exercise," then they cannot serve their purpose (Tanusha Tyagi, 2025).

India's Context: A Balancing Act Between Innovation and Regulation

India's socio-economic conditions differ greatly from those in the European Union. More than 50 percent of India's population is still offline. Many government services, like welfare programmes, require digital identity and data collection. The government argues that exemptions are necessary to deliver these services quickly and efficiently.

However, these conditions cannot be used as a justification for ignoring accountability. Other developing countries have adopted strong privacy laws with adequate safeguards. India must find a way to support digital innovation without compromising user rights.

It is not enough to pass laws; their actual operation must be such that they generate confidence among citizens and trading partners.

Challenges to Global Adequacy: Where India Falls Short

To be granted adequacy status by the EU, a country must show that its data protection rules offer essentially the same level of protection as the GDPR. This does not mean the systems must be identical. However, they must include strong rights for users, clear limits on state access, an independent regulator, and effective enforcement.

Right now, India does not meet all these standards. In addition to the issues already discussed, India also lacks transparency in how its surveillance systems work. The Supreme Court's 2017 ruling in ***Puttaswamy vs Union of India*** recognised privacy as a fundamental right. However, this has not yet led to clear rules that govern surveillance or interception.

Moreover, the DPDPA contains vague language. For example, terms like "as may be prescribed" appear too often, making the law dependent on future rules. Until these rules are made and enforced, the law cannot be considered fully functional.

Steps India Must Take to Gain Global Trust

India can take several clear steps to improve its system:

1. **Set Up the Data Protection Board:** The Board must be established quickly, with rules to ensure its independence from the government.
2. **Limit Exemptions:** Any exemptions for government agencies must pass a test of necessity and proportionality. They must also be reviewed by an independent body.
3. **Simplify User Rights:** People must be able to use their data rights without technical or legal difficulty. This includes removing the need for specific IDs or complicated forms.
4. **Create Clear Rules on Surveillance:** The government must explain when, why, and how it can access personal data. These rules must include oversight to prevent misuse.
5. **Engage with the EU and Other Countries:** India must show its willingness to follow international best practices. This means open dialogue, transparency, and respect for privacy principles.

By taking these actions, India can move closer to being recognised as an adequate jurisdiction.

Conclusion

India's Digital Personal Data Protection Act (DPDPA) is a step forward, but mere legislation is not enough—fair implementation, clear safeguards, and genuine rights enforcement matter. While the law shows India's commitment to data protection, it falls short of the GDPR's standards due to excessive government exemptions, weak oversight, and cumbersome user rights. To gain global trust, India must limit state powers, ensure an independent regulator, and make privacy rights accessible. Without these changes, cross-border data flows will remain restricted, stifling India's digital potential.

The EU's rejection of unrestricted data transfers to India proves that trust depends on action, not just laws. Though India's unique challenges demand flexibility, unchecked state access and vague rules undermine confidence. By strengthening the Data Protection Board, tightening surveillance laws, and simplifying redress, India can align with global norms without copying the GDPR verbatim. In the digital age, trust is the currency of progress—and India must earn it to lead.

Prelims

800-Year-Old Pandya-Era Shiva Temple

Sub-Topic: *Salient aspects of Art Forms, literature and Architecture from ancient to modern times.*

Context:

In a remarkable archaeological discovery, the remnants of an 800-year-old Shiva temple dating back to the **later Pandya period have been unearthed in Udampatti village,** located in Melur taluk, Tamil Nadu.

About the Pandya Dynasty

- The Pandya dynasty, **one of the three crowned Tamil dynasties alongside the Cholas and Cheras**, was a prominent power in South India, with **roots tracing back to the 4th century BCE**.
- Initially ruling from Korkai, they later moved their capital to Madurai. The dynasty experienced a **revival under Kadungon in the 6th century**, pushing out the Kalabhras, and reached its **golden age under Maravarman Sundara Pandyan** and **Jatavarman Sundara Pandyan in the 13th century**.
  - **Territorial Expansion:** The Pandyas **controlled extensive territories**, including **parts of Kerala**, **Sri Lanka**, and **Telugu country**, and had **trade links with Southeast Asian maritime empires like Srivijaya**.
  - **Economic Strength:** They **dominated pearl fisheries along the South Indian coast**, producing some of the finest pearls in the ancient world, and maintained **diplomatic relations as far as Rome**.
  - **Cultural Contributions:** The **Pandyas were patrons of Tamil literature**, hosting the legendary **Sangams in Madurai**. They contributed to art, music, dance (**notably Bharatanatyam**), and temple architecture, including the iconic **Meenakshi Temple in Madurai**.
  - **Religious Influence: Shaivism** and **Vaishnavism flourished under their rule**, with the **Shaivite Nayanars** and **Vaishnavite Alvars gaining prominence** after the dynasty's revival.

Decline of the Pandya Dynasty

- The Pandyas faced repeated **conflicts with the Pallavas, Cholas, Hoysalas, and later the Muslim invaders** from the Delhi Sultanate.
- By **1323, the Jaffna Kingdom in Sri Lanka declared independence**, and **in 1335, the Pandyas lost Madurai to the Madurai Sultanate**.
- They continued to rule regions like Tirunelveli and Tenkasi until the **Madurai Nayak dynasty emerged in 1529**.

Ahilyabai Holkar

Sub-Topic: *Modern Indian history from about the middle of the eighteenth century until the present- significant events, personalities, issues.*

About

- Ahilyabai Holkar **(31 May 1725 – 13 August 1795)**, also spelled Ahalya Bai, was born in the **village of Chondi** (now in Ahmednagar district, Maharashtra) into a **humble Marathi Hindu family.**
- Following the deaths of Malhar Rao in 1766 and her son Male Rao in 1767, **Ahilyabai became the ruler of the Holkar dynasty, taking charge of the Malwa kingdom within the Maratha Empire.**

Reign and Governance

- Ahilyabai Holkar **ruled from 1767 to 1795,** with her **capital at Maheshwar on the Narmada River.**
- Her reign is widely regarded as the **golden era of the Holkar dynasty,** noted for peace, prosperity, and just governance.
- She was accessible to her subjects, held daily audiences, and established courts for justice and arbitration.
- Breaking social norms, she **did not observe purdah (seclusion) and was known for her direct involvement in administration and military affairs**, even personally leading armies into battle when necessary.
- She appointed **Tukoji Rao Holkar as her military commander** and also **modernised her army by engaging foreign experts.**
- Ahilyabai was a **pragmatic ruler who strengthened the kingdom's finances**, revitalised trade routes, and created grain reserves to mitigate famine.
- She also **encouraged bandit communities to turn to honest livelihoods, further stabilising her region.**

Social Reforms and Philanthropy

- She built **hundreds of Hindu temples, ghats, wells, rest houses (dharmshalas),** and gardens across India, not just within her own territory but in distant pilgrimage centers such as **Kashi (Varanasi), Somnath, Gaya, Ayodhya, Mathura, Haridwar, Ujjain, Omkareshwar, and Kanchipuram.**

- Her most notable contributions include the **rebuilding of the Kashi Vishwanath Temple in Varanasi and the Grishneshwar Temple near Aurangabad.**
- She also established a **textile industry in Maheshwar,** giving rise to the famous Maheshwari sari.

Legacy

- Ahilyabai Holkar is remembered as **one of India's most visionary and benevolent female rulers.**
- Her reign is often cited as a **model of good governance, social welfare, and religious tolerance.**
- She is revered as a **saintly figure (Sadhvi)** and is affectionately called **"Lokmata" (Mother of the People) and "Punyashlok" (One as Pure as the Sacred Chants).**
- Upon her death in 1795, **she was succeeded by Tukoji Rao Holkar.**

Her legacy is celebrated annually on **Ahilyabai Holkar Jayanti (31 May),** and her contributions to Indian society, architecture, and culture are still honoured today.

Bharatiya Bhasha Anubhag

Sub-Topic: *Salient aspects of Art Forms, literature and Architecture from ancient to modern times.*

Context:

In a significant move aimed at reducing the dominance of foreign languages in government communication, **Union Home Minister Amit Shah on Friday (June 6, 2025)** launched the **Bharatiya Bhasha Anubhag (BBA)** — or **Indian Languages Section**.

About

- The **Bharatiya Bhasha Anubhag** (Indian Languages Section) is a newly launched initiative by the Indian government aimed at promoting Indian languages in governance and reducing dependence on English.
- **Objective:** To empower Indian languages in official administration and reduce English dominance in governance.
- **Budget Allocation:** ₹56 crore in the **Union Budget 2024-25**.
- **Technology Integration:** Developed in partnership with the **Centre for Development of Advanced Computing (C-DAC)** to facilitate universal translation between Indian languages.
- **Impact:** Enables official correspondence and decision-making in regional languages, making governance more accessible to citizens.
- **Cultural Significance:** Amit Shah emphasised that all Indian languages are interconnected, forming the "Ganga of Indian culture."

Practical Implementation

- **Universal Translation System:** Allows seamless translation of official documents between Indian languages.
- **Decolonisation of Administration:** Aims to free governance from the influence of foreign languages.
- **Public Engagement:** Strengthens linguistic inclusivity and cultural empowerment.
- This initiative aligns with India's broader efforts to **promote mother tongue-based education** and **enhance linguistic diversity in governance**.

Practice Questions

1. Consider the following statements regarding Bharatiya Bhasha Anubhag:

1. It will be operated under the Ministry of Culture.
2. It aims to empower Indian languages in official administration.

Which of the statements given above is/are correct?

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

2. Consider the following statements regarding the Pandya dynasty:

1. They were part of the Muvendar triumvirate in the Sangam period.
2. They had diplomatic relations with Rome.
3. They declined due to Delhi Sultanate invasions.

How many of the given above statements are correct?

(a) Only one (b) Only two
(c) All three (d) None

Polity, Governance & Social Justice

Mains

Justice Hema Report and Gender Reforms

Sub-Topic: *Mechanisms, laws, institutions and Bodies constituted for the protection and betterment of these vulnerable sections.*

Context:

In a significant development, the **Kerala Police dropped 35 sexual assault cases on June 4, 2025**, which had been filed in the wake of the explosive Justice Hema Committee report on gender discrimination and sexual harassment in the Malayalam film industry.

What Is the Justice Hema Committee Report?

- The Justice Hema Committee was constituted in July 2017, following a **high-profile sexual assault case involving a prominent Malayalam film actress** who was **abducted and assaulted in a moving car on February 17, 2017.**
  - Popular actor Dileep was accused of masterminding the attack.
- The Committee submitted its findings in December 2019, but the **report remained confidential for over four years.**

Key Findings of the Justice Hema Report

- The report painted a damning picture of the Malayalam cinema ecosystem, exposing:
  - A widespread **culture of sexual harassment**
  - **Casting couch practices** where women were coerced into sexual favors for roles
  - Frequent **vulgar comments and workplace misconduct**
  - **Incidents of drunk male co-actors entering women's rooms**
  - **Reluctance among women to report harassment, fearing career repercussions**

What Next for Gender Justice in Kerala's Film Industry?

- Women working in Malayalam cinema say that **dropping the cases is not the end—it's a wake-up call.**
- They have **urged the Kerala government to initiate systemic reforms** in the film sector, such as:
  - Establishing **Internal Complaints Committees (ICCs)** within film associations
  - **Creating safe reporting mechanisms**
  - **Enforcing codes of conduct across sets and production houses**

The Justice Hema Committee report and the subsequent wave of disclosures have opened a critical dialogue on gender rights in the entertainment industry. While the withdrawal of 35 sexual assault cases may seem like a setback, it also underlines the urgency of institutional reforms and long-term protections for women.

Foreign Universities In India

Sub-Topic: *Issues relating to development and management of Social Sector/Services relating to Health, Education, Human Resources.*

Context:

India is witnessing a major shift in its higher education landscape as several foreign universities prepare to establish branch campuses on Indian soil.

What is the current status?

- So far, **seven institutions from the UK, five from Australia,** and **one each from the United States, Italy, and Canada** have initiated or completed the approval process.
- Most of these campuses **will be based in GIFT City** (Gujarat International Finance Tec-City) **and Navi Mumbai.**
- While **India has aimed to attract global institutions** for over a decade, the **National Education Policy (NEP) 2020 gave fresh momentum** to this goal.
- The government has since **operationalised this vision by approving the University Grants Commission (UGC) Regulations 2023** for the establishment of foreign higher educational institutions (FHEIs) in India.

NEP 2020 and Foreign Universities in India

The National Education Policy (NEP) 2020 supported by University Grants Commission (UGC) guidelines, **allows top-ranked foreign higher education institutions (HEIs) to establish campuses in India.** Only foreign universities **ranked in the global top 500 (overall or subject-wise) or those with exceptional expertise** in specific fields are **eligible** to apply for setting up campuses in India. The UGC determines

and updates these criteria periodically. The **UGC provides autonomy to these institutions** regarding academic, administrative, and financial operations. They **must comply with Indian laws** (such as FEMA and FCRA), submit annual audits, and can operate as either non-profit or for-profit entities. **GIFT City in Gujarat has emerged as a flagship international education hub**, offering regulatory and tax incentives to attract foreign universities. **Deakin University (Australia) and University of Wollongong (Australia)** are among the first to set up campuses in GIFT City, Gujarat. The University of Southampton (UK) is opening a campus in Gurugram, Haryana. In 2025, Letters of Intent were issued to five globally reputed universities: University of York, University of Aberdeen, University of Western Australia, Illinois Institute of Technology, and Instituto Europeo di Design (Italy), with operations expected to begin between 2026 and 2027.

Why Are Foreign Universities Setting Up Campuses in India?

- **Shifting Dynamics:** The expansion is largely **driven by shifting global higher education dynamics.**
- **Global North: Countries in the Global North**—such as the UK, US, Canada, and Australia—witnessed a **surge in higher education demand** post-World War II.
  - However, **falling birth rates over the past two decades** have led to **stagnating or declining domestic student enrollments.**
- **Infrastructure and Funding:** With **overbuilt infrastructure and reduced public funding,** foreign universities began depending heavily on international students for both enrollment and revenue.
- **Foreign Students: UK universities** now enroll international students at **one-fifth of their total intake**, similar to **Australia** and **Canada**, and much higher than that of the **US**.
- **India:** With traditional student pipelines narrowing, **India has emerged as a strategic alternative.**

Brain Drain and India

Brain drain refers to the ***emigration of highly skilled and educated individuals from their home country to other nations*** in search of better job opportunities, higher salaries, advanced research facilities, and improved quality of life. **In 2024 alone,** over **600,000 people left India,** with major destinations including the United States, Canada, Australia, the United Kingdom, and several European and Gulf countries.

- Its **young population, growing economy, and increasing education aspirations** make it a promising market for global universities looking to diversify revenue streams and maintain global presence.

What are the Key Challenges for Foreign Universities in India?

- **Affordability Gap:** India's higher education market is massive in volume **(over 40 million students)** but constrained by the **limited spending capacity** of average households.
  - However, **rising incomes and an expanding middle class** suggest that the demand for high-quality, premium education will likely grow in the coming years.
- **Lack of High-Quality Domestic Alternatives:** A handful of public institutions (like the IITs and IIMs) and a few private universities offer global-standard education. But the vast majority remain **mediocre or under-resourced.**
  - **Foreign branch campuses can help fill this quality gap** and meet the growing demand for international-caliber programs.
- **Shifting Student Preferences:** While many Indian students still seek international degrees as a pathway to migration, an increasing number prefer to stay and work in India.
  - Foreign branch campuses will cater to this segment, offering globally recognised degrees without the cost and logistics of studying abroad.

India's New National Policy for Senior Citizens

Sub-Topic: Welfare schemes for vulnerable sections of the population by the Centre and States and the performance of these schemes.

Context:

The Indian government is in the process of drafting a **new National Policy for Senior Citizens**, aiming to address the country's shifting **demographic realities** and evolving needs of its elderly population. The **Union Ministry of Social Justice and Empowerment spearheads it**. This initiative marks a major policy update since the National Action Plan was introduced in 2020.

Why is a New Policy Needed?

- India is on the path to becoming a rapidly ageing society. According to current projections (**8%** in **2011**), senior citizens will comprise **one-fifth** of the **overall population** by **2047**.
- This demographic shift has necessitated a **comprehensive policy overhaul** to ensure social security, dignity, and inclusive growth for India's elderly.

Key Developments: National Council for Senior Citizens Meeting

- The **fourth meeting of the National Council for Senior Citizens** focused on:
  - Discussing the **draft National Policy for Senior Citizens**
  - Incorporating **stakeholder feedback**
  - Reviewing progress on key schemes such as **Rashtriya Vayoshri Yojana (RVY)** and the **Integrated Programme for Senior Citizens (IPSrC)**

Focus Areas of the Draft Policy

- **Digital Inclusion:** With rapid digitisation, the policy will prioritise bridging the **digital divide** among senior citizens, enhancing their access to online services like **healthcare, pensions, and grievance redress mechanisms**.
- **Institutional Role of NGOs & Elder Associations:** The government aims to **institutionalise the role of NGOs** and senior citizen associations in **policy formulation, implementation, and feedback systems**, making the process participatory and people-centric.
- **Grievance Redressal for Elder Abuse:** The draft explores establishing dedicated mechanisms to combat **elder neglect and abuse**, a growing concern amid shifting family dynamics.
- **Minimum Standards for Old Age Homes:** To ensure quality care, the policy may enforce **uniform standards for old age homes and senior care institutions**, focusing on infrastructure, staff, and healthcare services.
- **Community Engagement & Intergenerational Bonding:** The policy encourages initiatives that promote **social inclusion, active ageing**, and **intergenerational relationships**, helping reduce isolation among seniors.

Review of Key Welfare Schemes

- **Rashtriya Vayoshri Yojana (RVY)**
  - Over **5 lakh senior citizens** have benefited from **free assisted-living devices.**
  - Focus on **post-distribution follow-up and service quality enhancement**
- **Integrated Programme for Senior Citizens (IPSrC)**
  - Operates **old age homes, mobile medicare units**, and **physiotherapy centres**
- Both programmes fall under the **National Action Plan for Welfare of Senior Citizens (2020)**.

Constitutional and Legal Backing:

- **Article 41** of the Constitution mandates state support in cases of old age
- **Maintenance and Welfare of Parents and Senior Citizens Act, 2007** – makes it legally binding for children/legal heirs to support their elders.
- Other provisions include **income tax benefits, concessions in travel**, and **personal laws** favouring senior welfare.

Practice Questions

1. Discuss the challenges related to policies associated with senior citizens in India. How can the National Policy for Senior Citizens be resolved? **(*Answer in 150 words*) 10**
2. The establishment of foreign universities can reverse the brain drain in India. In the context of the given statement, analyse how foreign universities in India facilitate the educational empowerment in the country. **(*Answer in 250 words*) 15**

Prelims

UMEED Portal

Sub-Topic: Mechanisms, laws, institutions and Bodies constituted for the protection and betterment of these vulnerable sections.

Context:

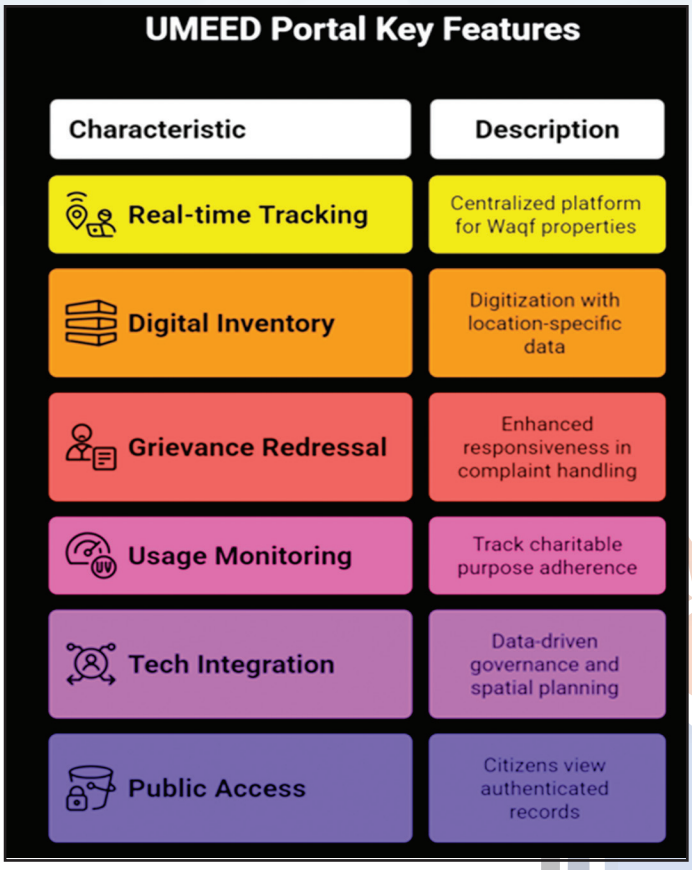
In a historic move to digitise and streamline the administration of Waqf properties in India, the **Union Minister for Minority Affairs**, Kiren Rijiju, launched the **Unified Waqf Management, Empowerment, Efficiency and Development (UMEED)** Portal on **6th June 2025** in New Delhi. Developed under the Ministry of Minority Affairs, this initiative seeks to bring greater transparency, accountability, and efficiency in Waqf property governance.

About the UMEED Portal

Developed By: The **Ministry of Minority Affairs**, Government of India, developed the UMEED Portal as a part of its digital empowerment initiatives for minority communities.

Need for Launching this Portal Now

- **Widespread Mismanagement Allegations:** Numerous reports over the years have highlighted the lack of accountability and **misuse of Waqf properties** by local boards or custodians.
- **Inaccessibility of Records:** The **absence of digitised inventories** has made verification and legal enforcement extremely difficult.



- **Lack of Public Participation:** The Waqf system, though meant for the welfare of the Muslim community, has often **operated in isolation** from the beneficiaries.
- **Push for Digital Governance:** UMEED aligns with broader **Digital India** objectives, encouraging tech-driven public asset management.
- **Vulnerability of Beneficiaries:** Waqf assets are intended primarily for the upliftment of the poor, particularly **Muslim women and children**, who often remain excluded due to lack of transparency.

How UMEED Portal solves Waqf Property Governance in India?

- **Empowering the Muslim Community:** By ensuring proper utilisation of endowed assets for education, health, livelihood, and welfare.
- **Historic Reform:** Marks a long-awaited structural change in Waqf property administration by integrating modern technology.
- **Enhanced Accountability:** Centralised monitoring and public scrutiny reduce the scope for corruption or arbitrary usage.
- **Institutional Strengthening:** Positions the Waqf boards as digitally equipped institutions aligned with modern governance norms.
- **Social Justice & Inclusion:** Ensures that the benefits of Waqf assets are equitably distributed among marginalised sections.

Dharti Aba Janjatiya Gram Utkarsh Abhiyaan (DAJGUA)

Sub-Topic: *Welfare schemes for vulnerable sections of the population by the Centre and States and the performance of these schemes.*

Context:

In a notable shift from past policy, the Union Government has initiated direct involvement in the implementation of the **Forest Rights Act (FRA), 2006** by setting up structural mechanisms at both district and state levels. The initiative is part of the **Dharti Aba Janjatiya Gram Utkarsh Abhiyaan (DAJGUA).**

What is DAJGUA?

- The **Dharti Aaba Janjatiya Gram Utkarsh Abhiyan (DAJGUA)** is a **comprehensive initiative** launched by the **Government of India** to drive **inclusive and sustainable development** in tribal regions.
- DAJGUA brings together **25 interventions from 17 Central ministries** to accelerate development in **over 68,000 tribal-dominated villages**. One of its key components is to **expedite pending FRA claims**, especially those delayed despite DLC approvals.
- According to a **March 2025 progress report**, around **15% of the FRA claims** across 21 States and Union Territories remain pending. Among the **total claims**, more than **two-fifths have been rejected**.

What Are FRA Cells?

- **FRA Cells** are newly established **Forest Rights Act (FRA) facilitation units** sanctioned by the **Union Ministry of Tribal Affairs** under the **DAJGUA**.
- As part of DAJGUA, the Union government has **sanctioned 324 district-level FRA cells** across **18 States and UTs**, and **State-level FRA cells** in **17 of these regions**.
- These cells are expected to serve as **facilitators**, helping individuals and Gram Sabhas prepare their claims and manage data, rather than functioning as decision-making bodies.

Structure and Functions of FRA Cells

- As per the DAJGUA guidelines, these cells are to operate under the **supervision of State Tribal Welfare Departments and district administrations**, helping claimants and Gram Sabhas with:

- Paperwork preparation for claims, including evidence collection and Gram Sabha resolutions.
- Conversion of forest and un-surveyed habitations into revenue villages.
- Demarcation of forest land already vested to claimants.
- Digitisation of records and updating government portals.

- The government has clarified that these FRA cells **will not interfere** with the decisions made by the **Gram Sabha**, **Sub-Divisional Level Committees (SDLCs)**, **District Level Committees (DLCs)**, or **State departments** designated under the FRA.

Central Funding and Administrative Shift

- FRA cells are funded **by the Centre through Grants-in-aid General**.
- Sanction orders reviewed in States like **Assam, Himachal Pradesh, and Odisha** confirm this central funding.
- Although funded centrally, the **cells operate under State government machinery**, primarily directed by **State Tribal Welfare Departments** and **district administrations**.

Practice Questions

3. UMEED Portal, sometimes mentioned in the news, is associated with:

(a) Administer Waqf properties

(b) Land acquisition in forest areas

(c) Offering employment opportunities

(d) Pension grievance system for senior citizens

4. Consider the following statements regarding the Dharti Aba Janjatiya Gram Utkarsh Abhiyaan (DAJGUA):

1. It works under the Ministry of Tribal Affairs.
2. It facilitates the establishment of Forest Rights Act cells in districts.
3. It operates only in Sixth Scheduled Areas.

Which of the statements given above is/are correct?

(a) 1 and 2 only 2 and 3 only

(b) 1 and 3 only 1, 2 and 3

Mains

Blue Food Revolution

Sub-Topic: *Food processing and related industries in India- scope and significance, location, upstream and downstream requirements, supply chain management.*

Context:

With dense coastal populations and rich seafood traditions, East Asia is well-placed to lead the global transition to sustainable aquatic food systems. As land-based agriculture faces climate and resource challenges, blue foods offer a vital solution for food security and resilience.

Why Blue Foods Matter for East Asia's Food Security

- Blue foods — fish, shellfish, seaweed, and other aquatic species — are **vital to the diets, economies, and cultural heritage** of communities across **China, Japan, South Korea, and Taiwan.**
  - The **region contributes over 35% of the world's fish and seafood,** largely driven by **China's dominance** in global aquaculture.
  - Yet, this success comes with **rising environmental concerns:** overfishing, aquaculture pollution, and coastal ecosystem degradation threaten the long-term viability of blue food systems.
- Contrary to the belief that simply expanding production will solve food insecurity, **East Asia must shift from quantity-focused models to ecologically optimised, climate-resilient aquaculture practices.**
  - The region must prioritise low-impact systems, such as bivalve and seaweed farming, which naturally purify water, cycle nutrients, and reduce carbon emissions.

India and Blue Food

India is emerging as a **key player** in the blue food sector—encompassing fish, seafood, and aquatic plants—leveraging its vast coastline and water resources to enhance food security, climate resilience, and rural livelihoods. As the **world's second-largest fish producer,** India supports millions of jobs and **generates $8 billion annually from seafood exports,** while initiatives like the **Pradhan Mantri Matsya Sampada Yojana (PMMSY)** aim to double aquaculture production. Challenges like overfishing, pollution, and infrastructure gaps are being addressed through sustainable aquaculture, seaweed farming, and policy reforms, positioning India to become a global leader in climate-friendly blue foods. With innovations in alternative seafood and seaweed-based biofuels, India's blue food revolution promises nutritional security, economic growth, and environmental sustainability.

Sustainable Innovation: From IMTA to Seaweed Farming

- Key innovations such as **Integrated Multi-Trophic Aquaculture (IMTA)** — where different species like fish, shellfish, and seaweed are cultivated together — are reshaping blue food systems across the region.
  - In **China's Sanggou Bay, IMTA contributes nearly 40% of national mariculture output**, reducing environmental impacts through closed-loop nutrient cycles.
  - Similarly, **Japan has modernised its centuries-old polyculture systems** to mitigate sedimentation, eutrophication, and harmful algal blooms.
- **South Korea leads in low-carbon aquaculture**, particularly through large-scale seaweed and shellfish farming, which sequester carbon and support marine biodiversity.
  - **Taiwan's Coastal Blue Economy Growth program** and **Community-Based Sea Farming project** promote ecosystem-based mariculture that boosts coastal resilience and food security.

Governance Gaps and the Need for Regional Cooperation

- Despite these promising initiatives, blue food governance **remains fragmented.** While Japan and South Korea have well-developed regulatory frameworks, **inconsistencies in enforcement across China, Taiwan, and other parts** of the region weaken ecological sustainability and food safety.
- To maximise impact, **East Asian nations must align blue food strategies with global sustainability goals. This includes:**
  - **Integrating blue foods into climate commitments** under the **Paris Agreement** to access climate finance.
  - Expanding eco-certification programs like the **Marine Stewardship Council (MSC) and Aquaculture Stewardship Council (ASC).**
  - **Promoting fiscal incentives**, such as tax breaks and targeted subsidies, to encourage sustainable practices.
  - **Establishing cross-border cooperation** in managing transboundary fisheries, especially in sensitive areas like the South China Sea and East China Sea.

Advancing the Sustainable Development Goals (SDGs) with Blue Foods

By embedding blue food strategies into their **Nationally Determined Contributions (NDCs)**, East Asian nations can contribute directly to key Sustainable Development Goals:

- **SDG 2:** End hunger through nutrition-rich aquatic foods.
- **SDG 12:** Promote sustainable consumption and production via eco-labelling and supply chain transparency.
- **SDG 13:** Support climate action through carbon-sequestering aquaculture.
- **SDG 14:** Conserve marine ecosystems through sustainable fisheries management.

Aviation Safety in India

Sub-Topic: *Infrastructure: Energy, Ports, Roads, Airports, Railways etc.*

Context :

Flight AI-171, a Boeing 787-8 Dreamliner (VT-ANB) bound for London-Gatwick, crashed **30 seconds after take-off** from Ahmedabad, slamming into the B.J. Medical College hostel and killing 279 people (241 on board, 38 on the ground); only one passenger survived .

About the Aircraft Accident Investigation Bureau (AAIB)

- Established under Rule 8 of the **Aircraft (Investigation of Accidents and Incidents) Rules, 2017**, the **AAIB** is India's designated **accident-investigation authority** .
- In practice, it remains an attached office of the **Ministry of Civil Aviation (MoCA)**, and its **Director General** reports to the **Civil Aviation Secretary**.
- Objective per Rule 3: **"prevention of accidents… not to apportion blame or liability."**

What is the present institutional arrangement for aircraft-accident investigation in India?

- **Statutory design** – The **Aircraft Accident Investigation Bureau (AAIB) and the Directorate-General of Civil Aviation (DGCA)** are both *subordinate offices* of the Ministry of Civil Aviation (MoCA). Their heads are appointed, transferred and funded by the same Ministry that frames policy and supervises the airlines they may have to investigate.
- **Bharatiya Vayuyan Adhiniyam, 2024** – although it repeals the 1934 Act, it *retains* MoCA's "superintendence" over AAIB and DGCA and permits the Centre to review or modify their orders. Thus, structural dependence continues.
- **ICAO Annex 13 mandate** – international practice requires the investigating body to be "functionally independent" of the regulator and service providers it investigates. India's model therefore falls short of the global norm.

Aviation-Safety Architecture in India

- **J.K. Seth Committee Report (1997)**
  - Warned that the **DGCA "cannot be prosecutor, jury and judge"** in cases involving its own oversight; advocated a fully **independent investigation bureau** with its own cadre and budget.
  - Called for unified **flight-safety data-sharing**, crew-resource-management training, and active stakeholder consultation—recommendations largely shelved.
- **Aircraft Rules 2017 – Key Provisions**
  - Codify ICAO **Annex 13** principles: independence, no-blame, and time-bound reporting (ideally within 12 months).
  - Empower **AAIB** to issue safety recommendations, maintain a public database, and publish bulletins
  - Yet Rule 8(2) keeps AAIB **within MoCA**, compromising actual autonomy.

What are the Major Lacunae in India's Investigation Ecosystem?

- **Institutional dependency**: AAIB/DGCA personnel and budgets controlled by MoCA, diluting impartiality.
- **Resource deficits**: Less than 50 full-time investigators for one of the world's fastest-growing markets; limited labs and flight-data decoding capacity.
- **Delayed & contradictory reports**: Many exceed the 12-month ICAO timeline; inconsistencies (e.g., "entered cloud" vs. clear weather) erode credibility.
- **Judicial misuse**: AAIB's technical findings are often treated as **legal verdicts**, leading to quick "pilot-error" blame; inhibits a **just culture**.
- **Poor follow-up**: Only a fraction of AAIB safety recommendations achieve "closed-acceptable action" status.

India's New EV Import Policy

Sub-Topic: *Infrastructure: Energy, Ports, Roads, Airports, Railways etc.*

Context:

In a landmark move aimed at accelerating the adoption of electric vehicles and attracting foreign investment, the Indian government has introduced a new EV policy titled the **Scheme to Promote Manufacturing of Electric Passenger Cars in India** (**SPMEPCI**). This policy aims to transform India into a global EV manufacturing hub while supporting its climate goals, job creation, and industrial growth.

Key Features of the EV Policy

- **Import Duty Reduction**: Import duties on **Completely Built Units (CBUs)** of electric four-wheelers with a **minimum Cost, Insurance and Freight (CIF) value of $35,000** have been **reduced from 110% to 15%**. This concession is valid for **five years** from the date of approval.
- **Annual Import Cap**: Automakers can import up to **8,000 electric cars per year** at a reduced rate. **Unutilised import quotas** can be carried over to the next year.
- **Investment Commitment**: Minimum investment required: More than **Rs 4,000 Crore (~$500 million)**. Investments can include **R&D, machinery,** and **tools**, with:
  - **5% allowed for charging infrastructure**
  - **10% for land and factory buildings**

Eligibility Criteria & Milestones

- **Turnover Requirements**: ₹2,500 crore by the second year, ₹5,000 crore by the fourth year, and ₹7,500 crore by the fifth year.
- **Local Value Addition**: At least 25% by third year and 50% by fifth year.
- **Eligibility**: Applicants must have at least ₹10,000 Crore in global automotive revenue or ₹3,000 Crore in assets (for investment firms).
- **Application Window**: The application window will open shortly and remain available for **120 days**, with flexibility to reopen until **March 15, 2026**.

Strategic Exclusion of Chinese Companies

- The scheme **excludes Chinese firms** due to **national security**, **dumping**, and **geopolitical concerns**.
- Past rejections:
  - **BYD's $1 billion** plan was rejected in **July 2023**
  - **Great Wall Motors (GWM)** shelved its plans due to lack of approval
- **BYD India** officially confirmed in October 2024 that it is **not applying** under this policy.

India's EV Market: Small but Rapidly Growing

- India's EV market is still in its early stages, with electric vehicles making up **just 3%** of total car sales in 2024—far behind **China (≈50%)** and the **US (>10%)**. In contrast to China's 11 million electric car sales in 2024, India sold only about **111,300 units**.
- According to research firm ICRA, **EV penetration in passenger vehicle sales is expected to rise to 15% by FY30**, up from 3% in FY25, driven by broader product offerings, improved charging infrastructure, and declining battery prices.

Global EV Landscape

- **China's EV Push:** China's EV success is backed by its national policy, **'Made in China 2025'**, and massive incentives:
  - **Subsidies up to $15,000** per vehicle.
  - Manufacturer grants for EVs with 300+ km range.
  - Up to **$3,000** for scrapping older cars to buy EVs.
  - Government-funded **charging infrastructure** expansion.
- **US EV Policy:** The **Inflation Reduction Act (IRA)** has supercharged the US EV ecosystem:
  - **$7,500 federal tax credit** for new EVs.
  - **$4,000 tax credit** for used EVs.
  - **$35/kWh production subsidy** for batteries, **$10/kWh** for modules.
  - Additional **state-level incentives** and support for EV manufacturing and battery supply chains.

Semiconductor and Electronics Manufacturing

Sub-Topic: *Infrastructure: Energy, Ports, Roads, Airports, Railways etc.*

Context:

In a significant push to strengthen India's semiconductor ecosystem and reduce dependency on imports, the Government of India has relaxed key rules governing **Special Economic Zones** (**SEZs**).

Special Economic Zones (SEZs) in India

These are designated areas that operate under more liberal economic laws than the rest of the country, with the primary goal of attracting investment, boosting exports, and generating employment. These zones were introduced under the Foreign Trade Policy in 2000, replacing the earlier Export Processing Zones (EPZs), and are now governed by the SEZ Act, 2005 and SEZ Rules, 2006.

Key Features of SEZs include Tax and Duty Benefits, Simplified Procedures, Infrastructure, Employment and Investment and Sector Diversity. Some of the **most prominent SEZs** include: Kandla SEZ (Gujarat), SEEPZ (Maharashtra), Noida SEZ (Uttar Pradesh), MEPZ (Chennai, Tamil Nadu), Cochin SEZ (Kerala), Falta SEZ (West Bengal) etc. Each SEZ is **managed by a Development Commissioner** and **operates under the SEZ Act, 2005.**

Why Are Semiconductors Crucial to India's Economic Future?

- Semiconductors are the **foundational building blocks of the digital age.**
  - These tiny chips **power almost every modern device** — from smartphones, laptops, and TVs to smart cars, defence systems, and AI-enabled tools.
  - As artificial intelligence, machine learning, and Industry 4.0 technologies expand, the global demand for semiconductors continues to skyrocket.
- According to the **Semiconductor Industry Association**, **China accounted for 35% of global semiconductor production in 2021.**
  - The **COVID-19 pandemic exposed the vulnerability of global supply chains,** prompting countries like India to localise the production of critical electronic components.
  - A diversified and resilient semiconductor supply chain is now seen as a national strategic priority.

What are the changes done in the SEZ Rules?

- **Reduction in Minimum Land Requirement for SEZs:** Previously, companies setting up SEZs exclusively for semiconductor or electronic component manufacturing required a minimum contiguous land area of 50 hectares. The revised rule now reduces this threshold to just 10 hectares.
  - This change lowers the **entry barrier for investors**, **allowing mid-sized and emerging tech companies** to establish SEZs with smaller investments, while still enjoying tax benefits, duty-free imports, and infrastructure support.
- **Relaxation of 'Encumbrance-Free' Land Requirement:** The amendment to **Rule 7** of the **SEZ Rules** enables the **Board of Approval** to relax the mandatory requirement for land to be **"encumbrance-free."**
  - In India, **land titles are often unclear or disputed** due to outdated land records and legal complexities. This rule change allows SEZ proposals to move forward even when the land has minor legal claims or administrative hurdles.
  - It removes a major bottleneck in land acquisition, thereby speeding up project approvals and encouraging quicker implementation of semiconductor manufacturing zones.
- **Permission for Domestic Sales by SEZ Units:** Traditionally, SEZ units are required to focus on exports.
  - However, under the amended **Rule 18**, **SEZ units** producing semiconductors and electronic components can now sell in the domestic market after paying applicable duties.
  - This not only shields manufacturers from volatile global trade conditions but also strengthens India's internal supply chains, ensuring local availability of critical components for industries like electronics, EVs, aerospace, and telecom.

India's Digital Divide

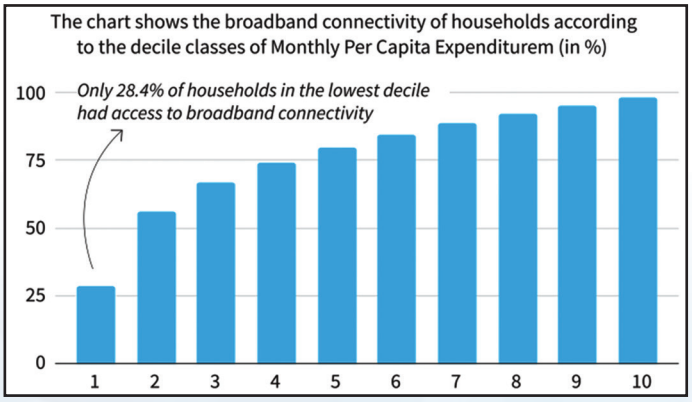
Sub-Topic: *Inclusive growth and issues arising from it.*

Context:

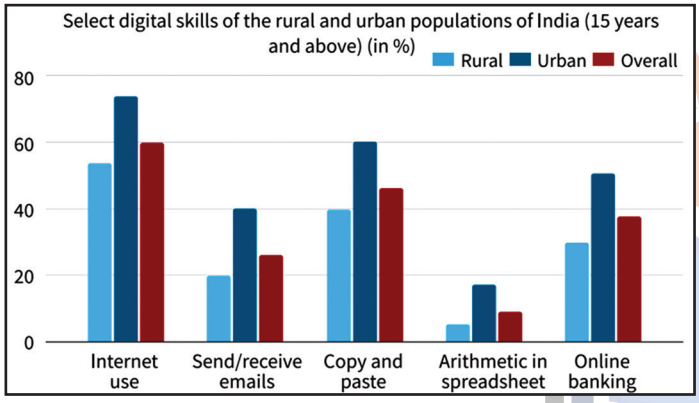
According to the **National Sample Survey Office's (NSSO) Comprehensive Annual Modular Survey** (**CAMS - country's first large-scale survey focusing on digital technology usage across demographics**), India has access to robust nationwide data on digital access and skills.

How is broadband access in India showing uneven landscape?

- **National:** At a **national level**, more than **three-fourths of Indian households now have broadband Internet.**



- **Urban-Rural:** While **urban India boasts 86.5% connectivity, rural areas are not far behind with more than 70%**—signalling widespread Internet penetration.
  - However, this **digital expansion is marked by stark inequalities** across states, castes, income groups, and genders.
- States like **Delhi, Goa, Mizoram, Manipur, Sikkim, Haryana, and Himachal Pradesh** lead with over **90% of households having broadband access.**
- In contrast, **West Bengal**, **Andhra Pradesh**, **Odisha**, **and Arunachal Pradesh** lag behind.
- If assessed socially, **general category households** have the highest broadband access, followed by **Other Backward Classes**, **Scheduled Castes**, and **Scheduled Tribes**.



What is the impact of digital divide?

- The CAMS report highlights a **strong correlation between monthly per capita consumption expenditure (MPCE) and broadband access**.
- While **rural and urban households** have mobile or telephone connections, individual access and usage paint a different picture.
- However, when focusing on exclusive **mobile usage with active SIMs for calls or Internet, the gender caste gaps are also apparent**.

Is India the world's fourth-largest economy?

Sub-Topic: *Indian Economy and issues relating to planning, mobilisation of resources, growth, development and employment.*

Context:

India is set to overtake Japan as the world's fourth-largest economy in 2025, according to recent projections by the **International Monetary Fund (IMF).**

Table 1: Ranks of the top 10 economies in nominal GDP at market exchange rates, 1990 to 2030, in U.S. dollars

Country	1990	2000	2009	2024	2025p	2030p
United States	1	1	1	1	1	1
China	11	6	3	2	2	2
Germany	3	3	4	3	3	4
Japan	2	2	2	4	5	5
India	**14**	**13**	**11**	**5**	**4**	**3**
United Kingdom	5	4	6	6	6	6
France	4	5	5	7	7	7
Italy	6	7	7	8	8	9
Canada	7	8	10	9	9	8
Brazil	10	10	8	10	10	10

More on News

- With **an estimated GDP of $4.2 trillion,** India will **trail only the United States, China, and Germany.**
- **By 2028, India could climb to the third position,** with government sources hailing this as a result of strong leadership and a step toward achieving the ambitious 'Viksit Bharat 2047' vision.
- While this milestone has generated significant media and political attention, the celebration of India's economic size **demands deeper scrutiny.**

Table 2: Ranks of the top 10 economies in nominal GDP at PPP exchange rates, 1990 to 2030

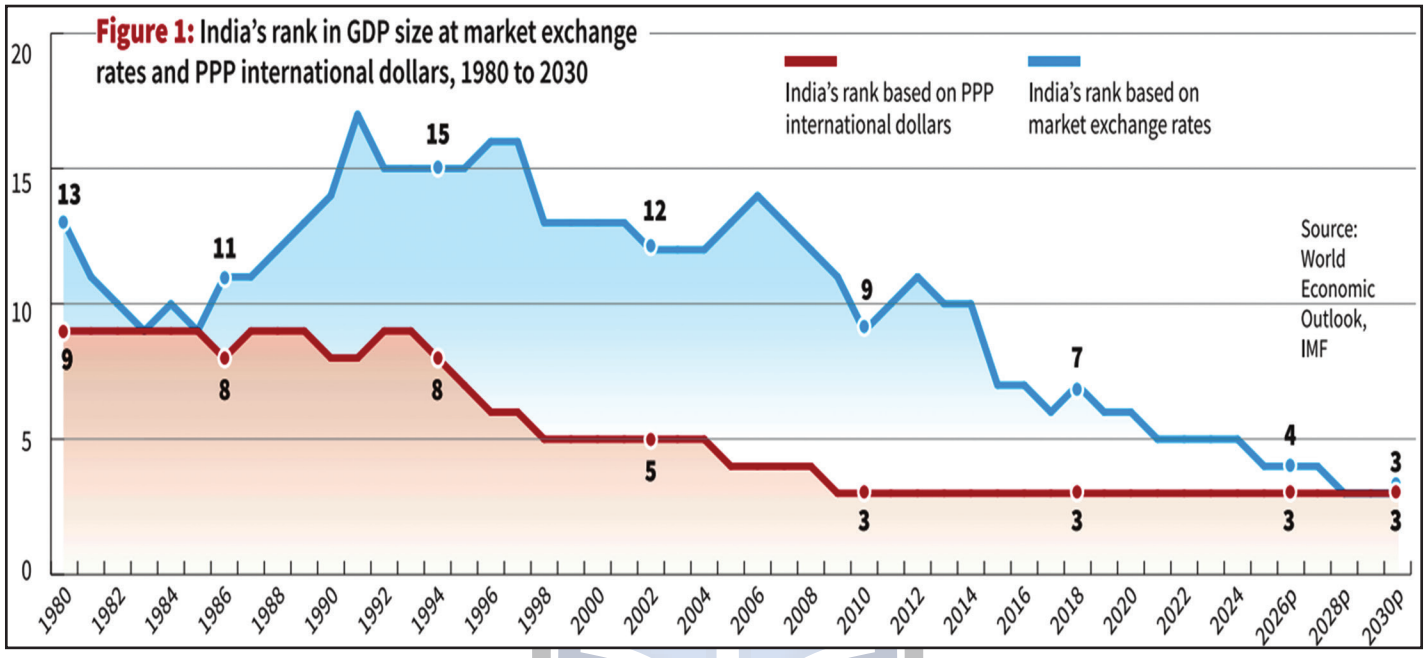
Country	1990	2000	2009	2024	2025p	2030p
China	7	3	2	1	1	1
United States	1	1	1	2	2	2
India	**8**	**5**	**3**	**3**	**3**	**3**
Russian Federation	-	9	6	4	4	4
Japan	2	2	4	5	5	5
Germany	3	4	5	6	6	6
Brazil	9	10	8	7	8	8
Indonesia	13	14	12	8	7	7
France	5	7	7	9	9	10
United Kingdom	6	8	9	10	10	9

Many Faces of GDP: Why Bigger Doesn't Always Mean Better

- **Limitations of GDP:** Gross Domestic Product (GDP) is a **common measure of a country's economic output.**
  - However, **GDP does not reflect how wealth is distributed, how healthy or educated people are, or how well they live.**

- It also **ignores unpaid but essential economic activities**, such as domestic work, often carried out by women.
- Over time, **many experts and economists have called for moving beyond GDP** as the sole measure of national progress. Still, global and domestic discourse continues to prioritise it.

- **Politicisation:** What complicates the picture further is the **politicisation of statistics in recent years,** which often distorts objective assessments.
  - The current debate on India's GDP rank is one such example. **Comparing the GDP of different countries is far from straightforward**—it depends on how GDP is calculated and converted into a common currency like the U.S. dollar.

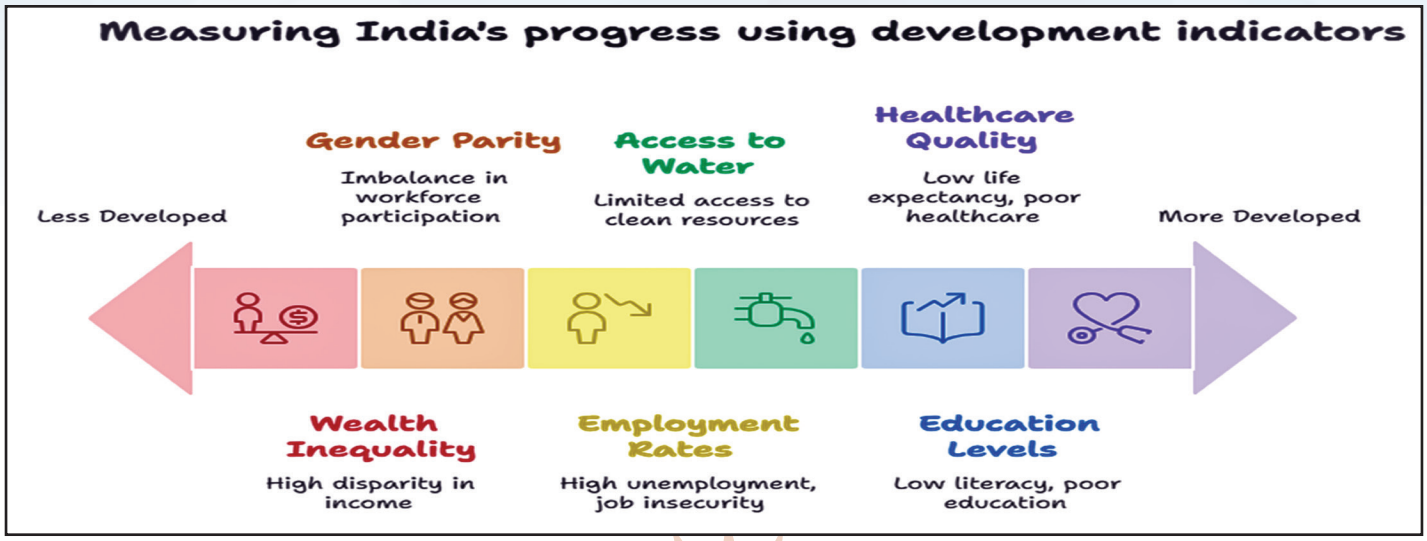


Understanding the Limitations of PPP and GDP Rankings

- While **PPP-adjusted GDP offers a fairer view of real economic capacity,** it **can also inflate the economic status of poorer countries.**
- This is **because low wages and prices make goods and services appear more affordable.** But these lower prices also stem from deep structural issues such as:
  - Widespread informal employment
  - Low productivity
  - Wage suppression
  - Unpaid labor
- For instance, around **80% of India's casual agricultural workers and 70% in construction earn below minimum wage** (ILO **India Employment Report**, 2024).
  - The reality is that lower prices in India reflect economic underdevelopment, not superior affordability.
- **Statements like those** by NITI Aayog Vice-Chairperson Suman Berry, who claimed India's PPP-based GDP had reached $15 trillion—half that of the U.S.—**must be treated cautiously.** These figures mask the glaring gap in per capita income and quality of life.

India's Per Capita GDP: The Real Indicator of Well-Being

- **Per Capita GDP:** India may be climbing in total GDP size, but its **per capita GDP remains low due to its massive population: $2,711 in 2024 (current dollars)** – placing India **among lower-middle-income countries.**
  - In contrast, **Vietnam and Sri Lanka have almost twice the per capita GDP.**
  - Even in **1991, India had a higher per capita GDP than Vietnam**—but by 2024, Vietnam had surged ahead.
- **Market Exchange Rate:** In terms of market exchange rate, **India ranked 144th out of 196 countries in per capita GDP in 2024.**
  - **Even with PPP adjustments, it ranked only 127th.**
  - This mismatch between total GDP and per capita GDP has led many to call this the ***"big economy illusion"*—a scenario where total output hides persistent poverty and inequality.**



Govt Sets Up Expert Panel to Collect Income Data

Sub-Topic: *Indian Economy and issues relating to planning, mobilisation of resources, growth, development and employment.*

Context:

The Government of India, through the Ministry of Statistics and Programme Implementation (MoSPI), is planning to conduct **India's first full-scale all-India Household Income Distribution Survey** in 2026.

About the Survey

- This will be the **first comprehensive and nationwide effort** to directly collect data on household incomes, marking a significant shift in India's statistical architecture which **traditionally relies on consumption data** as a proxy for income.

Has India attempted income surveys in the past?

Yes, several **experimental or pilot surveys** were conducted by NSSO:

- **9th Round (1955)** and **14th Round (1958)** attempted income data collection, but results weren't released.
- **19th and 24th Rounds (1964-70)** under the Integrated Household Survey collected data on income and disbursements.
- In **1983-84**, a pilot enquiry was again conducted but could not be scaled to a national level.

Reasons for failure:

- **Income underreporting**: Reported incomes were **lower than** reported **consumption and savings**, raising doubts about reliability.
- **Operational complexities** in capturing all income sources, especially informal and self-employed income.
- **Lack of technological and methodological capacity** at the time.

Private entities like **NCAER** and **PRICE** have since conducted their own income surveys, but these have lacked official status or nationwide coverage.

What is the difference between income and consumption data, and why has India relied on consumption instead of income so far?

- **Consumption data** measures what households spend, while **income data** measures what households earn.
- In developing countries like India, **income data is often under-reported**, especially for informal sector workers, leading to a **preference for consumption data**, which is easier to observe and recall.
- NSS has consistently used **Consumer Expenditure Surveys (CES)** since the 1950s as a **proxy for income**.
- However, consumption data can **miss savings, inter-household transfers, or new income sources** (e.g., gig work), hence the push for income data.

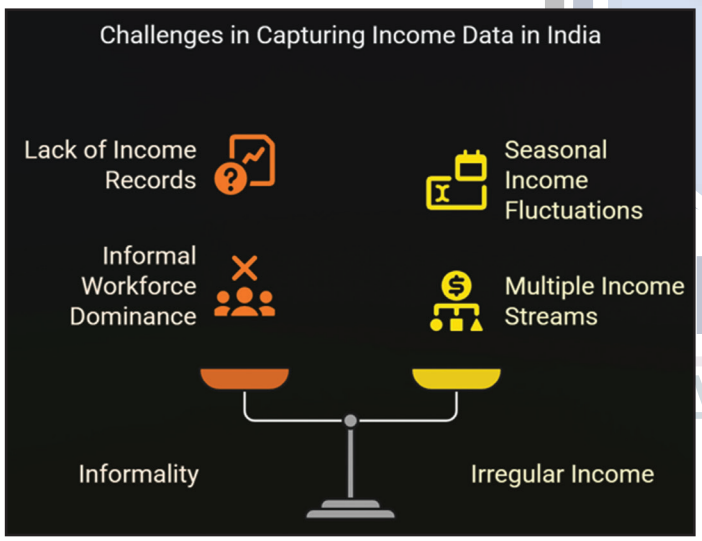
Why is this income survey significant?

- **Data Gap**: India lacks reliable, nationwide data on **household income**. Most welfare policies and economic planning rely on **consumption data** collected through the National Sample Survey (NSS), which is an imperfect proxy.
- **Policy Planning**: Direct income data will help better target **welfare schemes**, assess **income inequality**, and measure the impact of **technological and structural changes** in the economy.

- **Global Practices**: Unlike India, many countries routinely collect income data for **evidence-based policymaking**.
- **Inequality Debate**: The growing divergence between **Consumption Expenditure Survey (CES)** and **National Account Statistics (NAS)** has led to concerns about underestimation of poverty or misrepresentation of well-being. Income data will provide clarity.

What are the expected outcomes of this income survey?

- **Accurate income distribution data** for policy planning
- Better understanding of **income inequality**, **regional disparities**, and **inter-generational mobility**
- Enhanced ability to **target subsidies and social welfare schemes**
- Support for India's commitment to **Sustainable Development Goals (SDGs)**, especially those related to poverty and inequality
- Rich database for **academic research**, government planning, and budgetary prioritisation



How can the survey improve fiscal policymaking and welfare targeting?

- **Better Beneficiary Mapping**: Direct income estimates will help government schemes like **PM-KISAN, Ujjwala, PDS** or **pension plans** to be **better targeted**.
- **Inequality Monitoring**: It will help measure **Gini coefficient**, **income deciles**, and **growth incidence curves**, allowing more nuanced decisions on **redistributive taxation or subsidies**.
- **Budget Prioritisation**: Insights from the income survey could shape **Budget allocations** and **sectoral investments**.

Practice Questions

3. How can blue foods and aquaculture help in consolidating India's food and nutritional security? **(*Answer in 150 words*) 10**
4. What is the digital divide? How does it affect inclusive economic growth? **(*Answer in 150 words*) 10**
5. Despite India becoming the fourth-largest economy, inclusivity and economic equality are still lacking in the country. Comment. **(*Answer in 250 words*) 15**

Prelims

Collection of Real-Time Observations & Photo of Crops (CROPIC)

Sub-Topic: *E-technology in the aid of farmers.*

Context:

The Ministry of Agriculture and Farmers Welfare is set to launch **CROPIC**, an AI-driven study aimed at gathering crop information through field photographs. This initiative will enhance crop monitoring, automate loss assessment, and streamline compensation under the **Pradhan Mantri Fasal Bima Yojana (PMFBY)**.

What is CROPIC?

- **CROPIC** stands for **Collection of Real-Time Observations & Photo of Crops**.
- It involves photographing crops **four-five times** during their cycle to assess their health and potential mid-season losses.
- The study will be conducted for **two seasons initially**:
  - **Kharif 2025**
  - **Rabi 2025-26**

Why is CROPIC significant?

- It will help **monitor crop health and stress** using real-time images.
- It will **automate crop loss assessment**, ensuring **faster compensation** for affected farmers.
- The study will contribute to **building a rich directory of crop signatures**, aiding future agricultural research.
- It is part of **digital innovations in agriculture**, fostering **financial resilience** for farmers.

How Will CROPIC Work?

- Farmers will **crowd-source field photographs** using the **CROPIC mobile app**, developed by the **Union Ministry of Agriculture and Farmers' Welfare**.

- The collected images will be analysed for: **Crop type, Crop stage, Crop damage and its extent.**
- The **AI-based cloud platform** will process the images, and a **web-based dashboard** will visualise the data.
- Officials will also use the **CROPIC mobile app** to collect photographs when compensation or insurance claims need to be processed.

Pradhan Mantri Fasal Bima Yojana (PMFBY)

- PMFBY was launched on **February 18, 2016**, by Prime Minister Narendra Modi.
- The scheme **aims to protect farmers from crop losses** due to natural calamities like droughts, floods, hailstorms, diseases, and pests.
- It provides **financial support to farmers, stabilising** their **income** and **encouraging innovative agricultural practices**.
- It utilises **modern technology** like: **Satellite imagery, drones, Unmanned Aerial Vehicles (UAVs),** and **remote sensing**.

Pradhan Mantri Gram Sadak Yojana (PMGSY)

Sub-Topic: *Infrastructure: Energy, Ports, Roads, Airports, Railways etc.*

Context:

The Union Ministry of Rural Development (MoRD) has introduced a new initiative to improve the quality and maintenance of rural roads constructed under the **Pradhan Mantri Gram Sadak Yojana (PMGSY)** by leveraging **QR code-based public feedback**.

What is PMGSY?

- The **Pradhan Mantri Gram Sadak Yojana (PMGSY)** is a flagship scheme aimed at improving **rural road infrastructure**.
- **Launched:** December 25, 2000, under PM Atal Bihari Vajpayee's NDA government.
- **Goal:** Provide all-weather road connectivity to unconnected villages and habitations.

What are the different phases of the PMGSY?

- **Phase I (2000)**: Focused on providing basic road connectivity.
- **Phase II (2013)**: Consolidation of the existing rural road network.
- **Road Connectivity Project for Left Wing Extremism Affected Areas (RCPLWEA) in 2016**: Aimed specifically at enhancing connectivity in insurgency-hit regions.
- **Phase III (2019)**: Focused on upgrading existing roads.
- **Phase IV (Approved on September 11, 2024)**: Targets connecting **25,000 unconnected habitations** with population thresholds based on terrain:
  - **500+ in plains**
  - **250+ in northeastern and hill states/UTs, special category areas** (Tribal Schedule V, Aspirational Districts/ Blocks, Desert areas)
  - **100+ in LWE-affected areas**, as per **Census 2011**

What's New: QR Codes for Maintenance Feedback

- **New Directive from MoRD:** The **National Rural Infrastructure Development Agency (NRIDA)**, the technical arm under MoRD responsible for PMGSY implementation, has initiated the QR code project to incorporate **public feedback** into the **maintenance monitoring process**.
- **Purpose of QR Codes:** This move addresses a critical gap—while contractors are obligated to maintain PMGSY roads for **five years** post-construction, and inspections are conducted via the **e-MARG** system (electronic Maintenance of Rural Roads), **there was no structured mechanism to include citizen feedback** on road conditions.

How Does the New System Work?

- A new utility within the **eMARG** platform enables the **generation of a unique QR code** for each road. These QR codes are to be prominently displayed on **maintenance information boards** at the roadside, accompanied by instructions in **English and local languages** on how to submit feedback.
- **Through this system:**
  - Any road user can **scan the QR code** using a smartphone.
  - The user is directed to a page with **road-specific details**.
  - Users can **click photographs** of the road and **report maintenance issues** directly.
- This citizen-captured data will then be:
  - **Integrated into Routine Inspection (RI) reports**
  - **Assessed using Artificial Intelligence** (AI) and **Machine Learning** (ML) to assist in the **Performance Evaluation (PE)** of the road's condition.
  - **Reviewed by engineering staff**, who will cross-check the data before finalising PE scores.
- According to NRIDA, this mechanism will make the maintenance process under PMGSY more **realistic and transparent**, allowing for **public participation** in evaluating road quality.
  - The **eMARG system** will now function as a more **accountable platform**, aligning feedback from both official inspections and everyday users.

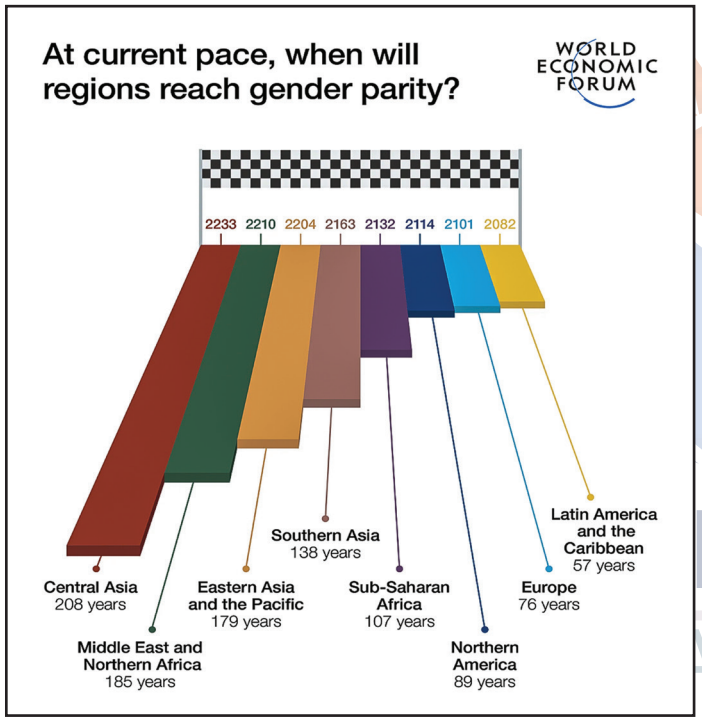
Funding and Progress: Initially, a **Centrally Sponsored Scheme**, from **2015-16**, the funding split changed to **60:40** between the Centre and states (except for northeastern and Himalayan states).

Global Gender Gap Report 2025

Sub-Topic: *Inclusive growth and issues arising from it.*

Context:

India has slipped two ranks to 131 out of 148 countries in the **World Economic Forum's Global Gender Gap Report 2025**, with an overall gender parity score of just 64.1%.



More on News

- This places **India among the lowest-ranked nations in South Asia**, raising concerns over the country's slow progress in achieving gender equality.
- The **Global Gender Gap Index evaluates countries across four key dimensions — economic participation and opportunity, educational attainment, health and survival**, and **political empowerment.**

Global and Regional Highlights

- Globally, the **gender gap has narrowed to 68.8%,** the **highest annual improvement since the COVID-19 pandemic.**
  - However, at the current rate, the **world is still 123 years away from achieving full gender parity.**
- For the 16th year in a row, **Iceland tops the index as the most gender-equal country**, followed by **Finland, Norway, the United Kingdom, and New Zealand.**
- In **South Asia, Bangladesh emerged as a standout performer**, surging 75 places to **rank 24th globally**, thanks to robust gains in political empowerment and economic participation. **Other regional rankings include:** Nepal: 125, Sri Lanka: 130, Bhutan: 119, Maldives: 138 and **Pakistan: 148 (lowest globally).**

How has India performed?

- India saw a **modest rise in economic parity** (especially in income parity though stagnation in the **labour force participation rate for women**).
- Significant **improvement** is witnessed in **educational parity**, which is attributed to **rising female literacy rates** and **greater female enrolment in tertiary (higher) education**, marking a strong step towards long-term gender equality.
- On the health front, **India registered improved parity in sex ratio** at birth and healthy life expectancy, helping boost its score in this dimension.
  - However, the report noted that overall life expectancy declined for both men and women globally — parity was achieved, but under less favourable conditions.
- A concerning drop was observed in India's political empowerment score for the second consecutive year.

Practice Questions

5. The Global Gender Gap Report, sometimes mentioned in the news, is published by:

(a) World Bank

(b) World Economic Forum

(c) United Nations Women (UN Women)

(d) Oxfam International

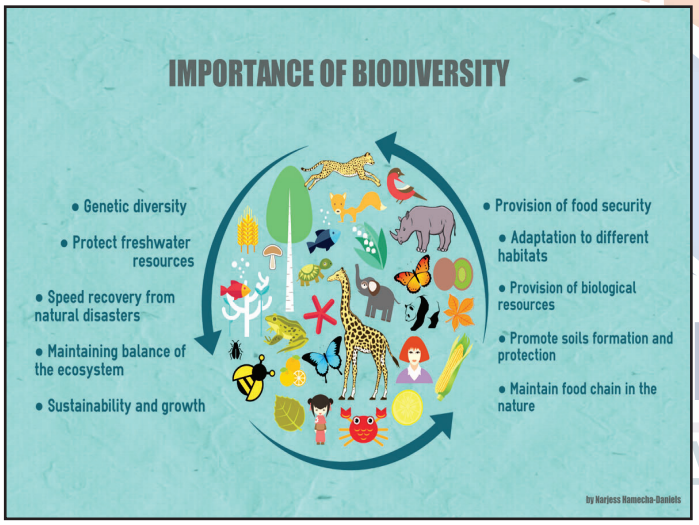
Mains

Wind Turbines and Bird Deaths

Sub-Topic: *Conservation, environmental pollution and degradation, environmental impact assessment.*

Context:

In a groundbreaking ecological study, the **Wildlife Institute of India (WII)** has reported that **wind turbines in Rajasthan's Thar Desert are causing an estimated 13,359 bird deaths annually,** including 953 raptors, due to collisions with turbine blades and associated infrastructure.



More on News

- Published in the **Scientific Reports journal** on June 1, 2025, the research underscores the **urgent need for eco-sensitive planning in renewable energy development.**
- Spanning a 3,000 sq km area of the **Thar Desert—India's largest arid landscape and a critical biodiversity hotspot**—the study assessed the **impact of approximately 900 wind turbines.**
- The **average bird mortality rate was found to be 1.24 deaths per turbine per month,** with an adjusted annual mortality rate of 4.47 birds per 1,000 sq km, placing this region near the upper limit of global bird death estimates caused by wind farms.

Case Study: The Great Indian Bustard (GIB)

The Supreme Court's 2024 judgment in ***M.K. Ranjitsinh v. Union of India*** marked a critical shift in balancing wildlife conservation with renewable energy development. Revisiting its 2021 directive mandating the undergrounding of all power lines across ~88,000 sq km to protect the critically endangered Great Indian Bustard (GIB), **the Court limited this requirement to the smaller Priority Area (13,163 sq km),** while **allowing overhead lines with bird diverters in the broader Potential Area.** A 9-member expert committee was constituted to assess undergrounding feasibility and create guidelines for bird-safe infrastructure. Acknowledging India's renewable energy targets, such as achieving 500 GW by 2030, the **Court emphasised the impracticality of blanket undergrounding and underscored the constitutional imperative of sustainable development under Article 21.**

Impact of Power Lines on Biodiversity Loss in India

- **Direct Habitat Loss and Fragmentation:** Construction and maintenance of power lines require the clearing of vegetation along wide corridors known as **rights of way (RoW).**
  - In forested areas, this often means felling mature trees and clearing native vegetation over swathes of 30 to 50 meters or more, leading to direct habitat destruction.
- **Collisions:** Overhead power lines pose a severe collision risk for large, low-flying birds.
  - **Example:** The **Great Indian Bustard (GIB)**, a **critically endangered** species found mainly in Rajasthan and Gujarat, is especially vulnerable.
- **Electrocution:** It is another major concern. **Large birds and mammals,** such as elephants, have died after coming into contact with live wires.
  - **Example:** In **Karnataka alone, 78 elephants were killed by electrocution over five years.**
- **Habitat Degradation and Secondary Effects:** The regular clearing of vegetation under power lines promotes the spread of invasive species, increases the risk of fires, and leads to further habitat degradation.

Solutions to Mitigate Wind Turbine and Power Line Impacts on Birds

- **Strategic Placement of Wind Turbines & Power Lines:** In **Norway**, **power lines are rerouted away from key habitats** of the white-tailed eagle to reduce collisions.
- **Bird-Friendly Turbine Designs & Operations:** ***"Shut-down-on-demand"*** systems (used in **Germany's North Sea wind farms**) halt turbines during peak bird migration.

- **Power Line Mitigation Measures:** Bird flight diverters (spiral or flapper markers) reduce collisions **(used for bustards in South Africa**).
- **Underground Cabling in Critical Habitats:** The **Great Indian Bustard (GIB) conservation plan** mandates **underground cables in priority zones (Rajasthan).**
- **AI & Radar-Based Monitoring Systems:** Radar systems (**like MERLIN in the Netherlands**) detect bird movements and automatically shut down turbines.
- **Habitat Restoration & Compensation:** ***"Offset habitats"*** are **created near UK wind farms to compensate for lost bird habitats.**

Stratospheric Aerosol Injection

Sub-Topic: *Conservation, environmental pollution and degradation, environmental impact assessment.*

Context:

As global greenhouse gas emissions continue to rise, researchers are exploring alternative technologies to combat climate change. One such method is **Stratospheric Aerosol Injection (SAI)** — a controversial yet increasingly studied geoengineering technique.

The Climate Crisis and the Need for Urgent Alternatives

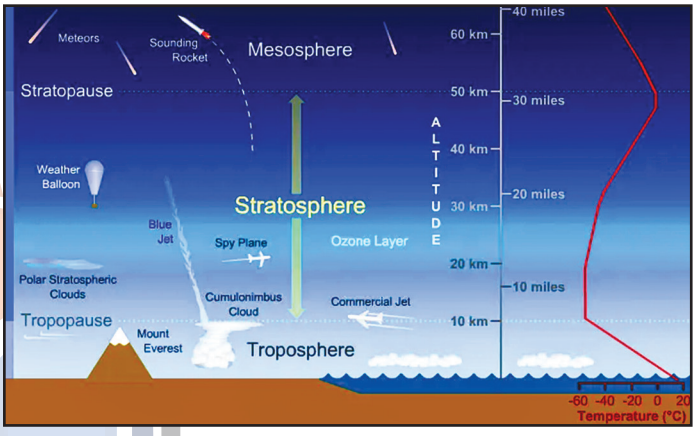
- Global greenhouse gas emissions are **increasing**, with climate mitigation often sidelined due to **war, poverty, disease, and inflation**.
- Reducing reliance on fossil fuels is critical, but the pace is slow and uneven.
- In this context, researchers are exploring **planet-cooling technologies** as supplementary tools to fight climate change.

What Are Aerosols?

- **Aerosols** are **small particles suspended in the atmosphere**.
- They are often **not visible** or **barely visible** to the human eye.
- They play significant roles in **climate, weather, human health, and ecosystems**.
- Size range: From **a few nanometers** (smaller than viruses) to **tens of micrometres** (similar to the width of human hair).
- **Types of Aerosols:**
  - **Primary Aerosols:** Directly injected into the atmosphere. Examples include **Sea spray, Mineral dust, Smoke** (from fires or combustion), and **Volcanic ash.**
  - **Secondary Aerosols:** Formed **indirectly** from gaseous emissions. Created through **chemical reactions** in the atmosphere. Common sources include **Sulphate aerosols** from volcanic eruptions or industrial pollution.

What is SAI?

- **Stratospheric Aerosol Injection** involves **injecting tiny reflective particles (aerosols)** into the **stratosphere** to **reduce the amount of sunlight** reaching the Earth's surface.
- This technique aims to **cool the planet**, mimicking the **natural cooling effect** observed after **volcanic eruptions**.
- **Inspiration from Volcanic Activity:** Volcanic eruptions, such as **Mount Pinatubo in 1991**, released **millions of tonnes of aerosols** into the atmosphere, cooling the planet by about 0.5°C for over a year. SAI is based on replicating this **natural cooling mechanism** using **sulphur dioxide aerosols**.



Current Technical Challenges

- A key factor in the success of SAI is **the altitude, location, and timing** of aerosol injection. Most SAI proposals focus on injection **20 km or more above Earth**, especially in **equatorial regions**, where the **stratosphere is higher**.
- **Existing aircraft cannot fly** at such high altitudes, necessitating the development of **specialised aircraft**, which can take **up to a decade** and require **billions of dollars**.

A New, Cost-Effective Approach

- A recent study published in *Earth's Future, led by* ***Alistair Duffey*** *(UCL), explores the use of* **existing aircraft** to perform SAI at **lower altitudes** in **polar and extratropical regions**.
- In these regions, the **tropopause (boundary between troposphere and stratosphere)** lies at **lower altitudes**, making the **stratosphere more accessible**.
- **Study Findings:**
  - Researchers used the **UK Earth System Model 1 (UKESM1)** to simulate different injection strategies.
  - Injecting **12 million tonnes of sulphur dioxide per year** at **13 km altitude** during **local spring and summer** in each hemisphere could cool the planet by approximately **0.6º C**.
  - For **1º C of cooling**, **21 million tonnes per year** would be required.

- In contrast, if injection occurs at **higher altitudes in the subtropics**, **only 7.6 million tonnes** annually are needed for the same effect.

Advantages of the New Method

- **Cost-effective** and **faster to implement** by using **modified existing aircraft** like the **Boeing 777F**.
- Modifications include **insulated, double-walled pressurised tanks** to safely transport and manage aerosols during flight.
- Could begin much **sooner than high-altitude alternatives** that rely on specialised aircraft.

Risks and Controversies

- Despite its promise, SAI is **fraught with risks**. Deploying three times the usual amount of aerosols (as required in lower-altitude scenarios) could amplify **negative side effects**, such as:
  - **Delayed recovery of the ozone layer**
  - **Acid rain**
  - **Ecological disruptions**
  - Uneven regional impacts — with **stronger cooling in polar areas**, while **tropical regions**, where warming is more severe, may benefit less
- Moreover, **SAI does not reverse climate change** or address root causes like emissions and ecosystem degradation. It only temporarily **masks surface warming**, which could lead governments to **become complacent** about cutting emissions.
- Social, political, and **geopolitical implications** are even more contentious. Since the effects of SAI are **global**, the decision of a single country to proceed could affect the entire planet, potentially **triggering diplomatic disputes** or unintended climate consequences elsewhere.

WMO Reports Asia Warming Twice

Sub-Topic: *Conservation, environmental pollution and degradation, environmental impact assessment.*

Context:

The *State of the Climate in Asia 2024* report by the **World Meteorological Organisation (WMO)** reveals that **Asia is warming nearly twice as fast as the global average**. This accelerated warming is causing more frequent and intense **heatwaves, glacier retreat, sea-level rise**, and **extreme weather events** like floods and cyclones.

Why is Asia warming faster than the global average?

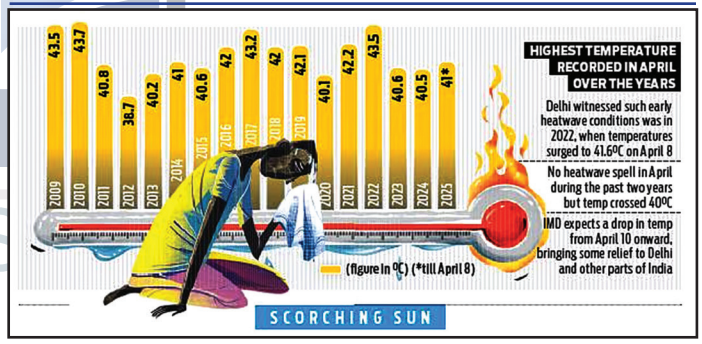
- According to the WMO, **land areas warm faster than oceans**, and **Asia has the largest continental landmass**, covering over **44.58 million square kilometers**. This makes the continent especially vulnerable to **land-based temperature increases**.
- Additionally, proximity to the rapidly warming **Arctic** further exacerbates temperature rises in northern Asia.
  - Global average temperature has already risen by approximately **1.2°C above pre-industrial levels**. In Asia, the increase has been **twice this rate** since the 1990s.

Where are the most concerning changes occurring?

- **High-Mountain Asia (HMA)** — including the **Himalayas, Tian Shan, and Hindu Kush** — witnessed **continued glacier mass loss**.
- **Northern Indian Ocean, Yellow Sea, and East China Sea** saw **record-high sea surface temperatures** and **severe marine heatwaves**.
- **Central Asia (Kazakhstan and southern Russia)** faced the **worst flooding in 70 years**.
- **UAE** experienced one of its most extreme rainfall events since **1949**.
- The **Wayanad landslide** in Kerala, India, caused by **record-breaking one-day rainfall**, was linked to a **10% increase in rainfall intensity** due to climate change.

India's Heatwave Crisis

Sub-Topic: *Conservation, environmental pollution and degradation, environmental impact assessment.*



Context:

India is undeniably heating up. Heat waves are arriving earlier, lasting longer, and intensifying in ways that are fundamentally reshaping life, work, and public health across the country.

What is a heatwave?

- According to the India Meteorological Department (IMD), a **heatwave** is declared when temperatures in the plains hit **40°C or more**, or **30°C in the hills**, and remain **4.5°C or more above normal for at least two consecutive days**. These conditions, once infrequent, are fast becoming the seasonal norm.

- The **Economic Survey 2024-25** observed a **200% increase** in the number of heatwave days.

What is heat stress and heat risk?

- **Heat stress:** When body temperature exceeds 37°C, leading to discomfort, cramps, or exhaustion. Above 40°C, heat stroke can occur.
- **Heat risk:** The probability of experiencing heat-related illness or death due to exposure to extreme temperatures.

It depends on the intensity of heat (including humidity), exposure level, and underlying vulnerabilities of communities.

How much is India vulnerable?

- A **CEEW report** notes that **three-fifths of India's districts**, which are home to **three-fourths of the population**, face **high to very high heat risk**. The most vulnerable states include: Delhi, Maharashtra, Kerala, Gujarat, Rajasthan, Tamil Nadu, Andhra Pradesh, Madhya Pradesh, and Uttar Pradesh.
- Notably, the number of **very warm nights** is rising **faster than hot days**, especially in urban centres, where concrete and asphalt absorb and retain heat — a phenomenon known as the **urban heat island effect**.
  - Rapid urbanisation has intensified this effect.

Impact of Heatwave

- **Reducing Productivity of Workforce:** The **International Labour Organisation (ILO)** in 2024 warned that over **70% of workers globally** face excessive heat exposure. **India is estimated to have lost $100 billion** due to **heat-induced productivity losses**.
  - This exposes informal workers, including **farmers, construction workers, delivery partners, and street vendors**.
  - Increased **absenteeism**, **sleeplessness**, and **illness**.
  - In **factories**, **manufacturing output** is estimated to **drop by ~2% for every 1°C rise in temperature**.
- **Falling Agro Yield and Production:** The **Economic Survey 2024-25** noted a decline in **certain agro-commodities**, including **pulses**.
  - A **1°C rise** reduces **wheat yield by 5.2%**.
  - Heatwaves during **late rice-growing seasons also harm** productivity.
- **Rise in Food Insecurity and Inflation:** A **decline in food production** reduces the **supply**, which is unable to meet the **population's demand**, coupled with **droughts**, leading to **food insecurity** and an **increase in food and retail inflation**.
- **Rise in Cardiac Arrests & Other Medical Issues:** From 2000 to 2020, more than **20,000 deaths** were officially attributed to heatstroke in India.

Institutional Response: Heat Action Plans

- India has begun responding through **Heat Action Plans (HAPs)**, pioneered in cities like **Ahmedabad**, where implementation in **2014** led to **1,190 fewer deaths annually** in the initial years.
- These plans include:
  - **Short-term measures**: water availability, cooling shelters, shaded areas, and public awareness.
  - **Long-term adaptation**: urban greening, restoration of water bodies, passive cooling in buildings.
- **Chennai** has incorporated **urban heat island mapping** into its **master plan**, while cities like **Bhubaneswar** and **Nagpur** are expanding green cover and adopting **rooftop reflectivity measures**.
- However, **rural India remains largely uncovered**. No heat governance equivalent exists for villages, despite the fact that **most vulnerable populations reside in rural areas**. Local bodies like **Gram Panchayats** lack funding, trained personnel, and institutional support to tackle heat systematically.

Funding and Policy Integration

- States can access their **State Disaster Management Fund** for emergency heat response. However, experts argue for **long-term investments** via:
  - **District Mineral Funds**
  - **Fifteenth Finance Commission allocations**
  - Integration with schemes like **MGNREGA, PM Awas Yojana, and National Health Mission.**
- Innovations such as **heatwave insurance** are being tested, where workers pay small premiums and receive compensation when extreme heat halts work. However, implementation remains inconsistent.

Blending Tradition with Modernity

- India's history holds valuable lessons. Traditional cooling techniques — **mud homes, step-wells, lime plaster, jaalis, water-cooled courtyards** — were not just cultural; they were *climate-wise*.
- Practices like **Navtapa** promoted light diets, hydration, and midday rest, aligning remarkably with modern climate science.
- **Glass facades, concrete homes**, and **tight work schedules** replaced solar-aligned, breathable, and adaptive lifestyles. **Planning codes** do not mandate passive cooling; **real estate finance** rarely supports traditional architecture.

Mangroves & Cyclones and Floods

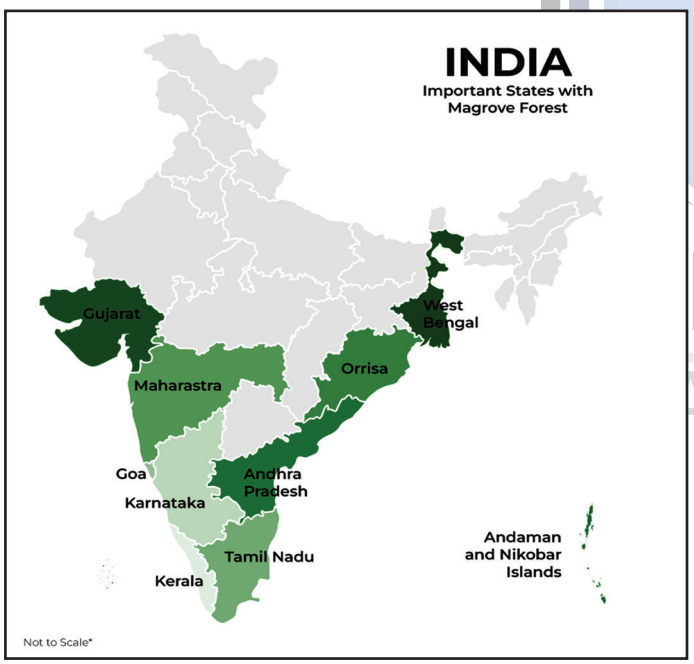
Sub-Topic: *Important Geophysical phenomena such as earthquakes, Tsunami, Volcanic activity, cyclone etc.*

Context:

Mangroves play a vital role in shielding India's eastern coast from cyclones and floods, making their preservation and restoration crucial for ecological protection and the resilience of coastal communities.

Why Are Mangroves Critical for Coastal Protection?

- **Mangroves** act as natural barriers, reducing the impact of **cyclones** and **floods** by absorbing tidal surges and stabilising coastlines.
- **Sundarbans** in **West Bengal**, the world's largest **mangrove forest**, protects against **cyclones** and **floods** at the confluence of the **Ganges**, **Brahmaputra**, and **Meghna** rivers.
- They support **biodiversity**, hosting diverse **flora** and **fauna**, and provide **environmental services** like nutrient enrichment through **mangrove root systems**.



How Mangroves Mitigate Cyclones?

- **Cyclone Dana:** Mangroves played a crucial role in mitigating the impact of Cyclone Dana in 2024, especially **near Odisha's Wildlife Sanctuary,** where they reduced tidal surges and minimised damage.
- **Super Cyclone:** Forest officials credit enhanced mangrove coverage since the devastating 1999 Super Cyclone for strengthening coastal defences.

What Threats Do Mangroves Face in Eastern India?

- **Climate change** increases **cyclone frequency** and **intensity**, exacerbating **land erosion** and **salinity** in **water** and **soil**.
- **Prawn aquaculture** in **Odisha** and unregulated **eco-tourism** in the **Sundarbans** degrade **mangrove ecosystems**.
- In the **Sundarbans**, deteriorating **embankments** and rising **river levels** cause frequent **flooding**, threatening **villages** and **agricultural lands**.
- **Man-eater tigers** pose risks to communities collecting **NTFPs**, complicating **mangrove conservation** efforts.

Role of Local Communities and Civil Society

- **Civil society organisations** like **ActionAid** engage **local communities**, particularly **women**, in **mangrove plantation** initiatives to combat **climate change** and **soil erosion**.
- **Women** in the **Sundarbans** have established **nursery beds** and planted **mangrove seeds**, creating **employment opportunities**.
- **Eco-development committees (EDCs)** and **women self-help groups (WSHGs)** promote **sustainable conservation** and reduce **forest dependency**.
- Collaboration among **governments**, **civil society**, and **local communities** is essential for **mangrove preservation** and **new plantations**.

Biohappiness in India

Sub-Topic: *Conservation, environmental pollution and degradation, environmental impact assessment.*

Context:

Biohappiness, coined by **Prof. M.S. Swaminathan**, **envisions development rooted in ecological balance and traditional knowledge**, positioning India to build sustainable nutrition and health models.

Why India Needs a 'Biohappiness'-Oriented Approach?Monoculture farming and simplified diets have **caused nutritional deficiencies** and **increased climate risks**, while **tribal communities like the Nyishi** and **Apatani** in **Arunachal pradesh** retain **rich knowledge of diverse, local foods**.

- Traditional crops such as **millets**, **yams**, and **pulses—nutrient-rich**, **climate-resilient**, and culturally rooted—offer pathways to sustainable and inclusive development.

Major Roadblocks in Achieving 'Biohappiness'

- **Agrobiodiversity Under Threat: Monoculture** and preference for **commercial crops** have led to a severe **loss of genetic diversity** and **traditional food systems**. Over **50% of plant-based calories** globally come from just **rice, wheat, and maize**, reflecting **dietary homogenisation** and **climate vulnerability**.

India's Biodiversity Wealth and its Underutilisation

- Despite occupying only **2% of global land area**, India harbours **8% of global biodiversity**, making it one of the **17 megadiverse countries**.
- The country intersects **4 of the 36 global biodiversity hotspots**, and serves as a major centre of **food crop diversity**.

- **Rising Environmental Disease Burden:** India bears **25% of the global environmental disease burden**. The **WHO GBD 2021** attributes around **20% of global deaths** and **5% of DALYs** to **Occupational and Environmental Health (OEH)** risks, with **air pollution alone causing 8 million deaths** globally—**3 million in India**.
- **Gaps in Public Health Frameworks:** Existing frameworks are limited, considering only **~11 risk factors**, and **ignore** critical threats like **chemical exposures**, **microplastics**, **noise pollution**, and **life-course effects**. They also fail to capture **interactions** with **metabolic, behavioural, and genetic risks**.
- **Climate Change as a Risk Multiplier: Climate change** worsens **air pollution**, **heat stress**, and **vector-borne diseases**, leading to **complex, interconnected health risks** that current systems struggle to address.

Policy Interventions and Strategic Pathways

- **Reviving Traditional Food Systems:** Initiatives like the **Odisha Millet Mission** and **MSSRF in Kolli Hills** have **revived millet diversity**, **empowered women farmers**, and promoted **crop diversification**, **soil health**, and **value addition**, integrating **millets into the PDS**.
- **Government Push for Millets:** Through the **International Year of Millets** and **Shree Anna Yojana**, India is **promoting production, exports, branding**, and **nutrition awareness**, while **State Millet Missions** focus on **ragi, jowar, and bajra**; future efforts must include **minor millets**, **wild greens**, and **diverse legumes** for **nutrition security**.
- **Mainstreaming Exposomics in Public Health: Exposomics**, inspired by the **Human Genome Project**, uses tools like **EWAS**, **GWAS**, **wearable sensors**, and **AI** to track **lifelong exposures** and inform **precision public health**; India must invest in **research infrastructure**, **data harmonisation**, and a **scientific ecosystem** for **disease prevention**.

Charting India's Path to Sustainable Biohappiness

- **Synergising for Biohappiness:** Achieving **biohappiness** demands integration of **biodiversity**, **nutrition**, **public health**, and **environmental stewardship** for holistic development.
- **Reviving and Mainstreaming Traditional Crops:** Focus on **reviving traditional food systems** and **mainstreaming orphan crops** into **national nutrition** and **agricultural policies** to enhance **food security** and **resilience**.
- **Advancing Precision Public Health:** Harnessing **exposomics** and **scientific innovation** to build **preventive, data-driven health frameworks**, merging **traditional ecological wisdom** with **modern science** for sustainable well-being.

Practice Questions

6. What is Stratospheric Aerosol Injection? How does it influence global climatic conditions? **(*Answer in 150 words*) 10**
7. The rising instances of heatwaves in India have a multifold impact. Analyse. **(*Answer in 150 words*) 10**

Prelims

Mount Etna

Sub-Topic: *Salient features of the world's physical geography.*

Context:

Italy's Mount Etna, Europe's largest and most active volcano, recently erupted in a dramatic display of volcanic power. The eruption sent **towering plumes of ash**, **smoke**, and rock fragments several kilometres into the sky, creating a breathtaking sight.

About Mount Etna

- Mount Etna is **situated on the east coast of Sicily**, the **largest island in the Mediterranean Sea**, just off the "toe" of Italy's boot-shaped mainland.
- As the highest peak in Italy south of the Alps, Mount Etna is a **dominant feature of the Sicilian landscape** and one of the most closely monitored volcanoes in the world.
- Designated a **UNESCO World Heritage Site in 2013**, Mount Etna has a **documented eruptive history spanning at least 2,700 years**, with geological records indicating volcanic activity dating back over 500,000 years.

What Triggered the Latest Mount Etna Eruption?

- According to experts at Italy's National Institute of Geophysics and Volcanology (INGV), the eruption likely **started due to increased internal pressure from expanding volcanic gases**.
- This **pressure is believed to have caused the collapse of Etna's southeast crater**, which in turn led to lava flows and the dramatic release of volcanic material into the sky.

Strombolian or Plinian: What Kind of Eruption Was It?

- Initial reports indicated Mount Etna underwent a Strombolian eruption, characterised by **moderate**, **explosive bursts ejecting lava** and **rocks due to gas bubbles** bursting in the magma.

- However, some experts believe the eruption's intensity and the ash cloud's height suggest a **Plinian eruption**, which is much more explosive, **sending ash and debris high into the stratosphere**, similar to the eruption of Mount Vesuvius in 79 AD.

Green Arabia

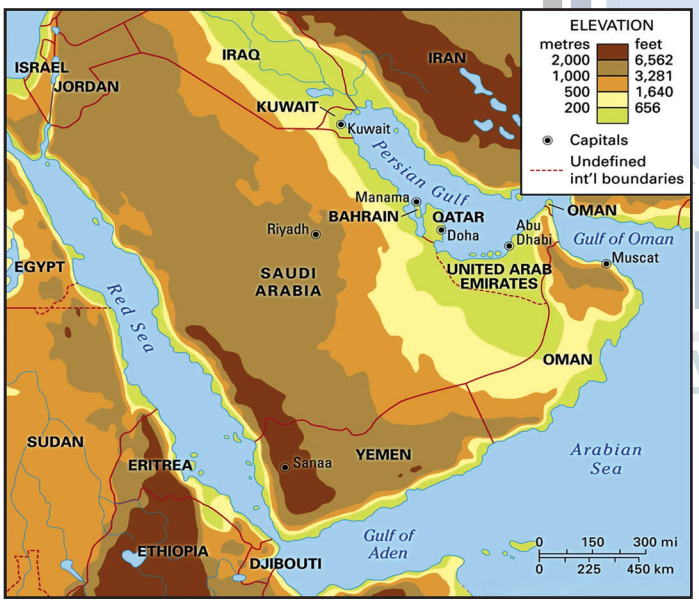
Sub-Topic: *Salient features of the world's physical geography.*

Context:

The vast expanse of the Arabian Peninsula, now known for its arid deserts and scorching heat, may have once been a green, life-sustaining corridor that facilitated the migration of early humans and animals out of Africa.

How has Arabian Peninsula transformed from arid barrier to migration bridge?

- Stretching **from Africa's Sahara Desert in the west to India's Thar Desert in the east**, the **Saharo-Arabian region** has long been viewed as **one of the planet's largest and most inhospitable arid zones.**



- For decades, scientists believed that this dry belt effectively blocked the movement of wildlife and hominins between Africa and Eurasia.
  - However, new fossil and mineral evidence is challenging that assumption.
- Discoveries of water-dependent species such as **hippopotamuses, crocodiles, and horses** in Arabia dating back to the **late Miocene and Pleistocene epochs** suggest that the region supported vibrant ecosystems as recently as 74,000 years ago.
- New research published in Nature provides compelling evidence that Arabia experienced **multiple humid phases over the last eight million years,** transforming it from a **formidable biogeographical barrier into a lush, green landscape.**

India Adds Two More Ramsar Sites

Sub-Topic: *Conservation, environmental pollution and degradation, environmental impact assessment.*

Context:

The **Khichan** wetland in Phalodi and **Menar** wetland in Udaipur, both in **Rajasthan**, inserted as new **Ramsar Sites** — wetlands of international importance under the Ramsar Convention. This brings **India's total number of Ramsar Sites to 91**.

What is the Ramsar Convention?

- It is an **intergovernmental treaty signed** in **1971 in Ramsar, Iran**, for the **conservation and sustainable use of wetlands**.
  - India became a party to the Ramsar Convention in **1982**.
- There are **9 criteria** to designate a wetland as a **Ramsar Site**, based on **biodiversity**, **waterbird and fish populations**, and **ecological uniqueness**.

What are wetlands?

- Wetlands are defined as **natural or artificial, permanent or temporary** water bodies, including **marine areas less than six metres deep** at low tide.
- Wetlands are described as **productive ecosystems** that support **biodiversity**, **climate regulation**, **flood control**, **groundwater recharge**, and **livelihoods**.
- They are known as "***kidney of the Earth***" due to their properties of water purification, storage, and nutrient cycling.

Khichan Wetland – Key Features

- Located in the **northern Thar Desert**, comprising: **Ratri nadi** (river), **Vijaysagar talab** (pond), **Riparian habitat and scrub land.**
- Supports **over 150 bird species**, thriving in the **desert ecosystem**.
- Internationally known for hosting **over 22,000 migratory demoiselle cranes** each winter.
- **Residents** actively help reduce crane mortality from **power line collisions** and **stray dog attacks**.
- Attracts **bird watchers, tourists, students, and scientists**, due to its spectacular **seasonal bird gatherings**.

Menar Wetland Complex – Key Features

- A **freshwater monsoon wetland** made up of: **Braham talab, Dhand tala, Kheroda talab** and the surrounding **agricultural land**.
- Habitat for **110 waterbird species**, including **67 migratory species**.

- Hosts **critically endangered** species like: **White-rumped vultures** and **long-billed vultures.**
- **Over 70 plant species**, including **mango trees,** support **Indian flying foxes**.
- Known for **community-led conservation**, **Menar villagers** play an active role in **wildlife protection** by preventing **poaching and fishing**.

Revised Green India Mission

Sub-Topic: *Conservation, environmental pollution and degradation, environmental impact assessment.*

Context:

The **Ministry of Environment, Forest and Climate Change** (MoEFCC) has revised the Green India Mission document for the period **2021-2030**.

What is the Green India Mission?

- Launched in **2014** as one of the eight core missions under India's **National Action Plan on Climate Change (NAPCC)**, GIM aims to:
  - **Protect, restore, and enhance India's forest and tree cover**
  - Use a blend of **climate adaptation and mitigation** strategies
  - Increase forest/tree cover on **5 million hectares** of land
  - Improve forest quality on an additional **5 million hectares**
- **Revised GIM Overview (2021-2030):** The revised mission will **focus on restoring ecologically vulnerable landscapes**, including:
  - **Aravalli Hills**
  - **Western Ghats**
  - **Mangrove forests**
  - **Indian Himalayan region**
  - **Arid regions of North-West India**
- The revised mission **projects a carbon sink of around 3.5 billion tonnes**, based on **Forest Survey of India** (**FSI**) estimates.

How Will Restoration Be Achieved?

- A **micro-ecosystem approach** will be adopted for **targeted interventions**.
- Restoration of **degraded forests**, soil and moisture conservation, and planting of **native high-carbon-sequestration species**.
- Strategies include **reforestation, tree plantation on wastelands, and along railways & highways**.
- Ensuring **land degradation neutrality** through best practices.

World Day to Combat Desertification and Drought

About: Established by the **UN General Assembly in 1994**, this day is observed annually on **June 17** to promote awareness and action against desertification and drought.

- The day commemorates the adoption of the **United Nations Convention to Combat Desertification (UNCCD)** in 1994 and was first celebrated in **1995**.
- **Theme 2025: "Restore the Land. Unlock the Opportunities"** – emphasising land restoration and sustainable development.
- **Importance:** Raises awareness about **land degradation**, promotes **policy action**, and encourages **global cooperation** for **sustainable land management** and **climate resilience**.

About Aravalli Hills and Western Ghats

Aravalli Hills:

- One of the **oldest fold mountain ranges** in the world, dating back to the Proterozoic era.
- Stretches across **Rajasthan, Haryana, Delhi, and Gujarat**.
- **Guru Shikhar** (5,650 ft) on **Mount Arbuda** is the highest peak.
- Acts as a **natural barrier** preventing desertification from spreading eastward from the Thar Desert.
- Rich in minerals and biodiversity, but faces threats from **illegal mining and deforestation**.

Western Ghats:

- The Western Ghats stretch approximately **1,600 km** along the western coast of India, covering the states of **Gujarat, Maharashtra, Goa, Karnataka, Kerala, and Tamil Nadu**.
- A **UNESCO World Heritage Site** and one of the world's **eight "hottest hotspots" of biodiversity**.
- Home to **over 7,400 species** of plants and animals, many of them endemic.
- Plays a crucial role in **monsoon regulation** and is a major **watershed** for peninsular rivers.

Sariska Tiger Reserve

Sub-Topic: *Conservation, environmental pollution and degradation, environmental impact assessment.*

Context:

The Rajasthan government has proposed a **rationalisation plan** to redraw the **Critical Tiger Habitat (CTH)** boundary of the **Sariska Tiger Reserve**.

About Sariska Tiger Reserve

- **Location & Size:** Sariska National Park is a famous tiger reserve in Rajasthan, surrounded by the Aravalli Hills, covering over 800 square kilometres.
- Renowned for its **Royal Bengal Tigers**, the park offers a rich blend of natural beauty, history, and biodiversity.

What Kind of Flora and Fauna Can Be Found in Sariska Tiger Reserve?

- The park's landscape is diverse, featuring **rocky terrain, scrub thorn forests, semi-deciduous woodlands**, **grasses**, and **hilly cliffs**. Trees such as **Dhok, Tendu,** and **Khair** thrive here.
- Key wildlife includes the iconic Royal Bengal Tiger, along with **Chital, Leopard, Sambhar, Nilgai, Four-Horned Antelope, Rhesus Macaque, Langur,** and **Wild Boar**.
- Among the birds, it is home to species such as **Peacocks**, **Sand Grouse**, **Golden-backed Woodpeckers**, **Crested Serpent Eagles** and **Harbour's Quail**.

What is Critical Tiger Habitat?

- Critical Tiger Habitat is a core or protected mentioned under **Section 38V** of the **Wildlife** (**Protection**) **Act**, **1972**.
- They are different from ***critical wildlife habitat***.
- These areas are identified on the grounds of scientific evidence and without affecting the rights of the **forest dwellers**.
  - They are free from **human activities**.
- They are notified by the **state government** after thorough consultation with the expert committee constituted for the purpose.

Air Conditioner Temperature Restrictions

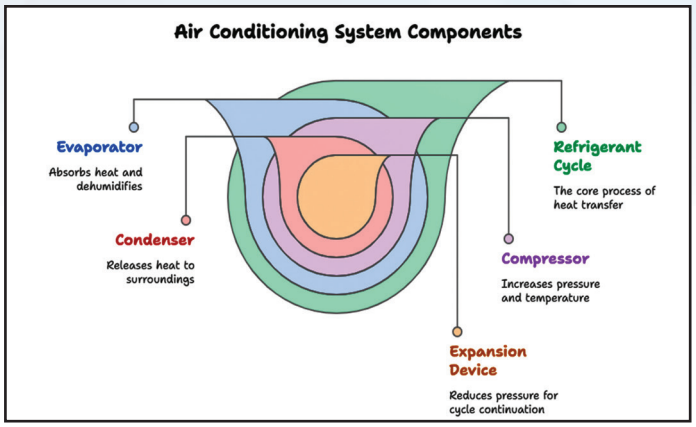
Sub-Topic: *Science and Technology- developments and their applications and effects in everyday life.*

Context:

The Union Ministry of Power is considering restricting the temperature range of air conditioners (ACs) in India to **between 20°C and 28°C**.

What is the objective behind this policy?

- **Reduce power consumption** due to excessively low AC settings.
- **Bring uniformity** in AC use across households, hotels, and vehicles.
- **Relieve pressure on the national power grid**, especially during summer months.



Why is this being considered?

- **Energy Efficiency and Savings: Each 1°C increase** in AC temperature setting results in a **6% reduction in electricity consumption**. If all users adopted a **24°C setting**, India could save **20 billion units of electricity per year**.
  - The **Bureau of Energy Efficiency (BEE)** estimated the **total AC load to reach 200 GW by 2030**.
- **Rising Power Demand**: India's power demand reached a record **241 GW**, driven by **high temperatures and cooling load**. **Managing peak demand** has become a **national priority**.
- **Public Health:** Temperatures below **18°C** are considered **uncomfortable and unhealthy**, especially for vulnerable populations (infants, elderly, people with cardiorespiratory diseases).
  - Cause **vasoconstriction and sympathetic activation**, raising **systolic blood pressure by 6–8 mmHg**.
  - Associated with increased **risks of hypertension, respiratory infections**, and **asthma**.

What does international data suggest?

- The **WHO's 2018 Housing and Health Guidelines** recommend a **minimum safe indoor temperature of 18°C** in temperate climates.
- Findings: **Health risks** associated with temperatures below **18°C**, including:
  - **Hypertension** (9% of population-attributable risk).
  - **Higher cholesterol** and **weaker grip strength** in colder homes.
  - **Lower vitamin D levels** and **poorer lung function** in people over **50 years old**.
- A **2013 study** with 12,000+ child-days showed: A drop in **lung function** and **slower exhalation** for every **1°C drop below 14–16°C**. Children in **Japan, New Zealand, and the UK** had **better breathing** when ACs were set above 18°C.
- A **2022 UK study** found that people living in persistently cold homes were at **twice the risk of depression and anxiety**, even after accounting for income and mental health baselines.

Flue Gas Desulphurisation (FGD)

Sub-Topic: *Science and Technology- developments and their applications and effects in everyday life.*

Context:

A committee led by **Principal Scientific Advisor Ajay Sood** recommended withdrawing the FGD requirement.

What is a FGD Unit?

- FGD units are pollution control systems used in **coal-fired thermal power plants (TPPs)** to reduce **sulphur dioxide (SO_2)** emissions from flue gases.
- Flue gas is a byproduct of fossil fuel combustion and contains **pollutants** like CO_2, SO_2, nitrogen oxides, and particulate matter.
- SO_2 is an **acidic gas**, and FGD units use **basic compounds** to neutralise it.
- **Types of FGD Systems:**
  - **Dry Sorbent Injection** – Powdered sorbents like limestone are introduced into the flue gas, where they react with SO_2. The resulting compound is then removed using fabric filters or electrostatic precipitators.
  - **Wet Limestone Scrubbing** – The most widely used and efficient method, this involves using a limestone slurry to react with SO_2. The byproduct, gypsum, is a stable and commercially valuable compound used in construction.
  - **Sea Water Scrubbing** – Common in coastal power plants, seawater absorbs SO_2 from the flue gas. The water is then treated before being safely discharged.

Why is SO_2 Emission Control Crucial?

- SO_2 is a **major greenhouse gas**, harms human health, and causes **acid rain**.
- It transforms into **secondary PM2.5**, which constitutes **15% of India's ambient PM2.5 levels**, of which **80% is from coal-based SO_2 emissions**.
- **Health Impacts**: Causes respiratory problems, increases healthcare costs, and reduces worker productivity.
- According to experts, **no alternative** exists to FGDs for SO_2 removal, as **coal washing** does not eliminate embedded sulphur.

Where Does This Matter Most?

- Especially **critical in Delhi-NCR** and other urban hotspots with high air pollution.
- Areas with dense population and poor air quality face the **worst health consequences**.
- **National Clean Air Programme (NCAP)** — ₹6,000 crore+ investment — risks being undermined.

What Are the Key Challenges?

- **High Capital Costs**: Utilities resist due to cost burdens.
- **Tariff Sensitivity**: Fear of rising consumer bills, especially with power demand rising.
- **Poor Coordination**: Ministries and TPPs are misaligned on timelines and expectations.
- **Policy Reversals**: PSA-backed recommendation to roll back mandatory FGDs.
- **Mixed Scientific Views**: NEERI claims low SO_2 impact, undermining the urgency.
- **Weak Enforcement**: Penalties (Rs 0.2–0.4/unit) exist but are **not enforced** due to repeated extensions.

Practice Questions

6. Which of the following statements regarding Critical Tiger Habitat?

1. They are established under the Environment Protection Act, 1986.
2. They are notified by the state government.
3. Human activities are allowed in these areas.

Select the correct answer from the code given below:

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

7. Consider the following statements:

1. India is the founder of the Ramsar Convention.
2. There are more than 100 Ramsar sites in India.
3. Khichan Wetland is recently declared Ramsar site in India.

Which of the statements given above is/are correct?

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

Mains

Battery Energy Storage Systems

Sub-Topic: *Conservation, environmental pollution and degradation, environmental impact assessment.*

Context:

The global climate crisis has fundamentally reshaped the definition of energy security. No longer limited to just the availability and affordability of energy sources, the modern view demands that energy be accessible and environmentally acceptable.

The Changing Landscape of Energy Security

- The climate crisis has fundamentally reshaped the concept of energy security. Today, a nation's energy sources must stand firm on four critical pillars: **availability, accessibility, affordability, and environmental acceptability**.
  - Among these, environmental acceptability addresses the trade-offs policymakers and the public make regarding pollution, biodiversity loss, and greenhouse gas emissions.
- Renewable energy has increasingly solidified its position as an environmentally sustainable and cost-effective power source, aligning with **Sustainable Development Goal (SDG) 7**, which advocates for universal access to clean energy.
- However, despite their benefits, renewables are inherently **intermittent**, posing challenges to grid stability and reliable power supply. **Battery Energy Storage Systems (BESS)** offer a crucial solution to mitigate this variability while enhancing overall grid resilience.

Why Energy Storage Matters?

- Energy storage technologies, particularly **BESS**, serve as vital components of the energy transition by enabling large-scale integration of renewables, improving grid operations, and ensuring **reliable** power supply.
- Among various energy storage methods, **BESS stands out** due to its affordability, scalability, rapid deployment, and geographical flexibility.

About BESS

- BESS technology is pivotal in enabling the energy transition. These systems:
  - **Stabilise the grid** by managing fluctuations in power supply and demand,
  - **Support peak load management**, and
  - **Facilitate decentralised energy systems** such as microgrids, bringing reliable power to underserved areas.
- Among available storage technologies, BESS stands out for its **cost-effectiveness**, **scalability**, **rapid deployment**, and **geographical flexibility**. By enabling higher penetration of renewables and reducing reliance on fossil fuel-based peaking power, BESS can significantly lower the **carbon intensity** of power systems.
- In just over a decade, battery costs have fallen nearly **90%**, spurred by global demand and technological innovation. Yet, **regulatory, technical, financial, and supply chain barriers** continue to limit BESS's widespread adoption — especially in emerging economies.

India's BESS Landscape

- India has emerged as a global leader in **renewable energy deployment**, with a commitment to installing **500 GW of non-fossil fuel-based capacity by 2030**.
  - As of **January 2025**, the country had already achieved **217.62 GW**, marking significant progress. To fully realise this ambition, **energy storage must grow in tandem** with renewable capacity.
- Recognising this, the Indian government has targeted **47 GW of BESS capacity by 2032**. Policy instruments such as **Viability Gap Funding** and waivers on **interstate transmission charges** for BESS projects commissioned before **June 2025** reflect strong commitment. However, the pace of progress has been mixed.
- Despite this progress, **scaling up BESS remains a challenge**. The **Economic Survey 2024-25** highlights several hurdles, including:
  - **Inadequate investment** in grid infrastructure upgrades,
  - **Slow deployment** of BESS by large consumers,
  - **Limited access to critical minerals** needed for domestic manufacturing, and
  - **Delays in concluding large-scale BESS procurement agreements**.
- The survey calls for **greater innovation and investment** to overcome these hurdles — particularly in areas like battery procurement, grid readiness, and critical mineral supply chains.

Driving Innovation Through Partnerships

- Strategic partnerships can accelerate BESS deployment in India. Collaborations between **public, private, and philanthropic** entities can help secure concessional funding and technical assistance.
- One pioneering example is the **Delhi BESS pilot** at the Kilokari substation.
  - Initiated by **BSES Rajdhani Power Limited**, in partnership with **IndiGrid Infrastructure Trust** and the **Global Energy Alliance for People and Planet (GEAPP)**, the **20 MW/40 MWh** project is India's first grid-scale BESS for a distribution network.
    - It will deliver reliable power to **over 12,000 low-income households**.
    - It provides a **technical blueprint** for future BESS projects.
    - It supports **regulatory reforms** and capacity-building for broader adoption.
- Similarly, the launch of **EnerGrid** — a $300 million platform by **IndiGrid**, **British International Investment**, and **Norfund** (the Norwegian Climate Investment Fund) — illustrates how concessional finance and private sector expertise can accelerate **greenfield BESS and transmission infrastructure** in India.
- Expanding such initiatives will be essential in increasing **BESS deployment**, fulfilling **SDG 7** commitments, enhancing **energy security**, and improving **grid resilience**.

A Global Role for India

- India is uniquely positioned to lead among emerging economies in **BESS innovation and deployment**. As a member of the **GEAPP-founded Global BESS Consortium**, India is already aligning its domestic strategy with international momentum.
- To strengthen its leadership, India must:
  - Accelerate **central and state-level BESS projects**,
  - Expand **concessional financing mechanisms**,
  - Localised **manufacturing and supply chains** for battery components,
  - Establish **recycling ecosystems** for end-of-life batteries, and
  - Build **technological capacity** across the public and private sectors.
- Through these measures, India can unlock the full potential of renewable energy, reduce dependence on fossil fuel imports, and improve **energy equity and resilience** — especially in underserved and climate-vulnerable regions.

Revolutionising Data Centre Cooling

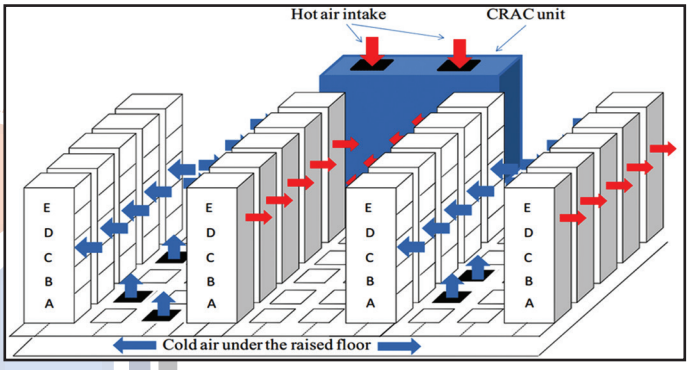
Sub-Topic: *Science and Technology- developments and their applications and effects in everyday life.*

Context:

A collaborative study by researchers from **Microsoft and WSP Global**, published in **Nature**, explores how **advanced cooling technologies** can reduce the environmental footprint of data centres.

More on News

- The study used a **life cycle assessment (LCA)** to evaluate cooling methods in data centres and their environmental impacts.



What are the key findings of the study?

- Study reveals **liquid cooling technologies** like **cold plates** and **immersion cooling**:
  - Cut **greenhouse gas emissions**, reduce **energy use**, and lower **water consumption**
- These improvements occur **regardless of cooling technology**, but combining renewable power with **liquid cooling amplifies the benefits**.

The Heat Problem and Why Cooling is Crucial?

- **Electronics generate heat** as transistors (like cooks in a crowded kitchen) work continuously, producing heat through microscopic collisions.
- More **densely packed chips** and higher computational loads result in more heat, just like a packed kitchen gets hotter and needs better cooling.
- Without cooling, hardware in data centres could **overheat and fail within minutes**.
- **Heat slows down electrons**, leading to performance degradation or failure, much like runners getting stuck in mud.
- **Effective cooling ensures** longevity, performance stability, and energy efficiency of electronic components.

Note: Read the Summary of "***The Energy Paradox***" in our **May 2025 Edition**.

Cooling Technologies

- **Cold Plates (Direct-to-Chip Cooling):**
  - It functions like an **ice pack on a fevered forehead**.
  - Uses **microchannel-equipped modules** placed directly on hot components.
  - **Coolant mix** (25% polyethylene glycol, 75% water) flows through these channels, carrying heat away.
  - **Liquid-to-air heat transfer ratio** ranges from **50% to 80%**, often more efficient than fan-based cooling.
- **Immersion Cooling:**
  - Equivalent to **dunking a hot pan into heat-absorbing oil**.
  - Two types:
    - **One-phase**: Oil remains liquid, and carries heat away.
    - **Two-phase**: Coolant **vaporises at low temp**, rises, condenses, and recycles — like a **mud pot cooling water**.
  - **Benefits**: Reduces corrosion, boosts hardware reliability, slashes carbon footprint, and operates **silently without fans**.
  - Already being deployed by tech giants like **Microsoft** and **Alibaba**.

What is the Path to Greener Data Centres?

- Advanced liquid cooling, when paired with **renewable energy**, emerges as a **twin-engine solution** for sustainable data centres.
- These innovations offer **significant reductions** in greenhouse gases, energy use, and water consumption.
- But **system-wide thinking**, **regulatory alignment**, and **careful trade-off analysis** are key to truly sustainable ICT infrastructure.

Practice Questions

8. While data centres pave the way for digitisation, they result in high carbon footprints. In the context of the given statements, discuss the cooling methodologies of data centres. **(*Answer in 150 words*) 10**

Prelims

Karlsruhe Tritium Neutrino Experiment (KATRIN)

Sub-Topic: *Science and Technology- developments and their applications and effects in everyday life.*

Context:

The **Karlsruhe Tritium Neutrino Experiment (KATRIN)** collaboration recently published an **upper limit** on the sum of the masses of the three known neutrino types.

What is the KATRIN Experiment?

- KATRIN is a **high-precision experiment** designed to measure the **mass of neutrinos**, which are among the **hardest-to-detect subatomic particles**.
- The **core instrument**, a **200-tonne spectrometer**, was constructed in **Deggendorf, Germany**, in **2006**.
- Due to its **massive size**, land transport was deemed **unsafe**, leading to an **8,600-km detour** to Karlsruhe via waterways, including: **Danube River → Black Sea → Mediterranean Sea → Atlantic Ocean → Rhine River.**
- The experiment closely observes the **disintegration of molecular tritium**, focusing on the **maximum energies of electrons emitted during tritium decay**, which carry information about **neutrino mass**.
- KATRIN collected data from **36 million electrons** to set the latest constraint.

What are Neutrinos?

- Neutrinos are **tiny, nearly massless subatomic particles**. Nicknamed **"ghost particles"** because they **rarely interact** with other matter, making them extremely difficult to detect.
- Neutrinos come in **three types (flavors)**: **Electron neutrino (ve), Muon neutrino (νμ), Tau neutrino (ντ).**
- Neutrinos are produced in various **high-energy processes**, including:
  - **Nuclear reactions in the Sun** (billions pass through your body every second!)
  - **Supernova explosions** (massive star deaths)
  - **Radioactive decay** (such as beta decay)
  - **Particle accelerators** (scientific experiments)
  - **Cosmic rays interacting with Earth's atmosphere**

Why is the KATRIN Result Significant?

- The new upper limit on neutrino mass is **20 times stronger** than the first constraints set in **1991** by experiments in **Los Alamos (USA) and Tokyo (Japan)**.
- Unlike other methods, KATRIN's result is **robust and assumption-free**, making it a **reliable benchmark** in neutrino physics.
- Other approaches, such as **cosmological observations**, set a tighter upper limit at **1.4×10^{-7} times the electron mass**, but rely on assumptions about the **early universe's evolution**, weakening their validity.
- Another method involves **neutrinoless double beta decay**, but it assumes neutrinos are **their own antiparticles** from the outset.
- KATRIN's **direct measurement approach** avoids such assumptions, making its findings **more reliable**.

Synthetic Aperture Radar (SAR) & NISAR Mission

Sub-Topic: *Awareness in the fields of IT, Space, Computers, robotics, Nano-technology, bio-technology and issues relating to intellectual property rights.*

What is SAR?

- SAR is a remote sensing technology that creates sharp, high-resolution images even in **dark, cloudy, or smoky conditions**. Instead of relying on visible light like traditional cameras, **SAR uses microwave pulses** to scan surfaces such as land, oceans, ice, or man-made structures.
- The system records the **echoes** of these pulses bouncing off various surfaces and uses **advanced signal processing** to reconstruct detailed images.

How SAR Works?

- The key component in SAR is the **antenna** used to receive the returning microwave echoes.
- Typically, image resolution improves with longer antennas. However, large physical antennas are **difficult to build and maintain**.
- SAR overcomes this by using a **small antenna on a moving platform** (like a satellite). Each pulse is received from a slightly different location due to the movement.
- By combining these echoes with precise **timing and phase data**, software can simulate a much larger antenna, effectively hundreds of metres long.

What are the advantages of SAR?

- **Microwaves penetrate clouds, smoke, and light rain**, enabling continuous data collection, **day and night, in all weather conditions**.
- Mounted on satellites, SAR can **map wide areas**, covering **hundreds of kilometres** in a single pass.
- Because different surfaces (soil, vegetation, water, metal) reflect microwaves differently, SAR can **detect subtle environmental changes** that **optical sensors may miss**.

The NASA-ISRO SAR (NISAR) Mission

- NISAR is a **joint mission between NASA and ISRO** designed to study Earth using SAR technology.
- Once launched, NISAR will:
  - **Scan nearly all of Earth's land and ice surfaces**.
  - Repeat this coverage **twice every 12 days**.
  - Provide **unprecedented volumes of environmental data**, aiding research in areas like deforestation, glacier melt, soil moisture, and natural disasters.

Hydrogen Plasma Method for Carbon-Free Nickel Extraction

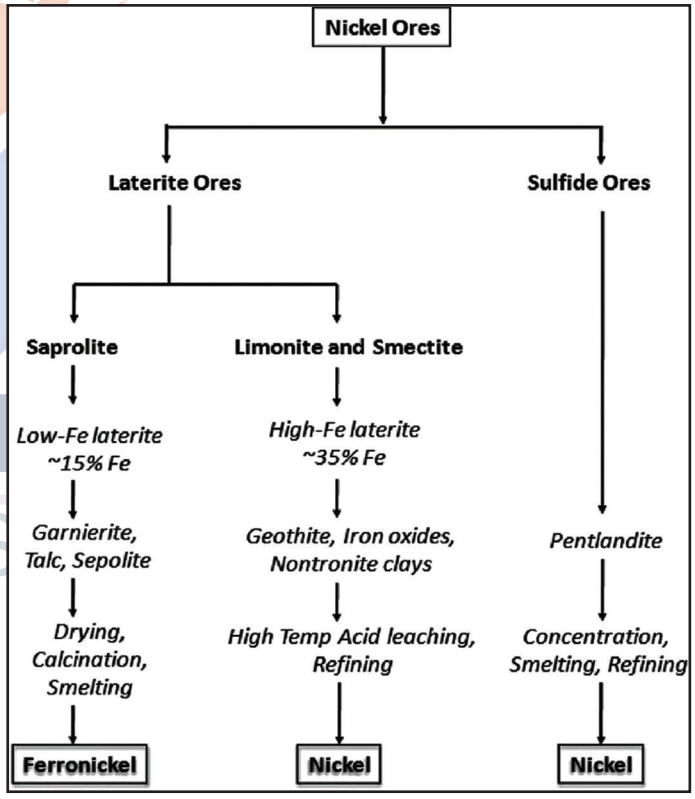
Sub-Topic: *Science and Technology- developments and their applications and effects in everyday life.*

Context:

A new study published in ***Nature*** by researchers at the **Max Planck Institute for Sustainable Materials** in **Düsseldorf**, **Germany**, introduces a groundbreaking method for extracting nickel using hydrogen plasma instead of carbon.

The New Extraction Methodology: Hydrogen Plasma

- Researchers bypassed the traditional **multistep process** (calcination, smelting, reduction, refining) and developed a **single metallurgical step** conducted in one furnace.



- The new method is **up to 18% more energy efficient** and **cuts direct CO_2 emissions by up to 84%** compared to conventional practices.
- Instead of using carbon, the process employs **hydrogen plasma** as the reducing agent and **electricity** as the energy source via an **electric arc furnace**.
- Hydrogen gas, when subjected to high-energy electrons in an electric arc, splits into high-energy ions, forming **plasma—the fourth state of matter**.

- This plasma rapidly reduces metal oxides, making the process **cleaner and significantly faster**.
- The reaction produces **water instead of carbon dioxide**, making it a **carbon-free** process.
- The **technology** supports India's dual goals of **accelerating industrialisation and infrastructure development** while also advancing the country's commitment to **achieving net-zero emissions by 2070**.

What is the importance of nickel?

- Nickel is a critical material in **lithium-ion batteries**, particularly in: **Electric vehicles (EVs)** – Enhances battery efficiency and lifespan. **Renewable energy storage** – Supports sustainable energy solutions.

India has nickel reserves primarily in the following regions:

- **Odisha – Sukinda Region:** Major nickel laterite reserves are located in **Sukinda Valley, Jajpur district, Odisha**. Found as **nickeliferous limonite** in chromite mine overburden with **0.4–0.9% nickel content**.
  - Odisha holds **93% of India's nickel resources**, estimated at **175 million tonnes**.
- **Jharkhand:** Nickel is found associated with **uranium deposits at Jaduguda**. Singhbhum East district has **9 million tonnes** of nickel resources.
- **Chhattisgarh & Nagaland:** Smaller deposits were reported in parts of **Chhattisgarh** and **Nagaland**. Nagaland has **5 million tonnes** of nickel resources.

- Nickel is a key component in **stainless steel**, which is used in: Construction (bridges, buildings), Kitchenware (utensils, appliances), and Medical equipment (surgical tools).
- Nickel-based alloys are used in: Jet engines (high-temperature resistance), Military equipment (armour plating), and Spacecraft components (durability in extreme conditions).
- It supports the **green economy** by enabling sustainable material production. Many countries use nickel alloys in coins due to their **durability and resistance to wear**.

Major Indian Government Steps in Nickel Extraction

- **National Critical Mineral Mission (NCMM):** Its objectives include enhancing domestic exploration, mining, processing, and recycling of critical minerals such as nickel, lithium, and cobalt.
- **Policy Reforms & Incentives:** The government has amended the Mines and Minerals (Development and Regulation) Act, 1957, introducing an "Exploration Licence" for 29 deep-seated and critical minerals, including nickel.
- **Block Auctions and Private Participation:** The Geological Survey of India (GSI) has handed over 20 mineral blocks for auction as exploration licenses, with 12 blocks already notified for auction across states like Rajasthan, Karnataka, Maharashtra, Andhra Pradesh, Madhya Pradesh, and Chhattisgarh.
- **Focus on R&D, Recycling, and Sustainability:** The NCMM emphasises research and development, including pilot projects for new extraction technologies (such as hydrogen plasma methods for low-grade laterite ores) and integration of renewable energy in mining processes.
- **Global Partnerships and Overseas Acquisitions:** India is actively securing overseas mineral assets through initiatives like the Mineral Security Partnership and **Khanij Bidesh India Ltd** (**KABIL**).

Nanozyme to Combat Abnormal Blood Clotting

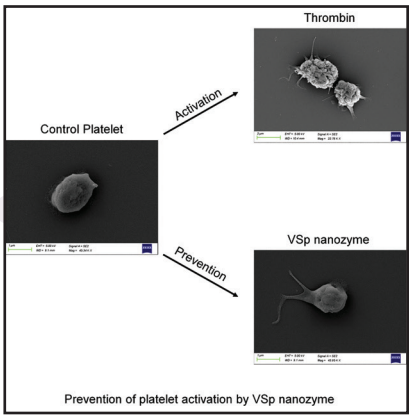
Sub-Topic: *Awareness in the fields of IT, Space, Computers, robotics, Nano-technology, bio-technology and issues relating to intellectual property rights.*

Context:

In a major breakthrough, scientists at the **Indian Institute of Science (IISc)** have developed a **novel artificial nanozyme that shows promising potential in preventing abnormal blood clotting,** particularly in life-threatening conditions like **pulmonary thromboembolism (PTE) and COVID-19-related thrombosis.**

Tackling Excessive Blood Clotting with Nanozymes

- **Haemostasis: Blood clotting, or haemostasis,** is a **natural defence mechanism where platelets form protective clots** around injured blood vessels.
  - This complex cascade is **regulated by interactions between proteins and chemical signals like collagen and thrombin.**



Prevention of platelet activation by VSp nanozyme

- **Overactive:** However, in disorders such as PTE and severe viral infections like COVID-19, this regulatory mechanism becomes overactive **due to increased oxidative stress and elevated levels of toxic Reactive Oxygen Species (ROS).**
  - This over-activation leads to **excessive clot formation, known as thrombosis, a major cause of death worldwide.**
- **Solution:** To address this challenge, a research team led by Prof. G. Mugesh at IISc has engineered **redox-active nanomaterials that mimic the function of natural antioxidant enzymes.**

- These synthetic nanozymes help **control ROS levels and prevent the excessive activation of platelets, thereby reducing the risk of thrombosis.**

Vanadium-Based Nanozyme Shows Superior Results

- The researchers **synthesised nanozymes of various shapes, sizes,** and structures using controlled chemical reactions. These were then **tested on human platelets activated by physiological agonists.**
- Among all the variants, **spherical-shaped vanadium pentoxide (V_2O_5) nanozymes emerged as the most effective** in curbing excessive platelet aggregation.
- These nanozymes **mimic the activity of glutathione peroxidase,** a natural antioxidant enzyme, to neutralise ROS and reduce oxidative stress.

Successful Testing in Animal Models

- The efficacy of the nanozyme was further validated in a **mouse model of pulmonary thromboembolism.**
- Results showed a **significant reduction in thrombosis and a marked improvement in survival rates.**
- Additionally, comprehensive post-injection monitoring over five days—including behavioural assessment, body weight tracking, and blood tests—revealed no toxic side effects.

Practice Questions

8. Consider the following events:

1. Nuclear reaction in the Sun
2. Particle acceleration
3. Radioactive decay
4. Supernova explosion

How many of the above events result in the formation of neutrinons?

(a) Only one (b) Only two
(c) Only three (d) All four

9. Consider the following fields:

1. Kitchenware
2. Medical equipment
3. Jet engines
4. Spacecraft

How many of the above-mentioned domains use nickel?

(a) Only one (b) Only two
(c) Only three (d) All four

Mains

India's Cyber Forensics

Sub-Topic: *Basics of cyber security; money-laundering and its prevention.*

Context:

Since 2020, India has intensified its cyber forensics capabilities to combat rising cybercrimes, enhancing national security through advanced labs, specialised training, and legal reforms to ensure robust digital investigations.

What are the main challenges facing India's cyberforensics ecosystem?

- **Uneven Development:** Disparities exist in lab equipment, software, and skilled personnel across states, especially in rural and remote areas.
- **Shortage of Qualified Professionals:** Many labs face acute shortages of trained forensic examiners, with high attrition due to better private sector opportunities.
- **Legal and Procedural Hurdles:** Frequent technical objections in courts and challenges in procedural compliance for digital evidence admissibility, despite clarifying legal precedents.
- **Cross-Border and Encrypted Data:** Investigators often face difficulties accessing encrypted or cross-border data, with mutual legal assistance treaties (MLATs) involving bureaucratic delays.
- **Conviction Rates:** Despite rising cybercrime cases, enforcement outcomes remain low—for example, only 22.6% of Bengaluru's cases resulted in a chargesheet in 2022.

What Prompted India's Push for Cyber Forensics Since 2020?

- **Surge in Cybercrime:** India recorded 65,893 cybercrime cases in 2022 alone, marking a sharp 24.4% increase from the previous year, highlighting the urgent need for robust digital investigative infrastructure.
- **Types of Cybercrimes:** These include online financial fraud, identity theft, ransomware attacks, and distribution of child sexual abuse material (CSAM).
- **Digital Transformation:** With one of the world's largest digital populations, the nature of crime itself has transformed, often originating in cyberspace.

What Are the Key Institutions and Initiatives Driving India's Cyber Forensics?

- **Indian Cyber Crime Coordination Centre (I4C):** Operational since January 2020 under the Ministry of Home Affairs (MHA), I4C is the national nodal agency for cybercrime prevention and response.
- **National Cyber Forensic Laboratory (NCFL):** A core initiative under I4C, providing advanced forensic capabilities and divided into specialized divisions.
- **Central Forensic Science Laboratories (CFSLs):** Now equipped with mobile forensics, cryptocurrency tracking, and secure cloud data analysis, linked through a national e-Forensics IT platform.
- **Cyber Crime Prevention against Women and Children (CCPWC) Scheme:** Funds forensic labs and training across 33 States and Union Territories, with over 550 mobile forensic vans deployed for on-site investigations.
- **National Forensic Sciences University (NFSU):** Upgraded to national status in 2020, offering courses and research in digital forensics and cyber investigations.

What Legal and Policy Frameworks Support Cyber Forensics in India?

- **Section 65B, Indian Evidence Act:** Supreme Court clarified that digital records must be properly certified under Section 65B, providing legal clarity for digital evidence in courts.
- **CERT-In Rules:** Under Section 70B of the IT Act, service providers must retain user activity records for 180 days, and VPN/cloud providers must store subscriber details for five years, improving traceability.
- **Content Takedown and Data Preservation:** I4C, since 2024, is a notified agency under Section 79(3)(b) of the IT Act, allowing it to issue takedown and preservation notices.
- **Sahyog Portal:** Streamlines legal coordination among law enforcement, service providers, and digital platforms, reducing bureaucratic delays.

What Are the Technology and Infrastructure Enhancements?

- **National e-Forensics IT Platform:** Integrates over 117 state and central forensic labs, enabling encrypted data transfer and real-time collaboration.
- **Mobile Forensic Vans:** Over 550 vans equipped for on-site data extraction, device cloning, and digital triage, especially useful in rural areas.
- **High-End Tools and Software:** States receive assistance to procure advanced forensic tools and software under various central schemes.

Drones Warfare

Sub-Topic: *Challenges to internal security through communication networks.*

Context:

India's **Operation Sindoor** in the wake of the Pahalgam terror attack has marked a notable shift in the country's adoption of **Unmanned Aerial Vehicles (UAVs)** in combat.

How are drones transforming modern warfare?

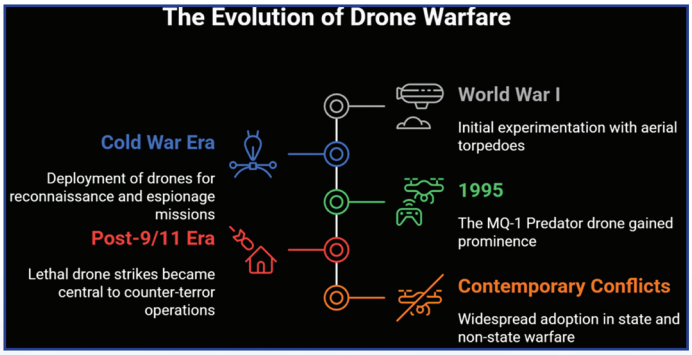
- **Force Multipliers:** They allow remote targeting, precision strikes, and real-time surveillance without risking pilot lives.
- **Asymmetric Tools:** Their **low cost** and adaptability enable even **non-state actors** or technologically inferior militaries to contest superior forces.
- **Current applications:** Additionally, UAVs are increasingly used in: **Border surveillance and anti-smuggling operations,** Targeted assassinations of high-value terrorist figures & Logistics in terrains inaccessible to conventional vehicles.

Global Examples:

- **Nagorno-Karabakh War (2020).**
- **Ukraine (Operation Spider Web).**
- **Myanmar:** Rebel forces use **3D-printed drones (e.g., Liberator MK2).**

How do drones function in modern military operations?

- **Surveillance and Reconnaissance**: Equipped with cameras, infrared sensors, and radar, they provide real-time intelligence.
- **Precision Strikes**: Armed drones like **MQ-9 Reaper** deliver targeted firepower with reduced collateral damage.



- **Logistical Support**: Delivery of supplies, ammunition, and medical aid to isolated areas.
- **Electronic Warfare**: Disrupting enemy communications or radar via signal interference.
- **FPV (First-Person View) Drones**: Agile and small UAVs for urban combat and **kamikaze**-style attacks.

What technologies are employed in anti-drone warfare?

- **Signal Jamming**: Disrupting control or GPS links.
- **Kinetic Kill Systems**: Use of anti-aircraft weapons or drones to physically destroy UAVs.
- **Drone-on-Drone Combat**: Interceptor drones neutralise hostile UAVs mid-air.
- **Directed Energy Weapons**: Laser systems offer precise, scalable, and cost-effective anti-drone solutions.

What are the ethical concerns associated with autonomous drones?

- **Delegation of Kill Decisions**: AI-driven drones making life-and-death choices without human intervention.
- **Lack of Moral Agency**: Machines cannot understand or respect humanitarian values.
- **Desensitisation to Violence**: Risk of making warfare more impersonal and frequent.
- **Loss of Accountability**: In the absence of a clear human operator, assigning legal responsibility becomes complex.

BIMSTEC's Bangkok Vision 2030

Sub-Topic: *Bilateral, regional and global groupings and agreements involving India and/or affecting India's interests.*

Context:

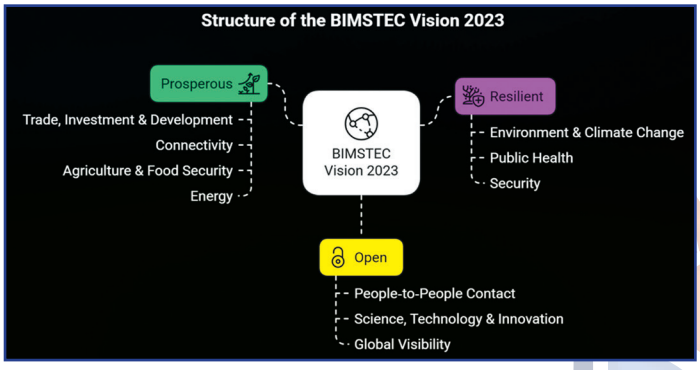
Amid rising geopolitical tensions in South Asia, BIMSTEC has made a breakthrough by adopting its first-ever Vision statement—**"Bangkok Vision 2030"**—at the Sixth Summit in March 2025. Backed by its 2023 Charter, the Vision aims to address past criticism by setting a clear five-year roadmap under the theme: ***"A Prosperous, Resilient, and Open BIMSTEC by 2030."***

What exactly is the "Bangkok Vision 2030"?

- It is BIMSTEC's first-ever formal vision statement, adopted at the Sixth BIMSTEC Summit in March 2025. Framed as *"A Prosperous, Resilient and Open BIMSTEC by 2030 for our people and future generations,"* it lays out priorities and measurable objectives for the next five years, re-organising the grouping's work into three value-laden pillars: **Prosperous, Resilient, and Open (PRO).**
- It was unveiled on **22 March 2025** at the **Sixth BIMSTEC Summit in Bangkok, Thailand**, marking the organisation's 28th anniversary year.

Why did BIMSTEC need a new vision now?

- **Action gap:** For years critics said BIMSTEC had plenty of meetings but no clear action plan.
- **Legal mandate:** Its first Charter (2023) required a strategic roadmap.
- **Regional flux:** SAARC is moribund, India-Pakistan tensions are peaking, Myanmar is in civil war, and a new government in Bangladesh has strained ties with New Delhi—pushing Bay-of-Bengal states to look eastward for cooperation.



- **Global headwinds:** Supply-chain shifts, climate risks, pandemics and digital divides demand coordinated responses.

What makes the "Prosperous BIMSTEC" pillar stand out?

- **Economic integration:** Fast-track the long-pending BIMSTEC Free Trade Area with safeguards for LDCs and land-locked states.
- **Seamless movement:** Conclude the BIMSTEC Motor Vehicle Agreement to knit together supply chains.
- **Energy security:** Finalise and implement the regional power-grid master plan released in H1 2025.
- **New growth engines:** Promote the digital, blue, mountain and sustainable-tourism economies.

What does "Resilient BIMSTEC" aim to achieve?

- **Health resilience:** Lessons from COVID-19 propel work on integrated disease surveillance and vaccine/medicine supply chains.
- **Climate resilience:** Joint early-warning systems, renewable-energy targets and green-finance mobilisation.
- **Human security:** Greater coordination against cyber-crime, drug & human trafficking, alongside regular Home and Health Ministers' meetings to institutionalise responses.

How will an "Open BIMSTEC" look and feel?

- **Shared identity:** Buddhist, temple and eco-tourism circuits, festivals, and cultural-industry hubs to showcase the region's heritage.
- **Knowledge-based growth:** Scholarship schemes, STEM exchanges and support for youth entrepreneurship.
- **Global voice:** Seeking observer status in key UN bodies to influence climate and development agendas.

Where are the main gaps and challenges?

- **Financing void:** No dedicated development fund or clear resource-mobilisation mechanism for the Master Plans.
- **Political fractures:** Bangladesh–India strain post-2024 regime change, Myanmar's civil war, and unresolved Rohingya crisis could stall consensus.
- **Human-security blind spots:** Limited attention to gender-responsive measures and protections for women and children.
- **Digital & environmental inequities:** Vision nods to emerging sectors but underplays regulatory harmonisation and the digital divide.
- **External partnerships:** Strategy for engaging global financiers and multilaterals remains vague.

India-US Trade Deal

Sub-Topic: *Bilateral, regional and global groupings and agreements involving India and/or affecting India's interests.*

Context:

As India and the US negotiate a bilateral trade deal, the Indian sugar and soybean processing industries have raised significant concerns about potential concessions that could impact domestic agriculture.

Why Is the India-US Trade Deal Significant?

- India and the US are negotiating a bilateral trade agreement to **enhance market access** and **reduce tariffs**, aiming for completion by fall 2025.
- The US seeks to **boost agricultural exports**, **targeting crops like corn, soybeans, and ethanol**, driven by a need to find alternative markets to China.

What Is the Core Concern of the Sugar Industry?

- The sugar industry is strongly opposed to **allowing imports of ethanol for blending with petrol**, as well as **imports of genetically modified (GM) maize/corn** for use as fuel ethanol feedstock.
- The **US is the world's largest producer and exporter of both** maize and fuel ethanol, making these commodities central to US trade interests with India.

How Has India's Ethanol Blending Programme Evolved?

- India's ethanol blending in petrol has surged from **1.5% in 2013-14 to 14.6% in 2023-24**, with a **target of 20% by 2025-26**.
- Since 2018-19, the feedstock for **ethanol has shifted significantly from sugarcane molasses to grains**, especially maize and surplus rice.

- Indian sugar mills fear that **increased imports would further marginalise sugarcane as a feedstock for ethanol**, threatening their future as the domestic market for sugar stagnates. Millers emphasise that using sugarcane for ethanol avoids the "**food versus feed**" **conflict**, as sugar is not a primary livestock feed, unlike maize.
- Diverting maize to biofuel **could strain supplies for the poultry and dairy sectors**, which depend on maize as a key feed ingredient.

Why Is the Soybean Processing Industry Opposed to Imports?

- The **Soybean Processors Association of India** (SOPA) opposes imports of soybeans, particularly GM varieties, due to logistical, economic, and livelihood concerns.
- Most Indian processing plants are located inland, far from ports, making it uneconomical to import beans, process them, and export the byproduct meal.
- The **livelihoods of around 7 million soybean farmers are at risk** if cheap imports flood the market, as domestic processors may be forced to operate below capacity or shut down.

How Do Import Duty Cuts and Price Trends Affect the Industry?

- The recent reduction in import duties on crude soyabean, palm, and sunflower oil 16.5% has made imported oils cheaper, squeezing margins for domestic processors.
- Soybean prices in key markets like **Madhya Pradesh** and **Maharashtra** have **fallen below the minimum support price (MSP)**.
- **Increased imports could depress prices further**, prompting farmers to shift to other crops.

How Do US Farm Subsidies Impact Negotiations?

- **US farmers receive substantial direct payments**, unlike **India's input subsidies**, creating an uneven playing field.
- These **subsidies enable US producers to offer competitive prices**, pressuring India to lower tariffs despite risks to local farmers.
- India seeks to protect its more than 90 million agricultural households, invoking WTO's "**special and differential treatment**" for developing nations.

G20 & Global Renewable Energy

Sub-Topic: *Bilateral, regional and global groupings and agreements involving India and/or affecting India's interests.*

Context:

The world's richest economies have caused the most climate damage through fossil fuel use, so a global phase-out by 2050 is essential, and African nations must adopt long-term renewable plans and secure G20 financing to benefit.

Why Are G20 Countries Critical for Climate Change Mitigation?

- The **G20**, comprising 19 major economies, the **European Union**, and the **African Union**, represents 67% of the global population and 85% of **GDP**.
- They account for 87% of energy-related **carbon dioxide emissions**, making their shift to **renewable energy** vital to limit **global warming**.
- A global **fossil fuel phase-out** by 2050 is essential to mitigate further **climate change** damage.

What Is the Renewable Energy Potential of G20 Countries?

- **G20 nations** have 33.6 million km² for **solar projects** and 31.1 million km² for **wind projects**, sufficient to meet global 2050 **electricity demand**.
- Countries like **Australia** and **Canada**, major **fossil fuel exporters**, possess significant **renewable energy potential**.
- Coordinated **investment** and **policy** efforts are needed to realise this potential fully.

How Can G20 Support Africa's Energy Transition?

- **Africa** can generate **solar** and **wind power** exceeding its 2050 **electricity needs** by developing just 3% of its potential.
- 600 million **Africans** lack **electricity access**, and new plants must prioritize **renewables** to align with **Paris Agreement** goals.
- **South Africa**, as **G20 president**, should advocate for **renewable energy investments** in **Africa** at **COP30**.

What Are the Main Obstacles to Renewable Energy Adoption?

- **Finance**: Securing funds for **renewable energy systems** is critical, particularly in **Africa**, where long-term **energy policies** are scarce.

- **Regulations**: Transparent, long-term **policies** are essential to attract **investors** and support **solar** and **wind industries**.
- **Manufacturing Capacity**: Developing local **renewable technology production** is vital for scaling deployment.

What Actions Should G20 Take at COP30 and Beyond?

- **South Africa** must push for reduced **greenhouse gas emissions** and increased **renewable energy funding** at **COP30**.
- **G20 nations** should establish fair **carbon budgets**, considering population, economic growth, and local **renewable resources**.
- Redirecting over $1.4 trillion in **fossil fuel subsidies** (2022) to **renewables** can accelerate the **energy transition**.

How Can Africa Benefit from G20 Collaboration?

- **G20 support** can fund **microgrids** and **regional power pools** to improve **electricity access** and connectivity in **Africa**.
- Developing **renewable energy** could enable **Africa** to export excess **power**, driving **economic growth**.
- Aligning with **Agenda 2063**, **Africa** can transition to a middle-income continent using **renewable energy**.

What Is the Role of Regional Power Pools?

- **Regional power pools**, like the **Southern African Power Pool**, enable **electricity sharing** via interconnected **grids**.
- They balance **supply and demand**, reduce **transmission losses**, and integrate **renewable energy sources** like **hydro** and **solar**.
- **G20 funding** can enhance **Africa's power pools** with **smart meters** and **AI-driven grids** to serve 600 million without **electricity**.

Why Is the G20 Criticised for Elitism?

- The **G20**, a self-selected group, excludes 90% of **UN member states**, limiting global representation.
- **South Africa** can form an **African G20 consultative group** to amplify regional voices and address **climate debt** owed to **Africa**.

What Is Climate Debt, and Why Does It Matter?

- Wealthy **G20** nations, responsible for most **emissions**, owe a **climate debt** to **Africa**, which faces severe **climate impacts**.
- **Action Aid** estimates a $36 trillion debt to **Africa**, with only 5% of global **climate finance** reaching the continent.
- **South Africa's G20 presidency** can push for **debt restructuring** and grants to fund **climate-resilient African cities**.

France's Nuclear Umbrella

Sub-Topic: *Effect of policies and politics of developed and developing countries on India's interests, Indian diaspora.*

Context:

French President **Emmanuel Macron** declared that **France is "*open to dialogue*"** on the potential **stationing of its nuclear weapons** in other European countries. This announcement marks a significant strategic development against the backdrop of escalating **security concerns in Europe**, driven by the ongoing **Russia-Ukraine war**.

Motivation Behind France's Offer

- The offer aligns with France's policy of **"European strategic autonomy,"** aimed at strengthening the European Union's ability to manage security and defence independently.
- This development is partly a response to unconditional US security guarantees to NATO allies, particularly in connection with the **2% GDP defence spending threshold**.
- European nations are therefore exploring additional security assurances beyond **NATO's traditional framework**.

Understanding the Nuclear Sharing Model

- France's potential move draws attention to the ***"nuclear sharing"*** model, a concept already in practice within **NATO**.
- Under this model, the **United States** stationed **tactical nuclear weapons** — specifically, **B61 gravity bombs** — in five allied non-nuclear states: **Belgium, Germany, Italy, the Netherlands, and Turkiye**.
- In these arrangements:
  - The U.S. **retains legal ownership and custody** of the weapons.
  - The decision to use the weapons rests with the **U.S. President**, though it is expected to be made in **consultation with NATO**.

Is France Equipped for Extended Deterrence?

- As of 2024, **France maintains nuclear warheads**, primarily deliverable through:
  - **Submarine-launched ballistic missiles (SLBMs)**
  - **Air-launched cruise missiles** via **Rafale fighter jets**
- According to a 2023 **Centre for Strategic and International Studies (CSIS)** report, expanding France's deterrent by basing nuclear weapons abroad would introduce **logistical and doctrinal complexities**. With its current arsenal, France may **struggle to support credible extended deterrence** without increasing its stockpile.

- Additional complications would include:
  - **Deploying French Air Force units** overseas
  - Building **secure infrastructure** and **command-and-control systems** in a **multinational setting**
  - Reconciling **national control protocols** with potential **shared operational responsibilities**

Strategic and Security Implications

- **Potential Benefits:**
  - It could **strengthen deterrence** against **Russia**, particularly as Moscow continues to issue threats and expand military operations near NATO borders
  - Demonstrates **European resolve** and reduces dependency on U.S. nuclear guarantees
  - May reinforce **internal cohesion** within NATO and the EU by offering new security assurances
- **Risks and Escalation:**
  - **Russia is likely to interpret** the move as a **major escalation**. Moscow has already warned against NATO's eastward expansion and militarisation.
  - In 2023, **Russia deployed tactical nuclear weapons in Belarus**, which many Western analysts see as an escalatory precedent.
  - A broader nuclear deployment across Europe may provoke **"military-technical" responses** from Russia, further destabilising the region.

Practice Questions

9. Do you think that the current cyber infrastructure in India can deter cyber threats and other associated risks? **(*Answer in 250 words*) 15**
10. The current nuclear order is fragile in terms of major powers offering and withdrawing a nuclear umbrella to their regional partners. **(*Answer in 150 words*) 10**

Prelims

Operation Sindhu

Sub-Topic: *Security challenges and their management in border areas - linkages of organised crime with terrorism.*

Context:

Rising conflict between Israel and Iran has prompted India to launch **Operation Sindhu** to evacuate Indian nationals from Iran safely.

What is Operation Sindhu?

- **Operation Sindhu** is a strategic evacuation programme aimed at repatriating Indian nationals from **Iran**, as full-scale conflict erupts between **Israel and Iran**.
  - The war which has caused extensive infrastructure damage, and severely disrupted airspace across the Middle East.
- **Operation Sindhu** is reminiscent of **Operation Ganga**, launched during the **Ukraine-Russia war** in 2022.

Other Operations

Name of the Operation	Country
Operation Indravati (2024)	Haiti
Operation Ajay (2023)	Israel
Operation Kaveri (2023)	Sudan
Operation Devi Shakti (2021)	Afghanistan
Operation Maitri (2015)	Nepal
Operation Raahat (2015)	Yemen
Operation Safe Homecoming (2011)	Libya
Operation Sukoon (2006)	Lebanon

Non-Proliferation Treaty

Sub-Topic: *Security challenges and their management in border areas - linkages of organized crime with terrorism.*

Context:

Amid heightened military and diplomatic tensions, Iran announced that its Parliament is drafting a bill to potentially **withdraw from the Nuclear Non-Proliferation Treaty (NPT).**

What Is the Nuclear Non-Proliferation Treaty (NPT) and Its Purpose?

- The NPT, **signed in 1968** and **in force since 1970**, aims to:
  - **Non-Proliferation:** Under the non-proliferation pillar, the **five nuclear-weapon states** (NWS) agreed not to transfer nuclear weapons or assist other countries in acquiring them.
  - **Peaceful Use of Nuclear Energy:** The peaceful use pillar allows all state parties to the NPT to develop and use nuclear energy for civilian purposes under IAEA safeguards.
  - **Disarmament:** Nuclear-weapon states committed to pursuing negotiations in good faith towards the goal of complete nuclear disarmament.

- The treaty **emerged after World War II**, amid global efforts to limit nuclear arms expansion.
- The US "**Atoms for Peace**" initiative (1953) and the **creation of the International Atomic Energy Agency** (IAEA) established global safeguards and inspections to monitor civilian nuclear activities.

Who Are the Members and Non-Signatories of the NPT?

- **191 states** are parties to the NPT.
- **Recognised nuclear weapon states** (tested before January 1, 1967): **US**, **UK**, **France**, **Russia** (formerly USSR), and **China**.
- **Non-signatories** include **India**, **Pakistan**, **Israel** (which neither confirms nor denies nuclear weapons), and **North Korea** (withdrew in 2003).
- The treaty is criticised for **being discriminatory**, **legitimising nuclear weapons only for the P5** and **reinforcing a nuclear hierarchy**.

How Can a Country Withdraw from the NPT?

- **Article 10** of the NPT allows withdrawal if "**extraordinary events**" jeopardise a country's supreme interests. The country **must give three months' notice** to all treaty parties and the **UN Security Council**, citing the extraordinary events.**What Are the Immediate Implications if Iran Leaves the NPT?**
- Iran would **no longer be subject to IAEA inspections**, which averaged 1.4 site visits per day in 2023.
- International oversight and transparency of Iran's nuclear activities would end, **raising concerns about potential weaponisation**.
- Iran's exit could set a precedent for other states to leave, **weakening the global non-proliferation regime** and cooperation.

Other Nuclear Disarmament Treaties

- **START I & II (1991–1993)** – Bilateral treaties between the USA and USSR/Russia to reduce deployed strategic nuclear warheads.
- **CTBT (1996)** – Bans all nuclear explosions; not in force due to non-ratification by major states like the USA, China, India, and Pakistan.
- **TPNW (2017)** – First legally binding treaty to fully prohibit nuclear weapons; entered into force in 2021 without participation from nuclear-armed states.
- **New START (2010)** – Limits deployed strategic nuclear warheads and delivery systems between the USA and Russia.

Does Withdrawal from the NPT Mean Iran Will Build Nuclear Weapons?

- Withdrawal does not automatically mean Iran will pursue nuclear weapons.
- However, historical precedent (e.g., North Korea) shows that withdrawal can precede weapon development.
- Iranian officials continue to deny intentions to build nuclear arms, but regional instability and lack of oversight fuel global uncertainty.

Practice Questions

10. Consider the following countries:

1. India
2. Iran
3. Israel

How many of the above-mentioned countries are non-signatories to the Non-Proliferation Treaty (NPT)?

(a) Only one (b) Only two
(c) All three (d) None

11. Consider the following pairs:

Humanitarian Operations	*Country*
Kaveri	Sudan
Raahat	Maldives
Sindhu	Iran

How many of the pairs given above are correctly matched?

(a) Only one pair (b) Only two pairs
(c) All three pairs (d) None of the pairs

Mains

Bengaluru Stampede

Sub-Topic: Disaster and disaster management.

Context:

The recent Bengaluru stampede during the IPL 2025 season has once again exposed the lack of accountability, planning, and empathy towards sports fans in India.

More on News

- What began as an exciting **celebration turned into a tragic case study of mismanagement, with all key stakeholders** — the police, politicians, BCCI, and franchise officials — **scrambling to deflect blame.**
- In December 2024, a tragic stampede occurred during the **'Pushpa 2'** premiere show attended by Telugu superstar Allu Arjun in Hyderabad. The event resulted in the **death of a woman and left her son critically injured, sparking intense legal, public, and media scrutiny regarding the responsibilities of celebrities and event organisers in crowd management.**

The State of Stadiums in India

- Even when fans do make it safely inside, **stadium conditions in India leave much to be desired.** For IPL 2025, tickets in Bengaluru ranged from ₹2,300 to ₹42,000, prices comparable to global sporting events.
- Yet, **spectators face stinking toilets, poor visibility, overcrowded food counters, and zero shade in many stands.**
- This starkly contrasts with stadiums in countries like **Australia**, where accessibility, hygiene, and fan support are top priorities, including volunteers for elderly visitors, disabled-friendly seating, and even free sunscreen on sunny days.

Responsibilities of Celebrities in Crowd Management

- **Ensuring Safety:** Celebrities must work with event organisers to ensure proper security measures, crowd control barriers, and emergency exits.
  - **Travis Scott's Astroworld Festival (2021):** Despite visible crowd surges, the concert continued, leading to **10 deaths and hundreds of injuries.** Critics argued Scott should have stopped the show earlier.
- **Encouraging Calm Behaviour:** They should use their platform to urge fans to follow safety protocols and avoid reckless actions.
  - **Justin Bieber's Meet-and-Greet Stampede (2013):** A free meet-and-greet in a mall led to a dangerous stampede, injuring fans due to poor crowd control planning.
- **Avoiding Provocative Actions:** Any call-to-action (e.g., "rush the stage") can lead to stampedes or injuries.
- **Collaborating with Authorities:** They should support law enforcement and security teams in managing large gatherings.

The Role of Technology in Crowd Safety

- **AI-Powered Crowd Monitoring:** CCTV with AI can detect overcrowding and alert security. **(Used in UEFA stadiums to prevent crushes.)**
- **Wearable Tech for Security Teams:** Smartwatches with panic buttons for security personnel to coordinate faster during emergencies.
- **Drones for Surveillance:** At Coachella, drones monitor crowd density and movement patterns to prevent bottlenecks.
- **Digital Ticketing & Entry Control: RFID wristbands** (like at Tomorrowland) help track attendee numbers and prevent gate-crashing.
- **Social Media & Real-Time Alerts: Taylor Swift's** team used geo-fenced push notifications during her Eras Tour to guide fans on exits and safety.

Practice Questions

11. Do you think that celebrities are responsible for stampedes and crowd mismanagement? Analyse the role of leaders in ensuring a peaceful and safe crowd assemblage. **(*Answer in 250 words*) 10**

Book Review

Our Living Constitution

Amidst the country is remembering the wraths created 50 years when the Emergency was imposed curbing civil liberties, it has been our robust Constitution that has stood the test of time. During this period, the book "***Our Living Constitution***" by **Shashi Tharoor** display the constitutional values and historical background that has kept democracy intact.

How this book helps in GS Preparation?

The book can help in providing citations related to different provisions of the **Constitution of India** which has a unique stance and stand apart from other Constitutions developed in other parts of the world.

Firstly, **voting rights for Women.** The Constitution-makers were clear since the beginning with the significance of **Universal Adult Franchise** and the impact it can create in the Indian society. The idea of conferring voting rights to women proposed in the **Motilal Nehru Report**, which was also implemented immediately after the Constitution came into effect. Ironically, our colonisers, i.e., the **British**, extended such rights to all women in their home in 1928, while the USA did not grant them until the **Civil Rights Movement** of the 1960s.

Secondly, **provisions related to land and agrarian reforms**. The **National Economic Programme** fuelled modern India's agricultural reforms and scripted her transition from a feudal to contemporary society in the years immediately after independence. Such programmes nudged the constitutional reforms in the form of **Article 48A** (modernisation of agriculture) and **300A** (along with **Articles 38** and **39**) through the **42nd Constitutional Amendment Act** and **the 44th Constitutional Amendment Act**, respectively.

The First Amendment to the Constitution of India

The First Amendment, enacted in 1951, introduced new grounds for restricting the freedom of speech and expression to protect laws related to public safety, press regulations, and criminal provisions being challenged by the judiciary. These changes were introduced to address judicial decisions that had struck down provisions of public safety laws and other regulations which were seen as incompatible with the constitutional right to freedom of speech and expression, but deemed essential by government to promote its social agenda and maintain peace in a strife-torn land just years after the country's violent Partition. Thus, the amendment created a whole new relationship between the citizen and the state.

Thirdly, **provisions related to the duties**. The author notes that the Fundamental duties were inspired not only by the Russian Constitution, but also by the **French Revolution's Constitution of 1795** and the **Mexican Cadiz Constitution of 1812**.

Fourthly, **the historical roots of constitutional republicanism**. The Constitution-makers highlighted the existence of some ancient Indian states that were republics, notably those of the Licchavis, who ruled northern Bihar and lower Nepal in the sixth and fifth centuries BCE (around the time of the Buddha), the **Mallas**, centred in the city of **Kushinagara**, and the **Vajji confederation**, based in the city of **Vaishali**.

Fifthly, **the Indian ethos led to the construction of constitutional pluralism**. Indian civilisation, from its inception, has incorporated diverse religions and cultural freedom. Due to this, other sections like **Jews** (who came to Kerala after the destruction by the **Babylonians** of their **First Temple**), **Christians** (through St Thomas the Apostle, who was welcomed by a **Jewish girl**), and **Islam** (through travellers, traders, and preachers). This has strengthened the notion of civic nationalism driving legitimacy from citizen's consent and active participation beyond **ethnicity**, **religion**, **language**, **culture**, etc.,.

9Cs of India

India, according to the author, is comprised of 9Cs - **Caste**, **Creed**, **Colour**, **Cuisine**, **Culture**, **Custom**, **Costume**, and **Conviction**, which further facilitates **democratic consensus**.

Sixthly, **the amendment of the Constitution**. The Constitution-makers realised and ensured that the Constitutional evolution aligns with the aspirations of society. Though amended over 100 times, the Constitutional provisions protected by basic structure doctrine avoid undermining its core values.

Summary of Key Articles - Yojana, Kurukshetra, EPW, Down To Earth

Operation Sindoor (Yojana)

Operation Sindoor was a response to the attacks on Pahalgam that occurred on **22nd April 2025**. The operation was a phenomenal success, considering the multifaceted impact it has created. ***Firstly***, **precision strikes on terror camps**. The operation was able to destroy and eliminate **nine major terror launchpads** in **Pakistan**, which killed more than 100 terrorists. These strikes also showcased the cross-border capability of the Indian defence system, including across the **Line of Control** (**LoC**). ***Secondly***, **such precision strikes were done without escalation**. The operation was intended to avoid civilians or non-terror military targets, showcasing its zero tolerance for terror while preventing the situation from escalating into full-scale war.

Thirdly, a **strategic red line for terrorism and state-sponsored terrorism**. India's security doctrine has added a "*New Normal*", which states that if terror is a state policy, it will be met with a visible and forceful response, thus displaying a shift from deter-

rence to direct action. With this, India has rejected the **artificial separation between terrorists and their backers**, striking both simultaneously.

Fourthly, the **defence superiority of India**. India's multi-layered air defence, including the indigenous Akashteer system, shot down hundreds of drones and missiles. This also showcased India's growing capabilities in exporting advanced defence systems.

Fifthly, the **exposure of Pakistan's air defence weaknesses**. Indian Air Force bypassed and jammed Pakistan's Chinese-supplied air defence systems, completing the mission in the stipulated timeline using **Rafale jets**, **SCALP missiles**, and **HAMMER bombs**, demonstrating India's technological edge.

Sixthly, **tri-services action**. The Indian Army, Navy, and Air Force worked in full coordination, demonstrating India's growing joint military prowess. ***Seventhly***, **widespread global support**. Unlike in previous conflicts, this time several global leaders backed India, rather than calling for restraint. The shift showed India's improved global standing and narrative control.

Ominous Exemptions (Down To Earth)

The recently held **Conference of Parties** (**CoP**) to the Stockholm Convention[1], with the goal of eliminating or reducing harmful and persistent chemicals, decided to allow the use of **UV-328** in the **aerospace** and **defence industries**. UV-328, an industrial chemical, was banned by the Parties in 2023, for use in **motor transport**, **instrumentation**, **industrial machines**, **medical** and **photography**.

The production of this chemical, since the 1970s, has been widely used in paints and plastics as a **UV absorbing material** to protect surfaces against **discolouration** and **degradation** under sunlight. It can be **toxic to the liver** and **disrupt hormones**. It is a **Persistent Organic Pollutant** (**PoP**) that exhibits three key traits: it persists in the environment for long periods, travels globally and becomes widely distributed geographically, and accumulates in fatty tissues. The problems associated with UV-328 first surfaced in the 2000s when the chemical was detected in the nearby regions of the **Arctic Ocean**.

Earlier in 2020, Switzerland proposed to list **UV-328** in **Annexe A** of the **Stockholm Convention**. As per the Convention, **Annexe A** lists chemicals to be eliminated; **Annexe B** lists chemicals whose production and release are restricted; and **Annexe C** lists chemicals whose unintentional production and release need to be minimised.

One of the most concerning parts is that the number of new chemicals listed under **Annexe A has dropped,** and the **number of exemptions** and the timeline for their production and use have **increased**. The other issue is that a global ban under the Stockholm Convention applies only when countries ratify the ban, with an option to opt out. For instance, in 2006, India declared that any amendment to Annexe A, B, or C *"shall enter into force only upon the deposit of its instrument of ratification, acceptance, approval, or accession with respect thereto."*

1. **Stockholm Convention** is a global treaty to protect human health and the environment from **persistent organic pollutants** (**PoPs**).

Chlorpyrifos

The 2025 Geneva COP also adds three new PoPs under Annexe A - **chlorpyrifos**, **long chain perflourocarboxylic acids** (LC-PFCAs), their salts and precursors, and **medium chain chlorinated paraffins** (MCCPs). **Chlorpyrifos** is an **insecticide** widely associated with neurodevelopmental issues. LC-PFCAs are **forever chemicals** used in cookware and are associated with cancer. MCCPs are a family of industrial chemicals used to make plastics flexible and durable. It is used in **polyvinyl chloride** (**PVC**) products, as well as in **paints**, **sealants**, and **rubber**.

Pollinator Crisis (Down To Earth)

Pollinators are the guardians of our ecosystems. They sustain life by ensuring food security and maintaining biodiversity. According to the **Food and Agriculture Organisation** (**FAO**), a **third of global food crops** rely on these pollinators for their yields. Among all, bees pollinate around 85% of all cultivated crops and a significant portion of the wild flowering plants globally[2]. Additionally, pollinators contribute to crops that provide **biofuels**, **fibres**, **medicines**, **forage for livestock**, and **construction materials**.

However, these pollinators are disappearing at an alarming rate in many parts of the world, largely due to **intensive farming practices**, **monocropping**, **excessive use of agricultural chemicals like pesticides** and **higher temperatures** associated with climate change, as observed by the **UN Environment Programme**. A study published in ***Current Biology*** shows yields of pollinator-dependent crops have stagnated or declined, while crops not reliant on pollinators remain unaffected (*check footnote*). This can be witnessed in India's case, where farmers reported a significant decrease in their crop yields in the **last ten to twenty-five years**. Across continents and ecosystems, the decline of pollinators has emerged as one of the most pressing and underappreciated crises of our time.

This silent crisis in pollination has given rise to a new business of assisted pollination. Beekeepers, who once relied on **honey production** and used to camp near **high-nectar-yielding crops** such as **mustard** and **lychee**, now earn more by renting out their colonies for pollination services as well. Another crucial solution that has been devised in recent times is the **hand pollination**, which was once exclusive to **vanilla orchids**, as they grow in areas outside their **natural range** in **Mexico**, where native pollinators like **Melipona bees are absent**. Now, this is becoming a prominent practice in the **Western Ghats**.

In Himachal Pradesh, over **4 lakh beehives** are rented annually in apple orchards of **Mandi** and **Janjehli Valley**, where wild

2. However, there are certain cereal crops like **wheat**, **rice**, and **maize** that are primarily **wind-pollinated or self-pollinated** and can successfully reproduce without relying on pollinators.

pollinators have vanished. In **Karnataka's Kodagu region**, coffee growers now rely on **manual pollination using cotton buds**, a practice spreading across spice, fruit, and vegetable farms. Even the famed **Shankarapura jasmine** of Udupi, a GI-tagged flower, has seen yields halve due to **air pollution-driven pollinator loss**, making **labour-intensive hand pollination** essential.

However, this artificial substitution also comes with concerns related to **high labour costs**, **input costs**, **material costs**, as well as **skill requirement**. Studies involving supplemental hand pollination of flowers have shown that seed production of plants is often limited by the quantity and quality of pollen received naturally. Some farmers in Karnataka are experimenting with **companion planting**, **pollinator gardens**, **reduced pesticide regimes**, and **beekeeping as a long-term solution**.

Apart from this**, pollinator sanctuaries** can be an effective solution,established by preparing a seed mix comprising a rich diversity of **annual**, **biennial**, and **perennial** plants comprising grasses, forbs, herbs, legumes, and local windflowers. The carefully selected plant diversity provides both nesting and foraging opportunities for the bees and enables them to nest in a purely natural ecological habitat. This helps in the replenishment of a bee colony by removing ecological stress and provides them with easy access to a rich diversity of plants suitable for collecting adequate nectar and pollen across the season.

Note: The aspect of pollinator sanctuaries has been covered from the ***Science Reporter*** **magazine**.

Himalayan High Altitude Atmospheric and Climate Research Centre (Science Reporter)

Recently, the **Himalayan High Altitude Atmospheric and Climate Research Centre was established in Jammu and Kashmir**. It was established in collaboration with the **Ministry of Earth Science**, the **Government of Jammu and Kashmir**, the **Central University of Jammu**, the **Swiss National Science Foundation**, and **ETH**, **Zurich**.

The location of the research centre has been strategically chosen. Located at Nathatop hill station, an area with extremely low pollution and clean air, the centre offers rare conditions ideal for studying **atmospheric processes in the free troposphere**. This is ideal, especially with the aspect of studying **cloud formation**, **aerosol behaviour**, and **weather dynamics**, and providing critical data for **developing accurate climate models** and **forecasts**.

The first major research initiative at the centre will be the **ICE-CRUNCH project**, which investigates **ice-nucleating particles** and **cloud condensation nuclei**. The research aims to fill a major data gap in the **Global East** and **South** and will contribute to reducing uncertainty in **climate modelling**. The data generated here will be integrated into the **World Meteorological Organisation's Global Climate Watch** programme, to which the centre aspires to be formally affiliated in the future.

Through this centre, the Himalayas will evolve from being known as the world's water towers to becoming vital climate observatories. This facility positions India at the forefront of **global climate science**.

Resolving Global Plastic Footprint (Science Reporter)

A recent study has reported that by 2050, the ocean may contain more plastic than fish, with over **5 trillion plastic pieces** floating in the oceans. Plastic pollution, though not confined to oceans, inevitably ends up in the oceans. Addressing this requires diverse efforts.

Firstly, Plastic Free Foundation has launched the **Plastic Free July Movement**. The movement's motto is to avoid using single-use plastics, such as **bags**, **straws**, **bottles**, and **packaging**. The movement also encourages the development of sustainable alternatives to plastics. On 3rd July, International Plastic Free Day is celebrated, which mainly focuses on the environmental pollution caused by plastic bags.

Secondly, the above movement has inspired countries like **Rwanda** and **Kenya** to implement strong policies. **Rwanda** banned plastic bags long back in 2008, becoming one of the cleanest countries in **Africa**. Similarly, Kenya imposes a strict policy regarding plastic bags, with heavy fines and even jail time for violations.

Thirdly, seeking alternatives like biodegradable, compostable, and even edible packaging from seaweed (marine plants and algae), which innovators in the UK and Indonesia have developed. Even a USA-based company has developed a mushroom packaging process using **mycelium**, the root structure of fungi, to produce packaging that replaces **Styrofoam**. Additionally, bioplastics offer potential alternatives to petroleum-based plastics. **Polyhydroxylalkanoates** (**PHAs**), natural bioplastics are produced through **bacterial fermentation of plant oils** or **organic waste**. They break down easily in soil, freshwater, and marine environments.

Stainless steel, glass, or bamboo straws can also be used as replacements for single-use plastic straws. Using compostable packaging made from cornstarch or sugarcane pulp can significantly reduce plastic waste. Several industries are also exploring other alternatives.

In India, the CSIR has been at the forefront of developing alternative technologies. Recently, researchers at **CSIR - Indian Institute of Petroleum**, **Dehradun**, have developed a technology to **convert waste plastic** into **high-quality diesel**. Similarly, researchers at the **CSIR-NCL** are actively working on **plastic pelletisation**, a process that converts plastic waste into reusable pellets. Additionally, institutes such as the **CSIR-Central Electronics Engineering Research Institute** (**CSIR-CEERI**), **Pilani**, and **the CSIR-Mechanical Engineering Research Institute** (**CSIR-CMERI**), **Durgapur**, are developing **plastic sorting technologies**, which are crucial for the **effective separation and recycling of mixed plastic waste**.

Cash Transfers to Women - A Case Study of Ladki Bahin Scheme (EPW)

The **Maharashtra government** launched the **Ladki Bahin Scheme** under which ₹ **1500/- per month** will be disbursed to women aged **21 to 65 years**. The eligible beneficiaries must earn less than ₹ **2.5 lacs annually**. However, the question arises regarding the "***free doles***" to the target groups.

According to the **National Statistical Office's Time Use Survey** (**2019**), women in India spend around six hours daily on unpaid work. This significant contribution to household welfare goes unrecognised in economic calculations but is essential for the well-being of society. Numerous studies have demonstrated that women tend to prioritise family and children's welfare when they receive financial support, making them **key agents of social** and **economic well-being**.

Considering the current assessment of eligible beneficiaries, it has been observed that majority are working class women, primarily in the informal sector. This high level of workforce participation highlights the "***need to work***" can be translated as "***need to support***". The other inference was devised that the women belong majorly from the nuclear families, which showcases the need for income in their hands to run their family. Apart from this, the **two-thirds of the eligible beneficiaries** have been found **illiterate** or with merely **primary education**. Also, three-fourths of them have been found above the poverty line. This, somewhere answers the question regarding such cash transfer programmes.

The answer can be further facilitated by the kind of expenditure done by beneficiaries. As per the survey findings, there are concrete evidence that cash transfers and basic income schemes show that people were quite capable of making rational decisions that improved their lives and their communities. This is because the money used by beneficiaries were for **essential needs**, **basic amenities**, followed by **education** and other discretionary expenses like **travel** and **religious activities**.

However, the scheme has found governance glitches as well. While around half of the eligible beneficiaries found the registration under the scheme hassle-free, the other half faced the challenges related to **documentation**, **proving financial eligibility**, and **Aadhaar linking of bank accounts**. While those connected with some informal social network found it easier to access the scheme, some of the portion of the public outside the ambit of the scheme were left behind due to misinformation.

Preferential Trade Agreements - Building Blocks than Stumbling Blocks (EPW)

Preferential trade agreements (PTAs) are currently the dominant feature of the international trading system. Hundreds of such agreements have been negotiated and almost all countries have participated in them. But what are the crucial forces that have driven many countries towards such arrangement in the international trading system.

Firstly, PTAs help developing countries and emerging economies to participate in free trade agreements because they have the opportunity to shape the mandate. They can exclude sensitive sectors and industries while gaining or retaining access to the markets of major economies.

Secondly, the cost of non-participation may be high for non-members. The incentive to lower trade barriers, thus, rises as competing domestic interests shift in favour of open trading regimes.

Thirdly, these agreements also manifest technology transfer so that less developed countries can proceed at their own pace and engage in the multilateral trading system one step at a time, instead of all at once. Thus, PTAs can be forum for experimentation as well as learning.

Fourthly, many PTAs include issues that fall under the WTO-extra (WTO-X) category, i.e., topics that lie beyond the the WTO mandate. For instance, labour standards, which is typically found in North-North PTAs or majorly between developed economies. This helps developing economies to avoid certain ambits of the WTOs and sign deals with lesser limitations and hiccups. Thus, PTAs are like the cushion that encourages international behaviour on regional basis first, then gaining support to legalise these practices multilaterally in the WTO would be an easier path.

Fifthly, PTAs help in trade creation by fostering these global value chains, something that has also been recommended to boost India's exports in the **Economic Survey 2019-20**. Global value chains create a positive spillover effect by accompanying developments, as countries gradually increase the level of cooperation between them and expand it to more areas.

Sixthly, PTAs also decrease the protectionist trend that may hind the convergence of world trade. Considering the current instances of **geoeconomic fragmentation**, **friendshoring**, and **economic nationalism**, especially in the case of advanced economies, PTAs allow developing countries to ensure better cooperation on economic and political regulations. Inter and intra-industry goods and services flow seamlessly without disruptions among trading partners and members can trade in the sectors that they have a competitive advantage in, which further results in trade creation.

Practice Questions

Prelims

12. Chlorpyrifos, sometimes mentioned in the news, is primarily used for:

(a) Cement
(b) Fire crackers
(c) Insecticide
(d) Paints

13. Consider the following fields:

1. Aerospace
2. Defence
3. Motor transport
4. Photography

How many of the above-mentioned domains use UV-328?

(a) Only one (b) Only two
(c) Only three (d) All four

14. Consider the following statements:

1. Bioplastics exists artificially only.
2. Polyhydroxylalkanoates are types of bioplastics.

Which of the statements given above is/are correct?

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

15. Why mountainous regions are strategic in terms of studying climatic conditions?

(a) Cold environment
(b) Glacial landforms
(c) Heavy rainfall
(d) Less effect of pollution

Mains

12. Reducing global plastic footprint needs multifaceted strategies. Substantiate with examples. **(Answer in 150 words) 10**
13. Cash transfers act as double-edged sword when it comes to streamlining governance process and ensuring social development. Analyse. **(Answer in 150 words) 10**
14. Highlight the major concerns of the international trading system. Suggest measures. **(Answer in 150 words) 10**
15. Caste census can create deep-rooted impacts. In context of the given statement, discuss about the caste census which will be conducted in India. **(Answer in 250 words) 15**

Answer Key

1. (b)	2. (c)	3. (a)	4. (a)	5. (b)
6. (a)	7. (a)	8. (d)	9. (d)	10. (c)
11. (b)	12. (c)	13. (d)	14. (b)	15. (d)

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