

**1. Charter acts**

**Charter Act 1813: Transforming East India Company in Colonial India**

- The British Parliament passed the Charter Act 1813, which significantly altered the governance and trade practices of the East India Company in India. This act effectively ended the Company's monopoly in a variety of ways while also introducing provisions for social and educational reforms. This article examines the key provisions of the Charter Act 1813, focusing on the East India Company's control and social responsibilities in colonial India.
- **Provisions of the Charter Act 1813: Breaking Monopoly, Empowering India's Growth**
- The Charter Act 1813 was enacted in response to demands from business interests in England seeking an end to the East India Company's monopoly over trade in India. The act aimed to address these grievances and introduce certain changes:
- **End of Monopoly Trade:** The act terminated the East India Company's monopoly over trade in India, allowing for competition in the Indian market. However, the Company still retained its monopoly over trade with China and the tea trade.
- **Shareholder Dividend:** Shareholders of the East India Company were guaranteed a dividend of 10.5 per cent on the revenue generated from India.
- **Retention of Territories and Revenue:** The act stipulated that the Company would continue to possess territories and collect revenue for another 20 years, without compromising the sovereignty of the British Crown. This was the first specific declaration of British territories' constitutional position in India.
- **Expansion of Powers of the Board of Control:** The act further expanded the powers of the Board of Control, granting it increased

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authority and control over the affairs of the East India Company.

- **Promotion of Literature, Learning, and Science:** A sum of one lakh rupees was to be allocated annually for the promotion, revival, and encouragement of literature, learning, and science among the native population of India. This provision highlighted the responsibility of the state in supporting education.
- **Parliamentary Oversight:** Regulations made by the Councils of Madras, Bombay, and Calcutta were required to be presented before the British Parliament, establishing a mechanism for parliamentary oversight.
- **Separate Accounting:** The act mandated the maintenance of separate accounts for commercial transactions and territorial revenues, ensuring transparency and accountability.
- **Permission for Christian Missionaries:** Christian missionaries were permitted to come to India and preach their religion, facilitating the spread of Christianity.
- **Impact and significance: Shaping India's Economy, Society, and Education**
- The Charter Act 1813 had far-reaching consequences for British colonial rule in India:
- **Economic Liberalization:** The abolition of the Company's monopoly trade with India encouraged competition and boosted economic growth. It enabled Indian merchants and other Europeans to trade, resulting in a more diverse and dynamic market.
- **Social and Religious Transformations:** The provision allowing Christian missionaries to enter marked a significant step forward in the spread of Christianity and the implementation of social and religious reforms. It influenced religious discourses and aided in the transformation of societal dynamics.
- **Financial Regulation and Accountability:** The provisions of the act pertaining to the separation of territorial revenues and commercial profits aimed to improve financial transparency and accountability within the East India Company.
- **Educational Development:** The provision for investing in Indian education recognized the significance of education in social progress and intellectual capacity development among the Indian population.

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- Finally, the Charter Act 1813 marked the beginning of a new era in British colonial rule in India. It ended the monopoly of the East India Company, instituted social and religious reforms, and promoted financial accountability and educational development. While it brought about significant changes, the consequences were complex and multifaceted. The act laid the groundwork for subsequent legislative measures and initiatives that would shape British governance and social transformation in colonial India.

### **Charter Act 1833: Transformative Shifts in British India**

- The British Parliament passed the Charter Act 1833, which was a key legislative milestone in the history of British administration in India. This legislation fundamentally altered the East India Company's governance and included provisions that laid the ground for social, administrative, and economic reforms. This article examines the history, important aspects, and significance of the Charter Act of 1833, focusing on its transformative impact on colonial India.
- **Background and Objectives of the Charter Act 1833: Reforming India's Governance & Society**
- The East India Company's grip over India had grown greatly by the early nineteenth century, prompting worries about its administrative practices and the impact of its rule. Several causes contributed to the enactment of the Charter Act 1833:
- **Governance and Administrative Reform:** There was a growing recognition of the need to streamline and reform the East India Company's governance structures, particularly in light of the inefficiencies and abuses highlighted by various reports and inquiries.
- **The Evangelical Movement and Social Reforms:** The Evangelical movement in Britain, which sought to address social issues and promote moral values, played a role in pushing for reforms in India in areas such as education, slavery, and religious practices.
- **Renewal of the Company's Charter:** The East India Company's existing charter was about to expire, necessitating its renewal and providing an opportunity to make significant changes.
- **Features of the Charter Act 1833: Shaping British India's Governance**
- The Charter Act of 1833, also known as the Government of India Act

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1833, introduced several significant features and provisions in the governance of British India:

- **Transition to an Administrative Body:** The Act marked the end of the company's commercial activities in India, transforming it into an administrative entity responsible for British Indian possessions. It shifted the company's primary role from trade to governance.
- **Closure of Trade Links with China:** The Act also led to the cessation of the company's trade links with China, redirecting its focus toward India's administration and governance.
- **Freedom for English Settlement:** It granted English individuals the freedom to settle in India, paving the way for British residents to establish a more substantial presence in the country.
- **Legalization of British Colonization:** This legislation effectively legalized British colonization in India, formalizing British control and governance over Indian territories.
- **Change in Territorial Ownership:** Although the East India Company continued to possess Indian territories, the Act stipulated that these territories were held "in trust for his majesty," signifying a shift in sovereignty from the company to the British Crown.
- **Provisions of the Charter Act 1833: Overhauling Governance in British India**
- The Charter Act 1833, also known as the Government of India Act 1833, introduced several significant provisions that had a lasting impact on the governance of British India:
- **Governor-General of India:** The Governor-General of Bengal was re-designated as the Governor-General of India, with Lord William Bentinck becoming the first Governor-General of India. This unification of administration placed the entire country under a single governing authority.
- **Centralized Legislative Powers:** The Governors of Bombay and Madras lost their legislative powers, and the Governor-General gained legislative authority over all of British India.
- **Authority to Amend Laws:** The Governor-General in council was granted the authority to amend, repeal, or alter any law applicable to all people and places in British Indian territories, regardless of their British, foreign, or Indian native status.
- **Civil and Military Affairs Control:** The Governor-General in council

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assumed control over both civil and military affairs of the company.

- **Formation of India Council:** The government of the Governor-General came to be known as the “Government of India,” and the council as the “India Council.”
- **Indian Law Commission:** The Act mandated that any law made in India had to be presented before the British Parliament and referred to as an “Act.” It established the Indian Law Commission, chaired by Lord Macaulay, to codify Indian laws.
- **Division of Bengal Presidency:** The Act provided for the division of the Bengal Presidency into the Presidencies of Agra and Fort William, although this division did not materialize.
- **Inclusion of Indians in Government Service:** It was the first Act to allow Indians to participate in the country’s administration. It emphasized merit-based employment in government service, irrespective of birth, color, religion, or race.
- **Mitigation of Slavery:** The Act addressed the issue of slavery existing in India at the time, aligning with the British Parliament’s abolition of slavery in Britain and its possessions in 1833.
- **Regulation of Christianity:** Given the increasing number of British residents, the Act permitted the presence of three Bishops in India and sought to regulate the establishment of Christian institutions in the country.
- **Significance of the Charter Act 1833: Shift to Crown Control & Legal Codification**
- The Charter Act 1833 is highly significant in the history of British India for several reasons:
- **Transition to British Crown Control:** The Act marked the definitive end of the East India Company’s commercial activities in India, transforming it into a trustee of the British Crown for the administration of India. This transition underscored the direct involvement of the British government in governing India.
- **Codification of Laws Under Macaulay:** The Act led to the establishment of the Indian Law Commission, chaired by Lord Macaulay. This commission played a pivotal role in the codification of Indian laws, laying the foundation for a more systematic legal framework.
- **Inclusion of Indians in Government Service:** Another noteworthy

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provision of the Act was the recognition of Indians in government service. It emphasized merit-based appointments, breaking away from considerations of birth, color, religion, or race.

- **Charter Act 1833 Drawbacks: Limits and Criticisms in Colonial Reform**

- While the Charter Act 1833 brought about significant changes in the governance of British India, it also had its drawbacks and limitations:
- **Limited Indian Representation:** The Act did not provide for Indian representation in the legislative or executive councils. It continued to concentrate power in the hands of British officials, limiting Indian participation in governance.
- **British Control:** While the Act centralized administration under the British Crown, it also reinforced British control over India. The East India Company's role shifted from a trading entity to a governing body, furthering British colonial rule.
- **Cultural Insensitivity:** Some provisions of the Act, particularly those related to the regulation of religious and social matters, were criticized for their cultural insensitivity and interference in Indian traditions and customs.
- **Codification of Laws:** While the codification of laws under Lord Macaulay was a significant step, it also led to the imposition of British legal systems and standards on Indian society, potentially undermining indigenous legal traditions.
- **Lack of Division in Bengal Presidency:** The Act's provision for the division of the Bengal Presidency into Agra and Fort William did not come into effect, leaving administrative challenges in the vast Bengal region unaddressed.
- **Inadequate Mitigation of Slavery:** Although the Act sought to mitigate slavery, it did not fully address the complexities of the practice in India, and its impact on slavery was limited.
- **Religious and Social Reforms:** The Act's regulations on religious and social matters, while well-intentioned, sometimes led to cultural clashes and misunderstandings between British authorities and the Indian population.
- **Continuation of Colonialism:** While the Act represented a shift in governance, it still upheld the institution of British colonialism in India, which had long-lasting and complex consequences for the

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subcontinent.

**Charter Act 1853: Transforming Colonial Rule in India**

- Charter Act 1853, passed by the British Parliament on August 13, 1853, was a watershed moment in British India's history. It acted as a link between previous acts of governance and the changing dynamics of colonial control. This act prolonged the British East India Company's dominion over India for another twenty years, consolidating British control over the country. Significant changes were implemented, including the separation of legislative and executive duties, the extension of parliamentary powers, and the institution of open competitive examinations for civil workers. The act also attempted to liberalize trade and commerce by removing the East India Company's trade monopoly and acknowledging Indian people's religious and cultural diversity.

**CHARTER ACT 1853**

**Legislative and Executive**

**Separation**

- Introduced a separation between legislative and executive functions

**Expansion of Legislative Council**

- Expanded the Legislative Council 12 members, including a mix of officials and representatives

**Governor-General's Authority**

- Empowered the Governor-General to nominate a vice president and required his assent for legislative proposals.

**Creation of New Provinces**

- Allowed the Court of Directors to create new provinces in response to administrative challenges

**Introduction of Indian Civil**

- Established ICS, based on merit through competitive exams, open to all.

**Services (ICS)**

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- **Charter Act 1853 History: Addressing Governance Challenges in India**
- The Charter Act 1853, which renewed the East India Company's charter, emerged in response to various historical factors.:
- **Excessive Expenditure and Delay in Business:** The presence of the board of directors and the court of directors resulted in excessive expenses and delays in the dispatch of business. These difficulties prompted questions about the East India Company's administration's efficiency and efficacy.
- **Territorial and Political Changes in India:** After the 1833 Act was passed, the British East India Company seized regions such as Sind, Punjab, and several other Indian states. These territorial and political shifts emphasized the need for reforms to address India's changing dynamics and governance issues.
- **Concerns over the Role of the Governor-General of India:** Concerns were expressed over the role of India's Governor-General, who simultaneously served as Governor of Bengal. It was anticipated that this dual function would lead to judgments favouring Bengal, weakening fair administration and equality across British India.
- **Demand for Decentralization and Indian Participation:** There was a growing demand for power decentralization and Indian participation in the management of their own affairs. The Indians demanded increased representation and participation in decision-making processes, arguing for greater representation and involvement in government.
- **Charter Act 1853 Objective: Shifting Powers and Ending Commercial Privileges**
- The Charter Act 1853 marked a significant shift in the British East India Company's authority and its relationship with the Indian colonies. While it restored the Company's jurisdiction, allowing it to manage properties and income from Indian territories on behalf of the monarch, it deviated from previous Charter Acts in a crucial manner.
- The Charter Act 1853 did not grant the Company any specific commercial privileges for a predetermined period. This departure signaled a change in the nature of British control in India, moving away from the Company's earlier exclusive commercial interests and towards a more centralized and direct form of governance.



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- **Charting Change: Key Features of Charter Act 1853 in India**
- Charter Act of 1853, also known as the Indian Government Act 1853, introduced several important features and provisions in the governance of British India:
- **Separation of Legislative and Executive Functions:** This legislation marked a historic moment as it separated the legislative and executive functions of the Governor-General's council for the first time. This laid the groundwork for the modern parliamentary form of government in India.
- **Foundation of Parliamentary Government:** The Act established a legislative wing within the Governor-General's Council, which operated on a parliamentary model, resembling the British Parliament in structure and function.
- **Indefinite Extension of Rule:** Unlike previous Charter Acts that had specified timeframes, the Charter Act of 1853 extended the rule of the East India Company for an indefinite period. This meant that British control in India could be taken over by the British government at any time.
- **Reduction of Company's Influence:** The Act reduced the influence of the East India Company by mandating that six members of the Board of Directors be Crown-nominated, thereby ensuring greater government oversight.
- **Indian Civil Services:** This legislation gave rise to the Indian Civil Services, which were open to all, including Indians. It replaced the system of appointments based on recommendations with a merit-based system of open and fair competition.
- **Introduction of Local Representation:** For the first time, the Act introduced local representation in the legislative council by including four members from the local governments of Bengal, Bombay, Madras, and the North Western Provinces. This move aimed to provide a voice to local interests.
- **Charter Act 1853: Overhauling Governance in British India**
- The Charter Act of 1853 made several noteworthy improvements and adjustments to British India's government. Let us look more closely at these specific provisions:
- **Governor-General's Office: 1853 Reforms in British India**

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- The Charter Act of 1853 introduced significant changes to the Governor-General's office.
- The Law member (fourth member) was granted full membership status, including the right to vote.
- The Legislative Council, which previously had six members, was expanded to include 12 members.

#### **Composition of the Legislative Council: Memberships in India**

The 12 members of the Legislative Council included:

- 1 Governor-General
- 1 Commander-in-Chief
- 4 members of the Governor-General's Council
- 1 Chief Justice of the Supreme Court at Calcutta
- 1 regular judge of the Supreme Court at Calcutta
- 4 representative members selected from among the company's servants who had served for at least 10 years.
- These representative members were appointed by the local governments of Bengal, Bombay, Madras, and the North Western Provinces.

#### **Governor-General's Authority: 1853 Changes in Legislative Role**

- The Governor-General was granted the authority to nominate a vice president to the council.
- The assent of the Governor-General was required for all legislative proposals.

#### **Creation of New Provinces: Charter Act 1853 Administrative Shifts"**

- The Court of Directors was empowered to create new presidencies or provinces due to the challenges of administering the growing Indian territories.
- As a result, two new provinces, Sind and Punjab, were added between 1833 and 1853. In 1859, a Lieutenant Governor was appointed for Punjab.
- The Act also led to the establishment of Assam, Burma, and the Central Provinces.

#### **Separate Governor for Bengal Presidency: Charter Act 1853 Administrative Reform**

- The Act provided for the appointment of a separate governor for the

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Bengal Presidency. This separated the roles of the governor of Bengal from the Governor-General, who was responsible for the administration of all of India.

- **Changes in the Board of Directors: Charter Act 1853 and Crown Nominations**
  - The number of members on the Board of Directors was reduced from 24 to 18, with 6 of them to be nominated by the British Crown.
- **Indian Civil Services (ICS): Charter Act 1853's Merit-Based Shift**
  - The Charter Act of 1853 had significant implications for the Indian Civil Services (ICS).
  - The Macaulay Committee of 1854 played a key role in establishing India's first civil services.
  - The Act removed the right of patronage held by the Court of Directors in civil service appointments.
  - Appointments to the civil service were to be made solely through open competition based on merit, and these opportunities were open to all.
  - The report emphasized selecting only the most qualified candidates for the ICS.
  - These provisions of the Charter Act of 1853 brought about substantial changes in the administrative and legislative structure of British India, particularly in terms of governance, representation, and the establishment of a merit-based civil service system.
- **Charter Act 1853 Significance: Shaping India's Parliamentary System**
  - The Charter Act of 1853 marked a turning point, underscoring the limited longevity of the East India Company's rule in India. Notably, it introduced a clear demarcation between the Legislative and Executive Councils, heralding the dawn of India's parliamentary system.
  - In a notable move, the Bengali government relinquished its oversight responsibilities over the Governor-General, thereby allowing him to function directly on behalf of the Indian government. This shift in authority was a significant development facilitated by the Act.
  - Another provision of the Charter Act of 1853 was the establishment and regulation of the Legislative Council. This constitutional provision holds immense significance as it laid the groundwork for India's evolving governance structure and parliamentary processes.

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- **Charter Act 1853 Criticism: Lack of Indian Representation**

- A notable drawback of the Charter Act of 1853 was its omission of Indian representation in the Legislative Council, a significant shortcoming that hindered the involvement of local voices in the governance of British India.
- The Act presented an opportunity for the Home Government to intervene and potentially assume control in India. This was primarily because the Act did not extend the East India Company's authority to govern India for an additional 20 years, creating a scenario where the British Crown could potentially take over. The events of 1857, often referred to as the "Mutiny" or the Indian Rebellion of 1857, played a pivotal role in hastening this process, as they heightened concerns and discussions about the future of British rule in India.
- A significant flaws in the Charter Act of 1853 was the glaring absence of Indian representation in the Legislative Council, a significant shortcoming that hindered the involvement of local voices in the governance of British India.
- The Act presented a pivotal opportunity for the Home Government to potentially assume control in India. This opportunity arose because the Act did not confer upon the East India Company the authority to extend its rule over India for an additional 20 years. The events of 1857, often referred to as the "Mutiny" or the Indian Rebellion of 1857, significantly expedited this process.

## 2. A Fact Check Unit That is Unconstitutional

Recently, **the Government of Tamil Nadu has taken a proactive step by issuing an official order to establish a Fact Check Unit.**

- The primary objective of this unit is **to rigorously examine and verify the accuracy of information disseminated across various media platforms** concerning the actions and policies of the Government of Tamil Nadu.
- This government order (GO) is **violative of several fundamental rights guaranteed by the Constitution of India**, and is unconstitutionally vague and arbitrary.
- **Key Highlights of Tamil Nadu Fact Check Unit**
- **Purpose and Scope:** The primary purpose of the fact-checking unit is **to verify the accuracy of information** related to announcements, policies, schemes, guidelines, and initiatives **of the Government of Tamil Nadu.**
- **Operative Details**
  - The fact-checking unit is empowered to scrutinise social media posts and articles.
  - It can take **Suo Motu cognizance (initiate action on its own)** or respond to complaints received from any source.
  - The unit **employs various fact-checking tools and verifies information** through official government sources, including websites, press releases, and government social media accounts.
- **Process of Fact-Checking**
  - Upon identifying complaints, **the fact-checking unit will conduct research and categorise the information** into actionable and non-actionable pools.
  - Thereafter, complaints falling under the actionable category **will be forwarded to the relevant authorities to initiate legal action.**
- **Dissemination of Verified Information**
  - **Once the authenticity of information is verified** from government-approved sources, **the fact-checking unit will**

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**disseminate creative content** through its social media platforms.

- The goal is not only to rectify misinformation but also **to create awareness among the public about the importance of relying on accurate sources of information.**
- **Significance of Tamil Nadu Fact Check Unit**
- **Authority and Accountability**
  - The fact-checking unit will operate with the authority to initiate legal action, and **indicates a serious commitment to combating misinformation.**
  - By specifying the use of government-approved sources, **the unit will strive to ensure accountability and reliability in the fact-checking process.**
- **Transparency and Communication**
  - **The inclusion of Annexure III in the Government Order provides more details** on the unit's functioning, promoting transparency.
  - The fact-checking unit **utilises social media platforms not only for corrective measures but also for preventive communication**, aiming to educate the public on discerning accurate information.
- **Fundamental Problems Associated With Tamil Nadu FCU**
- **In Violation of Settled Principles (Fundamental Rights)**
  - TN's FCU has a **chilling effect on the freedom of speech and expression**, a fundamental right guaranteed under **Article 19(1)(a) of the Constitution.**
  - This can only be reasonably restricted under Article 19(2) in the interest of the sovereignty and integrity of India, security of the state, friendly relations with foreign states, etc.
  - More importantly, **such restriction under Article 19(2) can only be by way of a law, which, as held by the Supreme Court of India, must be legislation passed by the State.**
  - Thus, it is settled law that a GO cannot impose restrictions on the freedom of speech and expression.
  - It is also important to understand that **public interest is not a ground under Article 19(2) to restrict the freedom of speech and expression.**

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- **Unconstitutionally Vague and Arbitrary**
  - A close analysis reveals that the proposed FCU lacks the clarity in the GO, **specifically where it is mentioned "information related to the Government of Tamil Nadu."**
  - **This vagueness makes the GO unconstitutional and arbitrary**, questioning whether various forms of expression, such as economic critiques or investigative journalism, would fall under the jurisdiction of the fact-check unit.
- **Entails Procedural Illegalities**
  - The GO **lacks provision for an opportunity of hearing for individuals** whose posts are subject to fact-checking.
  - The government's role has been defined as the judge, jury, and executioner without due process **which is a violation of fair procedure.**
- **Misalignment of GO with Stated Objectives**
  - The introductory paragraph of the GO states that the emergence of social media and its related issues of mis/disinformation, fake news, and hate speech have necessitated the creation of the fact check unit by the State government.
  - **This is only partly true because hate speech has no direct nexus with information related to the Government of Tamil Nadu, which is the focus of the fact check unit.**
  - Indeed, mis/disinformation and fake news are **a challenge for democracies throughout the world.**
    - This was most evident during the U.S. presidential election of 2016, the Brexit referendum, and the Colombian referendum of 2016.
    - The situation is no different in India wherein politicians and TV anchors peddle mis/disinformation with no remorse.
- **Way Forward**
- **The GO issued by the Government of Tamil Nadu is not a solution** to curb mis/disinformation and fake news.
- **Consultations need to be held with all stakeholders** including the public and intermediaries such as Facebook, X, and Google.
  - For instance, in Europe, the European Commission issued **the Code of Practice on Disinformation** on September 26, 2018,

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after a broad consultative process and opinion poll covering all member States.

- **These measures must include support for an independent network of fact-checkers** and promoting media literacy.
- **Conclusion**
- The fact-checking unit by the Government of Tamil Nadu **does not align with the principles of the constitution.**
- Misinformation is a challenge that all governments are fighting and **to combat misinformation there is a need for a comprehensive and proactive strategy rather than a GO that has the potential to curtail the fundamental right of citizens.**



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### 3. Peace Pipeline

The **Turkmenistan–Afghanistan–Pakistan–India (TAPI) Pipeline**, also known as **Trans-Afghanistan Pipeline**, is a natural gas pipeline being developed by the **Galkynysh – TAPI Pipeline Company Limited** with participation of the **Asian Development Bank**.

The pipeline will **transport natural gas from the Galkynysh Gas Field in Turkmenistan through Afghanistan into Pakistan and then to India**.

Construction on the project started in Turkmenistan on 13 December 2015, work on the Afghan section began in February 2018, and work on the Pakistani section was planned to commence in December 2018. The abbreviation TAPI comes from the first letters of those countries. Proponents of the project see it as a modern continuation of the Silk Road.

As of 2022, construction of the pipeline remains stalled.

#### Trans-Afghanistan pipeline

Route of the Turkmenistan-Afghanistan-Pakistan-India (TAPI) natural gas pipeline



#### TAPI pipeline route details

- If completed the **1,814-kilometer gas pipeline will pass through Afghanistan to Pakistan and India**. The TAPI gas pipeline will

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transport gas **produced from the Galkynysh gas field in Turkmenistan** to Afghanistan, Pakistan and India.

- The pipeline will start from **Mary region** of Turkmenistan and cover a total distance of 214km up to Afghanistan. The Afghanistan section will be built along the highway.
- The **pipeline will run through Kandhar and Herat highway in Afghanistan**, for a length of 774km. It will **cover 826km in Pakistan, across the cities of Quetta and Multan**, finally terminating in Fazilka at the Indo-Pakistan border in Punjab region, India.
  - **Financing**
- The TAPI project is being **funded by the Asian Development Bank (ADB)**, which is also acting as transaction adviser for the development.
  - **TAPI pipeline benefits**
- The pipeline is expected to facilitate a unique level of trade and co-operation across the region, while also supporting peace and security between the four nations.
- More than **1.5 billion people in Afghanistan, Pakistan, and India are expected to benefit** from the long-term energy security provided by the project.
- In addition, the project is expected to boost the revenues of Turkmenistan via the sale of gas.
- Afghanistan and Pakistan will also receive benefits through transit fees.
- Political instability and violence in Afghanistan, however, stalled its progress after a groundbreaking ceremony was held in Serhetabad in Turkmenistan in February, 2018.
  - **Importance of TAPI Pipeline**
- India's approach to TAPI positions Turkmenistan as a crucial nexus for its connectivity with Central Asia as a whole. Equally, for landlocked Turkmenistan, the much anticipated TAPI pipeline represents an opportunity to find alternative export partners and one that comes with few strings attached.
- The TAPI pipeline represents a small but important step away from coal in regions primed for economic growth. Residents of Mumbai, Karachi, Delhi, and Islamabad may get some relief from the respiratory diseases associated with air pollution.
- The TAPI pipeline's significance extends beyond energy security and

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into the geopolitical. TAPI may contribute to regional stability as Afghanistan, Pakistan, and India experience higher degrees of energy security.

- India is world's third largest energy consumer and fourth largest importer of Liquefied natural gas and India's energy requirement is increasing steadily.
- According to BP Energy Outlook 2035, India will account for 9% of world energy consumption, while its share in global production will remain at 5%. In the same period, natural gas demand will increase by 131% and domestic natural gas production will be far from meeting consumption. For this reason, India's natural gas imports are expected to quadruple by 2040. This emerging and future energy gap explains India's interest in TAPI and the importance of the project for India.
- Moreover, the project has the particular advantage of providing an entry point to Central Asia, enabling future energy deals or similar pipelines to be concluded with this energy-rich region. This is a very important factor for a large economy with a large population like India. In addition, the pipeline could lead to the creation of a trade corridor between the four countries, stretching as far as Kazakhstan.
- TAPI Gas Pipeline will transform the politics of this region and help build trust and confidence among ourselves as neighbours and partners in progress.

#### **4. Land Revenue Policy of British in India**

Land revenue was one of the major sources of income for Britishers in India. There were broadly three types of land revenue policies in existence during the British rule in India.

Before independence, there were three major types of land tenure systems prevailing in the country:

- The Zamindari System
  - The Mahalwari System
  - The Ryotwari System
- The basic difference in these systems was regarding the mode of payment of land revenue.

##### **The Zamindari System**

- The zamindari system was introduced by **Lord Cornwallis in 1793** through **Permanent Settlement** that fixed the land rights of the members **in perpetuity** without any provision for fixed rent or occupancy right for actual cultivators.
- Under the Zamindari system, the **land revenue was collected from the farmers by the intermediaries** known as **Zamindars**.
- The share of the government in the total land revenue collected by the zamindars was kept at **10/11<sup>th</sup>**, and the remainder going to zamindars.
- The system was most prevalent in **West Bengal, Bihar, Odisha, UP, Andhra Pradesh and Madhya Pradesh**.

##### **The Permanent Settlement Agreement**

- According to the Permanent Land revenue settlement the Zamindars were recognised as the permanent owners of the land.
- They were given instruction to pay 89% of the annual revenue to the state and were permitted to enjoy 11% of the revenue as their share.
- The Zamindars were left independent in the internal affairs of their respective districts.

##### **Issues with the Zamindari System**

- **For the Cultivators:** In villages, the cultivators found the system oppressive and exploitative as the rent they paid to the zamindar was very high while his right on the land was quite insecure.

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- The cultivators often had to take loan to pay the rents, on failing to pay the rent, they were evicted from the land.
- **For the Zamindars:** The revenue had been fixed so high that the zamindars found it difficult to pay, and those who failed to pay the revenue lost their zamindari.
  - The zamindars were not so keen about improving the land. As long as they could give out the land and get rent, they preferred it.
- **For the Company:** By the first decade of the 19th century, the cultivation slowly expanded and prices rose in the market.
  - Although this meant an increase in the income of Zamindars, it was no gain for the company since it could not increase a revenue demand that had been settled permanently.

### **The Ryotwari System**

- In the British territories in southern India, there was a move away from the idea of Permanent Settlement.
- A system that came to be known as the **Ryotwari System**, was devised by **Captain Alexander Read and Sir Thomas Munro** at the end of the 18<sup>th</sup> century and introduced by the latter when he was **governor of Madras Presidency (1819–26)**.
- Under the Ryotwari system, the land revenue was paid by the farmers directly to the state.
- In this system, the Individual cultivator called **Ryot** had full rights regarding sale, transfer, and leasing of the land.
  - The ryots could not be evicted from their land as long as they paid the rent.
- It was prevalent in most of southern India, first introduced in Tamil Nadu. It was later extended to Maharashtra, Berar, East Punjab, Coorg and Assam.
- The advantages of this system were the elimination of middlemen, who often oppressed villagers.

### **Issues with the Ryotwari System**

- This system gave much power to subordinate revenue officials, whose activities were inadequately supervised.
- The system was dominated by the mahajans and moneylenders who granted loans to cultivators by mortgaging their land.
- The moneylenders exploited the cultivators and evicted them from their land in case of loan default.

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### **The Mahalwari System**

- By the early 19<sup>th</sup> century, the Company officials were convinced that the system of revenue had to be changed again.
  - The revenues cannot be fixed permanently at such a time when the Company needed more money to meet its expenses of administration and trade.
- In 1822, Englishman **Holt Mackenzie** devised a new system known as the Mahalwari System in the **North Western Provinces of the Bengal Presidency** (most of this area is now in Uttar Pradesh).
- Under the Mahalwari system, the **land revenue was collected from the farmers by the village headmen** on behalf of the whole village (and not the zamindar).
- The entire village was converted into one bigger unit called '**Mahal**' and was treated as one unit for the payment of land revenue.
  - The revenue under the Mahalwari system was to be revised periodically and not fixed permanently.
- The system was popularised by **Lord William Bentick in Agra and Awadh** and was later extended to **Madhya Pradesh and Punjab**.

### **Issue with the Mahalwari System**

- A major drawback of the system was that the survey was practically based on faulty assumptions which left a space for manipulations and corruption.
- At times, it made the Company spend more for the collection than the revenue collected. Consequently, the system was regarded as a failure.

### **Implications of Land Revenue Policy of British**

With such hefty taxes levied under the three land revenue policies, there were certain implications, such as:

- **Absentee landlordism:** The Company's land revenue systems were exploitative in nature. It created landlordism in some parts and peasant proprietorship in some other regions.
  - In Bengal, it led to the emergence of absentee landlordism.
- **Commercialisation of agriculture: Since the rate of revenue under the Company's land revenue system was excessive, the peasants started producing all those crops with high market value. It is known as the commercialisation of agriculture.**
- It led to the change from home consumption to market consumption.
- Therefore, cash crops like cotton, sugarcane, jute, etc. began to be

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cultivated.

- **Social impact:** Land revenue policies had progressive significance over a period of time. It led to the disappearance of old rigidities like caste in village life and led to the emergence of class consciousness.
- **Peasant movement:** The anger of peasants and traditional zamindars culminated in a number of minor and major revolts.
- **Famines:** The periodic recurrence of famines and the economic depression in the nineteenth century aggravated the situation in rural areas, resulting in many peasant uprisings.
- **Rights of cultivators:** The cultivators lost their long-standing claims to the soil and other customary rights, and they were reduced to the low status of mere tenants.
  - For instance, some of their rights were sacrificed, including the use of pasture and forest lands, irrigation canals, fisheries, homestead plots, and protection from increases in rent.
  - In areas where they were made owners, their conditions are even worse.
- **Debt traps and stagnant productivity:** High revenue demand and the lack of investment in land led to peasants falling into debt traps and hindering agricultural productivity.

The drive to collect large revenue was central to British Policy. Sometimes, this led to the development of a land market - the sale and purchase of land. But at other times, the State's demands were so heavy that no purchasers were to be found. The need to collect so much was itself made necessary by the heavy expenditures of the Government in India and its need to send a lot of money to Britain for its expenses there.

### **Conclusion**

- Optimistic officials had imagined that the new system would transform the Peasants into rich enterprising farmers but this did not happen.
- Driven by the desire to increase the income from land, revenue officials fixed too high a revenue demand that peasants were unable to pay.
  - Consequently, the Ryots fled the countryside and villages became deserted in many regions.

### **Other Systems**

#### **Taluqdari System**

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- The term ‘taluqdar’ has different meanings in different parts of India. In Oudh, taluqdar is a great landholder.
  - But in Bengal, a taluqdar is next to zamindar in extent of land control and social status.
- The big zamindars themselves had created many taluqs under several denominations, such as, junglburi taluq, mazkuri taluq, shikimi taluq, and so on.
  - These were created partly as a strategy of zamindari management and partly as a fiscal policy measure for raising zamindari funds for specific purposes.
- After the Permanent Settlement, new varieties of taluqs were created by zamindars.
  - Under the pressure of the Permanent Settlement, many zamindars were creating dependent taluqs denominated as pattani taluq, noabad taluq and osat taluq.

### **Malguzari System**

- The land tenure prevailing in the erstwhile Central Provinces was known as Malguzari system in which the Malguzar was merely a revenue farmer under the Marathas.
  - When the Marathas came into power in this region, they farmed out the revenues of villages to persons of influence and wealth, who were called Malguzars.
- During the British Rule, they were given proprietary rights and were held responsible for payment of revenue.
  - If the headman of a village was weak or was for any other reason, unable to answer for the sum the authorities expected, or if a court favourite wanted the village, the headman was replaced without hesitation by a farmer.
- The farmer, or manager was at first called Mukaddam (the Hindi or Marathi form of Arabic Mugaddam).
- Under the Malguzari system, the Lambardar/Sadar Lambardar appointed from among the Malguzars, was the revenue engager.
- Other cultivators were either Absolute occupancy tenant, Occupancy tenant, Sub-tenant, Raiyat-Malik or lessees, who could be ejected from their holdings on various grounds. Malguzar (proprietor or co-sharer) held land under special description, namely, Sir land and Khudkasht land.



## 5. Education in British India

Different facets of life changed when British territorial rule over India was established. With the handover of power to the British, education was one of those areas that underwent significant change. The colonial rulers created the educational system in a colonial country to legitimise their rule and meet their own economic needs. The British Education System In India was formally established through the Charter Acts.

In 1813, when the Charter was up for renewal, the British Parliament ordered the East India Company to set aside Rs 1 lakh annually "for the revival and promotion of literature, the encouragement of the learned natives of India, and for the introduction and promotion of knowledge of the sciences among the inhabitants of the British territories."

As a result, the Queen made official financial arrangements for the first time, and the East India Company was given responsibility for the natives' education.

### **Policies under British Education System in India**

Before the acquisition of territorial power, the Company had no role in education; however, there were attempts by the missionaries to establish charity schools and to promote learning.

- Due to the fear of adverse reactions and opposition to their role by the local people, the Company maintained neutrality on education after becoming a territorial power.
- The opinions were also divided on whether the Company should promote western or oriental learning.
- Some individuals played a significant role in promoting English education in Calcutta. For example- The establishment of Hindu College by David Hare. Raja Ram Mohan Roy headed its foundation committee.

### **Education Reformer / Policy & Features / Recommendations**

#### **Warren Hastings**

- Established 'Calcutta Madrasa' in 1781 for the study and learning of Persian and Arabic.
- The motive was to develop friendly relations with the elites of the indigenous society and to understand their culture.

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### William Jones

- Established the Asiatic Society of Bengal in 1784 to encourage Oriental studies.
  - For roughly fifty years, it served as a significant academic hub and a unique institution that translated significant Sanskrit works.
  - Importance: Asiatic Researches.
- Warren Hastings believed that Hindus had laws that had not changed for thousands of years.
- Therefore, if the British wanted to establish their rule in the nation, they had to learn these laws and the Sanskrit language in which they were written.

### Jonathan Duncan

- In 1791, "Sanskrit College" was founded by him in Benaras.
  - The motive was to promote the study of Hindu laws and philosophy.
- These early attempts at education in the Oriental languages met with **little success**. It was found that there were more teachers than students.

### Lord Wellesley

- Fort William College, founded by Wellesley in 1801 to train young British recruits for the civil service in India
- It was meant to serve primarily for the purpose of making local British administrators familiar with Indian culture and tradition.
  - This university developed into a significant repository for information on and about India.
  - There were numerous departments there that conducted only research on Indian languages and literature.

### Charter Act of 1813

- The Act was the **first step** towards education being made an objective of the government.
  - It enabled the Company to set aside one lakh rupees for the revival and improvement of literature encouragement of learned natives of India

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- **Administrative needs** of the Company required Indians well-versed in the classical and vernacular languages.

Indians with Sanskrit, Arabic, or Persian skills were required to assess and explain Hindu or Muslim law in various departments of British administration.

### **Raja Ram Mohan Roy and the demand for Western education**

- Progressive Indian elements also **favoured the spread of English education** and Western learning.

- Raja Ram Mohun Roy **protested against the Government's proposal to strengthen Calcutta, Madras, the Benares Sanskrit College** and the establishment of more oriental colleges in Bengal.
- The administration decided to promote the study of English and other Asian languages.
  - The Calcutta Hindu College, founded in 1817 by progressive Bengalis, received a grant.
  - The college focused on the study of Western humanities and sciences and offered instruction primarily in English.

### **General Committee of Public Institution (1823)**

- Created to oversee the growth of India's educational system.

- Majority of members were from the Orientalist movement.

- Instead of promoting Western education, they fervently supported the promotion of Oriental learning.
  - The committee was **headed by Lord Macaulay and** consisted of ten European members
- As a member of the executive council, Macaulay drafted his renowned minute on educational policy, dated 2 February 1835, and presented it to the council.
  - "A class of persons, Indian in blood and colour, but English in taste, in opinions, in morals, and in intellect," was what he envisioned.

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**William Bentinck (1828-35)**

- William Bentinck accepted the Macaulay Committee report.
- He stated that the object of the Company's Government should be the promotion of European literature and sciences through the English language, and in future, all funds were to be spent for that purpose.
  - Macaulian system was a systematic effort to educate the upper classes of India. The general education of the populace was not Macaulay's goal.
  - He put implicit faith in the infiltration theory ('Downward Filtration Theory' or 'Trickle Down Effect'), which held that English-educated persons would act as the class of interpreters.
- Thus, learning local languages as a support for teaching English was a logical outcome of his theory.
  - The following are some of the key tenets of the resolution Bentinck declared in 1835:
    - Persian was abandoned as the official court language, and English took its place.
    - Printing and publishing English books was made free and available at a comparatively low price.
    - More funds were provided to support English education, while there was curtailment in the fund to promote oriental learning.

**Woods Dispatch (1854)**

- The policy that became the cornerstone of the Indian government's educational initiative was established by Sir Charles Wood, president of the Board of Control.
  - The dispatch came to be known as the Magna Carta of English education in India.
    - Recommendations:
      - The teaching of Western education was stated to be the goal of the government's educational policy.
      - The creation of a department of public instruction in each of the five provinces of the company's territory to review the progress of education in the province and submit an annual report to the Government.
      - Calcutta, Bombay, and Madras all received university proposals modelled after the London University.
      - Creating a system of graded schools, including high schools, middle schools, and elementary schools

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- The establishment of teachers training institutions on the model then prevalent in England.
- The promotion of vernacular language in primary schools, followed by Anglo-vernacular at secondary and English at the college level.
- the implementation of a grants-in-aid system to support and encourage private enterprise in the field of education.
  - The institutions had to hire qualified teachers and uphold appropriate teaching standards in order to qualify for this grant-in-aid.
- It emphasised education for women.
- It also proposed for promoting vocational education.
  - Impact: The new educational scheme was a slavish imitation of English models.
- Almost all of the proposals in Wood's Despatch were carried out.
- The Committee of Public Instruction and Council of Education were abolished in favour of the Department of Public Instruction in 1855.
- In 1857, the three universities of Calcutta, Madras, and Bombay were established.
- Girls' schools were modernised and included in the government's grant-in-aid and inspection systems, largely as a result of Bethune's efforts.

### **Hunter Education Commission (1882-83)**

- It was appointed to examine the implementation of the Dispatch of 1854.
  - Commission avoided investigating Indian universities' general functioning.
    - Recommendations:
  - It emphasised primary education.
  - There would be two divisions in secondary school:
    - Academic: leading to the university education
    - Technical: leading to commercial, vocational and technical education.
  - It emphasised education for women outside the presidency town.
  - It provided that private enterprises should be encouraged to enter the education sector.
    - Impact: The twenty years following the report of the commission saw unprecedented growth and expansion of secondary and collegiate education.

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- Another development of the period was the setting up of the teaching-cum-examining universities.
  - Punjab University was established in 1882, focusing on literature, teaching, and examination.
  - Allahabad University was established in 1887.

### **Indian Universities Act, 1904**

- The Act was based on the recommendations of the Indian Universities Commission of 1902 headed by Sir Thomas Raleigh.
- The Commission recommended,
  - The reorganisation of university administration
  - strict and organised oversight by the university of the colleges, and
  - stricter affiliation requirements as well as significant curriculum and exam changes.
    - Commission recommendations led to university control of secondary schools.
    - The Act of 1904 required university recognition of schools.

### **Sadler Commission (1917-19)**

- It was set up under the realisation of the need for improvement of secondary education for the improvement of University education
- Along with Saddler, the Commission also included two Indian members- Ashutosh Mukherji and Zia Uddin Ahmed.
- Recommendations:
  - It suggested bifurcation of higher education at the intermediate examination rather than at the matriculation examination.
  - It recommended that a Board of Secondary and Intermediate Education be established and entrusted with the administration and control of Secondary Education.
    - It recommended for a Special Board of Women Education at Calcutta University.
    - Impact: Seven new universities came into existence during 1916-21, namely Mysore, Patna, Banaras, Aligarh, Dacca, Lucknow and Osmania.
  - In 1920, the Government of India recommended the Sadler Report to provincial governments.

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### Education under the Dyarchy, 1921-37

- Montagu-Chelmsford Reforms transferred department education to provincial control.

### Hartog Committee (1929)

- **Appointed by the Simon Commission** to review the position of education in the country.

The commission was appointed as the quantitative increase of education inevitably led to the deterioration of the quality and lowering of the standards. There was considerable dissatisfaction with the education system.

#### **Recommendations:**

- It emphasised the national importance of primary education but condemned the policy of hasty expansion or attempt to introduce compulsion in education.

- Commission reports Matriculation Examination dominates secondary education, leading undeserving students to university.

It recommended a **selective system for admission** and urged the retention of most of the boys intended for rural pursuits at the Middle Vernacular School stage.

After the Middle Stage, students should be **diverted to diversified courses leading to industrial and commercial careers.**

- The Commission pointed out the weaknesses of university education and criticised the policy of indiscriminate admission, which led to lowering of standards.

It recommended that efforts should be concentrated on improving university work, in confining the university to its proper function of giving good advanced education to students who are fit to receive it

To make the university a more fruitful and less disappointing agency in the life of a community.

### Wardha Scheme of Education (1937)

- **Background:** The Government of India Act of 1935 introduced provincial autonomy, and popular ministries started functioning in 1937. The Congress party came into power in seven provinces. The Congress party set at work to

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evolve a national scheme of education for the country.

Mahatma Gandhi proposed the Basic Education Program, also known as the Wardha Scheme, in a series of articles he published in 1937 in his newspaper, The Harijan.

The main principle of Basic Education is "learning through activity".

- In October 1937 All-India National Educational Conference accepted Mahatma Gandhi's proposal.

On a national level, free and mandatory mother tongue education be provided for seven years.

During this time, education should revolve around doing manual labor or other productive work.

- The **main features** of the scheme were:

A fundamental craft will serve as the focal point of instruction for the entire education, which will be delivered through some industry or profession.

Education is to be self-supporting to the extent of covering teachers' salaries and aims at making pupils self-supporting after the completion of their course.

Every individual should learn to earn his living through manual work in life.

Learning is intertwined with home, community, life activities, and village crafts.

- The responsibility to prepare the syllabus was given to Dr Zakir Hussain.

- The Wardha Scheme came to be known as 'Nai Talim' and did not include religious instructions; therefore Muslim League rejected it.

- The outbreak of the war in 1939 and the resignation of Congress Ministries led to the postponement of the scheme.

### **Sargent Plan of Education (1944)**

- Sargent Report: Central Advisory Board examines post-war educational development.

- It visualised a system of education with-

- Pre-primary education is provided for students between the ages of 3 and 6.
- Universal, compulsory and free primary basic education for all children between the ages 6-11 (junior basic) and 11-14 (senior basic) as suggested in Wardha Scheme.



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- Senior basic be the final stage for most students.
  - It envisaged two main types of high schools academic and technical.

#### **Impact of British Education System In India**

- **Impact on governance:** The British Education System In India encouraged the teaching of the English language in schools and colleges as they needed people to work in the administrative offices either as clerks or babus.
  - It helped in creating a new class of people who later helped them in governance as well as in controlling many aspects of administration in India.
- **English as a link language:** The use of English by Indians provided one language that cut across the entire country and became a common link for them.
- **Growth of national consciousness:** English books and newspapers brought to Indians new ideas from the West, like freedom, democracy, equality and brotherhood.
- **Neglect of mass education:** This was one of the major weaknesses of the British Education System In India. In 1911, 94% of Indians lacked literacy, which changed to 92% by 1921.
- **Neglect of female education:** The almost complete disregard for girls' education, for which there were no funds allocated, was a significant flaw in the early policy of the British Education System In India.
- **Neglect of scientific and technical education: The Company's administration also neglected scientific and technical education. By 1857, the country had only three medical colleges at Calcutta, Bombay, and Madras and only one engineering college in Roorkee.**
- **Minimal financial support:** The issue of finance was at the heart of many of the drawbacks of the education policies during British India. The indigenous system of education was replaced by the new British Education System In India. There were many Englishmen who tried to promote oriental learning, but the Anglicists prevailed over such Orientalists. New schools and colleges were established to promote learning. New social, political and economic ideas came through the channel of Western education. But the British Education System In India ignored scientific and technical education. Moreover, the beneficiary of this education was mainly the upper crust of society. So the transformation that came with English education was very limited in nature.

**6. Committees & Commissions During British Rule**

**Civil Services, Police and Army Commissions**

COMMITTEE/COMMISSION	CHAIRMAN	OBJECTIVES	GOVERNOR GENERAL/VICEROY
<b>Aitchison Commission (1886)</b>	Charles Aitchison	To involve more Indians in Civil Service.	Lord Dufferin
<b>Fraser Commission (1902)</b>	Fraser	To investigate the working of police.	Lord Curzon
<b>Royal Commission on Civil Service (1912)</b>	Lord Islington	To give 25% high posts to Indian.	Lord Hardinge
<b>Lee Commission (1924)</b>	Lord Lee	To remove defects of Civil Service.	Lord Reading
<b>Sandhurst Committee (1926)</b>	Andrew Skeen	To suggest Indianization of Indian army.	Lord Reading
<b>Indian Jail Reforms Committee (1919)</b>	Sir Alexander Cardew	To improve the condition of prisoners	Lord Chelmsford
<b>Butler Committee (1927)</b>	Hercourt Butler	To Examine the relation between native states and the paramount power (Crown).	Lord Irwin

**Agriculture Commissions**

COMMITTEE/COMMISSION	CHAIRMAN	OBJECTIVES	GOVERNOR GENERAL/VICEROY
<b>Madras Agricultural Committee (1890)</b>		To examine the necessity of abandoning the attempts to teach the ryot until more is known, through careful enquiry of what his practices really are, and	Lord Lansdowne

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			the conditions under which he pursues them.	
<b>Irrigation Commission (1901)</b>	Sir Scott Crieff	To plan for the expenditure on Irrigation.		Lord Curzon
<b>Linlithgow Commission (1928)</b>	Linlithgow	To study the problem in agriculture. (Report by Linlithgow).		Lord Irwin
<b>Finance and Currency Commissions</b>				
COMMITTEE/COMMISSION	CHAIRMAN	OBJECTIVES	GOVERNOR GENERAL/VICEROY	
<b>Herschell Committee (1893)</b>	Herschell	To give suggestion Regarding currency.		Lord Lansdowne
<b>Opium Commission (1893)</b>		To investigate about the effect of opium on health.		Lord Lansdowne
<b>Flenry Fowler Commission (1898)</b>	H. Fowler	To give suggestions on currency.		Lord Elgin
<b>Maclagan Committee (1914-15)</b>	Maclagan	To advise for cooperative finances.		Lord Hardinge
<b>Labour Commissions</b>				
COMMITTEE/COMMISSION	CHAIRMAN	OBJECTIVES	GOVERNOR GENERAL/VICEROY	
<b>Whitley Commission (1929)</b>	J.H. Whitley	To study the condition of labor in Industries and gardens.		Lord Irwin (1926-1931)
<b>National Planning Committee</b>	Jawaharlal Nehru	To prepare economic plan.		Lord Linlithgow

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<b>(1938)</b>			
<b>Education Commissions</b>			
<b>COMMITTEE/COMMISSION</b>	<b>CHAIRMAN</b>	<b>OBJECTIVES</b>	
<b>Macaulay Minute (1835)</b>	Lord Macaulay	Allocate money for Educational expenditure	
<b>Woods Dispatch (1854)</b>	Charles woods	To recommend the Medium of primary, secondary and graduation level education.	
<b>Hunter Commission (1882)</b>	William Hunter	To study the development in education.	
<b>University Commission (1902)</b>	Thomas Raleigh	To study the Universities and introduce reforms.	
<b>Calcutta University Commission (1917)</b>	Michael Sadler	To study the condition of University.	
<b>Indian Disbandment Committee (1923)</b>	Lord Itchcap	To discuss the Central Committee of Education.	
<b>Hartog Committee (1929)</b>	Sir Philip Joseph Hartog	To address the decline in educational standards caused by the increased number of educational institutions	
<b>Sargent Plan (1944)</b>	John Sargent	To raise the standard of Education in British India.	
<b>Famine Commissions</b>			
<b>COMMITTEE/COMMISSION</b>	<b>CHAIRMAN</b>	<b>OBJECTIVES</b>	<b>GOVERNOR GENERAL/VICEROY</b>
<b>Strachey Commission (1880)</b>	Richard Strachey	To give relief to famine stricken	Lord Lytton
<b>Lyall Commission (1897)</b>	James Lyall	To give suggestion on earlier reports.	Lord Elgin
<b>MacDonnell Commission (1900)</b>	Anthony MacDonnell	To give the suggestion on famine report.	Lord Curzon
<b>Famine Inspection Commission (1943-44)</b>	John Woodhood	To investigate in events of Bengal Famine.	Lord Wavell

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<b>Law Commissions</b>		
<b>COMMITTEE/COMMISSION</b>	<b>CHAIRMAN</b>	<b>OBJECTIVES</b>
<b>First Law Commission(1834)</b>	Lord Macaulay	To recommend the codification of the Penal Code, the Criminal Procedure Code and a few other matters.
<b>Second Law Commission (1853)</b>	Sir John Romilly	To recommend about Indian Code of Civil Procedure, the Indian Contract Act etc.
<b>Third Law Commission (1861)</b>	Sir John Romilly	To recommend about Indian Evidence Act, the Transfer of Property Act etc.
<b>Fourth Law Commission (1879)</b>	Dr. Whitley Stokes	To recommend about Code of Negotiable Instruments , Code on Trusts Law, Code on Transfer of Property and Easements, Code of Criminal Procedure and Civil Procedure.

## 7. TIGERS - PPP 100

According to an updated analysis of the 2022 tiger census released recently, **India's tiger population increased to 3,682 in 2022, from 2,967 in 2018.**

### All India Tiger Estimation 2022:

- **Nodal Ministry:** Ministry of Environment, Forest and Climate Change (MoEFCC).
- **Trends in Tiger Population:**
  - **Mizoram, Nagaland, Jharkhand, Goa, Chhattisgarh,** and Arunachal Pradesh — have reported **“disquieting trends”**.
  - India is **home to approximately 75 percent** of the world's tiger population.
  - **Madhya Pradesh** has the **maximum number (785)** of tigers in the country, followed by **Karnataka (563), Uttarakhand (560), and Maharashtra (444).**

The number of tigers **“within the tiger reserve”** is **highest in Corbett (260)**, followed by **Bandipur (150)**, Nagarhole (141), Bandhavgarh (135), Dudhwa (135), Mudumalai(114), Kanha (105).

- **Increase:** Central India, the Shivalik Hills, and the Gangetic plains witnessed increases in tiger population, particularly in the states of Madhya Pradesh, Uttarakhand, and Maharashtra.
- **Decrease: Western Ghats** experienced **localized declines**, needing targeted monitoring and conservation efforts.
- Approximately **35% of the tiger reserves** urgently required enhanced protection measures, habitat restoration, ungulate (deer, chital, blackbuck) augmentation, and subsequent tiger reintroduction.
- **Methodology used in all India Tiger Estimation:**
- **Double Sampling Methodology:** It involves ground surveys of all tiger bearing forests, estimating prey abundance, understanding habitat characteristics, mapping other tiger signs, and camera trap pictures of tigers.
- **Protection Status of Tiger:**
- **Schedule I:** Indian Wildlife (Protection) Act, 1972
- **Endangered:** International Union for Conservation of Nature (IUCN)

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### Red List

- **Appendix I:** Convention on International Trade in Endangered Species of Wild Fauna
- and Flora (CITES)
  - Facts– Tiger
  - Tigers are the largest specimen in the cat family.
  - There are eight subspecies of tiger- Royal Bengal, Indo-Chinese, Sumatran, Amur or Siberian, South China, Caspian, Java, and Bali. Caspian, Java, and Bali tigers have been hunted to extinction.
  - Tiger chooses the lowlands and is frequently seen in grasslands, swamps, and mangroves. The Bengal mangrove ecosystem is a rich habitat for royal Tigers and they have adapted by being fervent swimmers.
  - Till 1972, the Lion was the national animal of India.
  - The Royal Bengal Tiger, ‘majestic creature’ was conferred as the national animal on November 18, 1972
  - The Tiger is the national animal of Bangladesh, South Korea, Vietnam, and Malaysia.
  - Nagpur is known as the ‘Tiger Capital of India’
  - **Scientific Name:** *Panthera tigris*
  - Indian Sub Species: *Panthera tigris tigris*.
  - **Habitat:**
    - Its habitat stretches from Siberian temperate forests to subtropical and tropical forests on the Indian subcontinent and Sumatra.
    - It is the largest cat species and a member of the genus *Panthera*.
    - Traditionally eight subspecies of tigers have been recognized, out of which three are extinct.
      - **Bengal Tigers:** Indian Subcontinent
      - **Caspian tiger:** Turkey through central and west Asia (extinct).
      - **Amur tiger:** Amur Rivers region of Russia and China, and North Korea
      - **Javan tiger:** Java, Indonesia (extinct).
      - **South Chinatiger:** South central China.
      - **Bali tiger:** Bali, Indonesia (extinct).
      - **Sumatran tiger:** Sumatra, Indonesia.
      - **Indo-Chinese tiger:** Continental south-east Asia.
  - **Protection Status:**

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- **Indian Wildlife (Protection) Act, 1972: Schedule I**
- **International Union for Conservation of Nature (IUCN) Red List: Endangered.**
- **Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES): Appendix I.**
- **Tiger Reserves in India**
  - **Total Number:** 53 according to NTCA.
  - **Largest:** Nagarjunsagar Srisailem Tiger Reserve, Andhra Pradesh on the basis of core area.
  - **Smallest:** Orang tiger reserve in Assam on the basis of core area.
- **Black Tigers in Similipal Tiger Reserve**
- The Indian government informed the **Rajya Sabha** that there are **10 black tigers (melanistic tigers)** in India, all of which are **exclusively found in Odisha's Similipal tiger reserve.**
- Black Tigers are not a distinct species but a rare colour variant of **Bengal Tiger.**
- The coat colour and patterning of black tigers are due to a single mutation in the **Transmembrane Aminopeptidase Q (Taqqep) gene.** This mutation is called **pseudo-melanism.**
- Similipal Tiger Reserve was designated in 1956, **part of Project Tiger since 1973**, and declared a **biosphere reserve in 1994.**
  - It is part of the **UNESCO World Network of Biosphere Reserves** and the **Similipal-Kuldiha-Hadgarh Elephant Reserve** popularly known as **Mayurbhanj Elephant Reserve.**
  - Similipal is rich in wildlife, housing tigers, elephants, different bird and amphibian species.
  - Two tribes, **Erenga Kharias and Mankirdias, inhabit Similipal** and engage in traditional agricultural activities.
- **International Big Cat Alliance (IBCA)**
- IBCA is launched for conservation of seven big cats namely Tiger, Lion, Leopard, Snow Leopard, Leopard, Cheetah, Jaguar and Puma harbouring our planet.
- Its members include 97 countries that are home to these big cats and



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Other interested parties.

- The IBCA will engage in advocacy, partnerships, capacity building, eco-tourism, and finance tapping.
- It will also disseminate information and create awareness among its members.
- **Tiger Landscapes of India:**
- Shivalik Hills and the Gangetic Plains
- Central India
- Eastern Ghats
- Western Ghats
- North-Eastern Hills and Brahmaputra Plains
- Sunderbans

### **Management Effectiveness Evaluation (MEE)**

On 9 April 2023, Prime Minister Narendra Modi released the summary report of the fifth round of Management Effectiveness Evaluation (MEE) in Mysore, Karnataka, ranking Satpura Tiger Reserve second and Kanha Reserve fifth among the top 5 tiger reserves in the country's 51 tiger reserves.

The position has been obtained.

It is worth mentioning that the first place was held by the Periyar Tiger Reserve of Kerala. Its Management Effectiveness Evaluation Score stood at 94.38%. On the Other hand, Satpura Tiger Reserve of Madhya Pradesh and Bandipur Tiger Reserve of Karnataka stood in third place. Both had a Management Effectiveness I score of 93.18%.

Apart from this, the Kanha Tiger Reserve of Balaghat in Madhya Pradesh has got the fifth rank and the Pench Tiger Reserve of Seoni has got the eighth rank. Satpura Tiger Reserve has got this rank due to better management, work, and a better team.

Ramgarh Vishdhari Tiger Reserve (Rajasthan) and Ranipur Tiger Reserve (Uttar Pradesh) notified in the year 2022 have not been included in this report. Presently there are a total of 53 tiger reserves in the country.

Significantly, Management Effectiveness and Evaluation is a third-party assessment, which releases its survey data once in 4 years. In the survey, the assessment team assesses the level of documentation, fieldwork, field staff and interactions with field staff & stakeholders, wildlife enhancement, protection and management systems.

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The community, streamlining tourism, good infrastructure for both the park and the animals, as well as active wildlife management, are some of the parameters on which the park is judged.

### **Satpura Tiger Reserve**

Satpura Tiger Reserve located in the Narmadapuram district is spread over 2130 square kilometres. It is part of the Deccan bio-geographic region. This is the country's oldest forest wealth full of unprecedented natural beauty, which has been preserved with great effort.

Some species of flora found in the Himalayan region and some species found in the forests of the south are also found in abundance in the forest area of Satpura Tiger Reserve. Some species like insectivorous Ghatparni, Bamboo, Hisalu, and Daruhaldi are found both in Satpura and the Himalayas.

There are 50 rock shelters in the hill range of Satpura which are between 1500 to 10 thousand years old. Along with natural importance, they also have archaeological importance. Thus the Satpura Tiger Reserve is the soul of the ecosystem of the central region of the country.

There are also plants like acai vat, and wild jasmine, which are not found elsewhere or very rarely. Apart from flora, there are 14 such wild animals whose life is in danger today, yet their habitat remains here, such as flying squirrels. Satpura Tiger Reserve is famous for the presence of tigers and their breeding area. This reserve is one of the areas in central India with a good presence of tigers.

17 percent of the country's tiger population and 12 percent of the tiger habitat area comes from Satpura.

The Satpura Tiger Reserve in a way forms a bridge of wildlife presence between the Himalayas and the Western Ghats. It is also an ideal habitat for Malabar Whistling Thrush i.e Oyster Bird, Dudhraj, Malabar Pied Hornbill i.e Dhanesh Bird.

- **Challenges:**
- **Poaching:** Poaching is driven by tiger parts used in traditional Chinese medicines, tiger skin is used for decorative and medicinal purposes.
  - Further, their demand for organs are big hurdles to survival.
- **Habitat Loss:** The fragmentation of tiger habitats due to human activities such as agriculture, logging, and infrastructure development continue to threaten tiger populations and give rise to **Tiger-Human conflicts**.
- **Lack of resources:** The resources available for the management and protection of tiger reserves are limited.

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- **Climate change:** Climate change may affect tiger habitats, prey availability, and other aspects of tiger ecology, which could further threaten tiger populations in the long term.
- **Benefits of Conserving Tigers:**
- **Umbrella Species:** Tiger is an “umbrella species” which **ensures viable populations of other wild animals** (co-predators, prey) and forest, thereby ensuring the ecological viability of the entire area and habitat,
- **Food Chain:** It is a top predator which is at the apex of the food chain and **keeps the population of wild ungulates in check**, thereby maintaining the balance between herbivores and the vegetation upon which they feed.
- **Tourism:** Tigers are an **iconic species and attract a large number of tourists** to protected areas. Ecotourism generates income for local communities and contributes to the economy.
- **Carbon sequestration:** Tiger habitats, particularly forests, are important for carbon sequestration and climate change mitigation.
  - Conserving these habitats helps to reduce greenhouse gas emissions and slow down the pace of climate change.
- **Indian initiatives to Protect Tiger:**
- **Project Tiger:** It was launched in **1973** from **Jim Corbett National Park, Uttrakhand**.
  - It is a **Centrally Sponsored Scheme** of MoEFCC, for creating a network of Tiger reserves and providing central assistance to tiger States for **tiger conservation in designated tiger reserves in India**.
  - The project is administered by the **National Tiger Conservation Authority (NTCA)**.
- **Tiger Census:** The Government **conducts a national tiger census every four years** to estimate the tiger population in the country.
- **Tiger Conservation Plan:** It is a document mandated under Section 38 V of the Wildlife (Protection) Act, 1972 for each tiger reserve, which prescribes management interventions for the said tiger reserve.
  - Core Plan
  - Buffer Plan
  - Adjoining Area/Corridor Plan
  - A Tiger Conservation Plan consists of three parts namely:
- **Conservation Assured | Tiger Standards:** CA|TS is a comprehensive system **that will provide a reference point** to evaluate the existing management effectiveness of tiger conservation within integrated landscape

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planning, and ensure that benefits from these efforts are optimized.

- **Community Reserves:** The Government has also established Conservation Reserves and Community Reserves to protect critical tiger habitats outside of the designated tiger reserves.
- **Lidar-based survey technology** is being used to deal with the challenge of human-animal conflict that was causing the death of animals.
- **M-STriPES (Monitoring system for tigers – intensive protection and ecological status):** It uses GPS to geotag photo-evidences and survey information of tiger.
- **CaTRAT (Camera Trap data Repository and Analysis Tool)** for automated segregation of camera trap photographs to species.
- **Global Initiatives to Protect Tiger:**
- **Global Tiger Forum(GTF):** Established in 1994, the Global Tiger Forum is the only inter-governmental body for tiger conservation.
  - Its membership includes seven tiger range countries: Bangladesh, Bhutan, India, Cambodia, Myanmar, Nepal and Vietnam.
- **Global Tiger Initiative(GTI):** It was **launched in 2008** as a global alliance of governments, international organizations, civil society and the private sector with the aim of working together to save wild tigers from extinction.
- **St. Petersburg Declaration on Tiger Conservation:** It was adopted In 2010, by the leaders of 13 tiger range countries (TRCs) assembled at an International Tiger Forum in St. Petersburg, Russia.
  - **13 tiger range countries** – India, Bangladesh, Bhutan, Cambodia, China, Indonesia, Lao PDR, Malaysia, Myanmar, Nepal, Russia, Thailand and Vietnam.
- **Way Forward:**
- **Minimize man-animal conflict:** The National Tiger Conservation Authority has issued **SOPs** to deal with emergencies arising due to straying of tigers in human dominated landscapes.
  - These SOPs **provide a structured framework** for the implementation of tiger conservation initiatives which include monitoring, protection, habitat management.
- **Habitat Protection and Restoration:** Tigers need large areas of forest to live and hunt, so protecting and restoring their habitat is crucial to their survival.
- **Anti-Poaching Efforts:** Anti-poaching efforts involve monitoring tiger populations and cracking down on illegal wildlife trade.
  - **Special Tiger Protection Force (STPF)** is a force raised on lines of the India Reserve Battalion. It is deployed in Tiger Reserves for

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focused anti-poaching operations.

- **Conflict Mitigation:** As human populations grow and encroach on tiger habitat, conflicts between people and tigers can arise.
  - Efforts to mitigate these conflicts can include measures such as **relocating problem tigers or providing compensation to people** who have lost livestock or crops to tigers.
- **Education and Awareness:** Raising awareness about the importance of tiger conservation and the threats facing tiger populations is key to building support for conservation efforts.
- **National Tiger Conservation Authority (NTCA):**
  - NTCA is a **statutory body** established in 2005 following the recommendations of the Tiger Task Force.
  - **Nodal Ministry:** Ministry of Environment, Forests and Climate Change.
  - **Merger of Project Tiger and Project Elephant:**
    - Project Tiger and Project Elephant have been **merged into a new division** the **'Project Tiger and Elephant Division'** under the **Ministry of Environment, Forest and Climate Change.**
  - **Reason for Merger:**

**Rationalizing of Funding:** The unification of Project Tiger and Project Elephant has been done to rationalize funding.

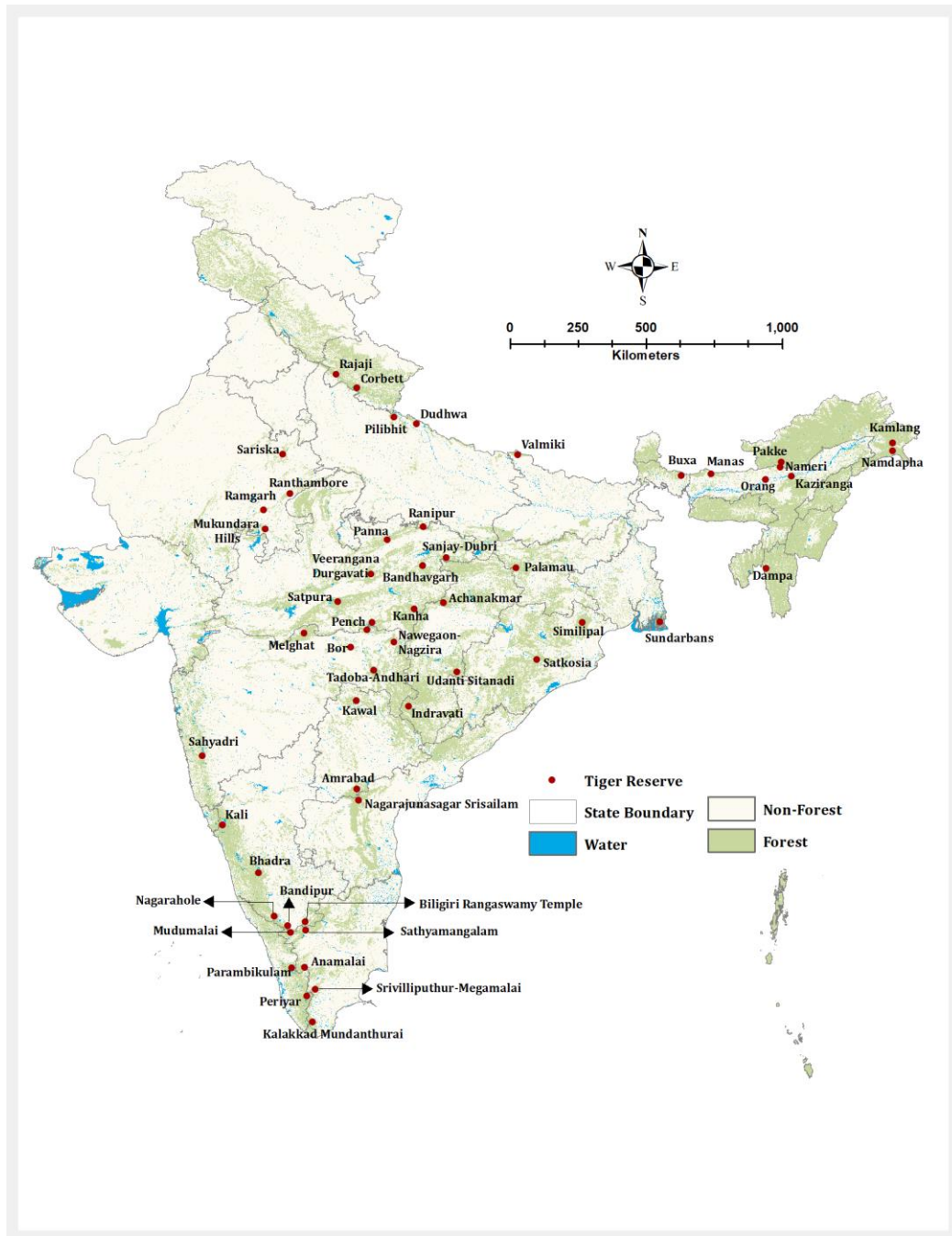
**Amalgamation to Strengthen Conservation:** The amalgamation will bolster the conservation of both the animals, as they often share the same landscapes in the country.

- **Rare golden tiger snapped in Kaziranga**
- A wildlife photographer recently captured an image of a tiger with a golden coat during a safari in Assam's Kaziranga National Park.
  - A golden tiger (also known as a golden tabby tiger) is a Bengal tiger exhibiting a color variation resulting from a recessive gene.
  - The golden tiger's coloring originates from a recessive trait known as 'wideband,' which influences the production of black pigments during the hair growth cycle.
  - Golden tigers are not a separate subspecies but rather a result of genetic variation within Bengal tigers.
  - They are exceptionally rare in the wild and even rarer in captivity.
- **Kaziranga National Park**
  - Location: It is located in the State of Assam. It is the single largest undisturbed and representative area in the Brahmaputra Valley

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floodplain.

- UNESCO World Heritage Site: The Park was declared as a National Park in 1974. In 1985, the park was designated as a World Heritage Site by UNESCO. Further, it was also declared as a Tiger Reserve in 2006.
- Important Bird Area: It is also recognized as an Important Bird Area by Bird Life International for the conservation of avifaunal species.



## 8. STUBBLE BURNING, GRAP- PPP 100 - PRELIMS 2024

### Stubble burning

**Stubble burning** also called as ***parali burning***, stubble burning is a method of removing paddy crop residues from the field to sow wheat.

It is usually done in the last week of *September to November*.

It is usually required in areas that use the combined harvesting method which leaves crop residue behind.

It is practised by the farmers to prepare the land for the next cultivation.

It is practised mainly in the *Indo-Gangetic plains* of Punjab, Haryana, and UP to clear the fields for rabi crop sowing.

- **Stubble burning**
- **High prevalence**
- Rice
- Punjab and Haryana
- Wheat
- Uttar Pradesh
- **Why stubble burning is practised?**
- **Limited duration**- Multiple cropping and shortened intervals between crops give a very short window of about 10–15 days during which the field needs to be prepared for the next crop.
- There is only short time available between rice harvesting and sowing of wheat as delay in sowing wheat affects the wheat crop.
- **Cheap**- It is considered one of the cheapest methods to clean the field after the harvesting season.
- **Labour shortage**- Use of expensive labour for stubble extraction is not feasible, especially in Punjab and Haryana where farm sizes are large.
- **Clears all stubble**- The use of mechanized harvesters leaves stubble of 10–30 cm in the field, depending on the type of crop, which was not the case earlier with manual harvesting.
- **Low crop residue**- The low commercial and economic value of crop residue, coupled with the high costs of processing, reduces its value for farmers.
- **Impacts of stubble burning**

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- **Air pollution**- It emits toxic pollutants in the atmosphere containing harmful gases like carbon monoxide (CO), methane (CH<sub>4</sub>), carcinogenic polycyclic aromatic hydrocarbons, volatile organic compounds (VOC).
- The combustion of agricultural residue is a prominent contributor to air pollution in certain regions of northern India.
- **Soil fertility**- Soil becomes less fertile and its nutrients are destroyed when the husk is burnt on the ground.
- **Heat penetration**- Stubble burning generates heat that penetrates into the soil, causing an increase in erosion, loss of useful microbes and moisture.
- **Climate change**- The release of toxic gases from stubble burning will increase global warming, further aggravating the climate change.
- **Uncontrolled firing**- Risk of fires spreading out of control, could turn into huge pit of flames.
  
- **Supreme Court's Remarks on Stubble Burning**
  - The court asked the Punjab government why it could not fund the costs of crop residue management machines for marginal farmers.
  - Punjab responded that the *issue of manpower and fuel* for the machines was
  - The court warned that paddy cultivation would deplete the water table in Punjab suggested switching to crops other than paddy to save water and reduce pollution.
  
- **Strategies to reduce stubble burning**
  - **Promote agri-implements**- Punjab has rolled out schemes for providing subsidy for mechanical implements that can mix the crop residue with soil to improve fertility.
  - Promote *co-ownership models* for the agri-implements which can make such implements accessible to farmers.
  - **Foster awareness**- Farmers should understand the value of crop residues and use of agri implements in extraction and packaging.
  - **Power generation**- State governments need to incentivise establishment of biomass-based power plants through fiscal interventions and prioritization. Example- *Biomass co-firing*
  - **Promote R&D**- *Punjab Agricultural University* is developing a variant of paddy straw that has *lower silica content*, thereby making it suitable for utilisation in biomass-based power plants.
  - **Biofuel production**- The State governments, along with appropriate policy interventions from the Central government need to incentivise utilisation of biofuels.
  - **Industrial application**- Biomass pellets can be sold commercially as the main fuel for industrial boilers and replace coal. Micro-pelletization should



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be incentivised and its local usage promoted.

- **Crop residue collection mechanism**- Create a uniform decentralised mechanism for the collection, storage and commercial sale of crop residue.
- **Bio-Decomposer to Tackle Stubble Burning**
- - Biodecomposer is designed to accelerate the **natural decomposition process of crop residues**.
  - It is typically a **concoction of various microorganisms like fungi, bacteria, and enzymes** that work together to **break down the plant material** into organic matter that enriches the soil.
  - **Examples:**
    - **Bacteria:** Bacillus, Clostridium, E. coli, Salmonella
    - **Fungi:** Mushrooms, Molds, Yeasts
    - **Earthworms**
    - **Insects:** Beetles, Flies, Ants, Maggots
    - **Arthropods:** Millipedes, Woodlice
  - **Pusa-Biodecomposer:**
    - It is a **fungi-based liquid solution** that can soften **hard stubble** to the extent that it can be easily mixed with soil in the field to act as compost.
      - The fungi thrive at 30-32 degree Celsius, which is the temperature prevailing when paddy is harvested and wheat is sown.
    - It produces enzymes to digest cellulose, lignin and pectin in paddy straw.
      - It is developed by the **Indian Council of Agricultural Research (ICAR)** and named after **ICAR's campus at Pusa in Delhi**.
    - It rapidly converts crop residues, animal waste, dung and other waste into organic manure.
  - **Benefits:**
    - The decomposer **improves the fertility and productivity** of the soil as the stubble works as manure and compost for the crops and lesser fertiliser consumption is required in the future.
    - It is an efficient and **effective, cheaper, doable and practical technique** to stop stubble burning.
    - It is an eco-friendly and environmentally useful technology

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and will contribute to achieving the **Swachh Bharat Mission**.

### ○ **Efficacy:**

- The microbial solution aims to decompose paddy straw left in the field post-harvest. It needs to be sprayed after harvest, ploughed into the soil, and lightly **irrigated for the stubble to decompose over a period of 20-25 days**.
- Farmers have emphasized the importance of aligning the spraying process with the timing of **harvest to maximize the effectiveness of the decomposer**.
- Factors like crop rotation, labor availability, and the type of crop grown **affect the relevance and usability of the decomposer** for farmers.
- The effectiveness of the microbial solution is also **dependent on weather conditions**, with less rain in September and October favoring its application.

- In-Situ Treatment of Stubble: For example, crop residue management by zero-tiller machine and Use of bio-decomposers.
- Ex-Situ (off-site) Treatment: For example, Use of rice straw as cattle fodder.
- Use of Technology: For example Turbo Happy Seeder (THS) machine, which can uproot the stubble and also sow seeds in the area cleared. The stubble can then be used as mulch for the field.
- The State Governments of Punjab, National Capital Region (NCR) States and the Government of National Capital Territory of Delhi (GNCTD) have developed **detailed monitorable action plans** based on the framework by the Commission for Air Quality Management (CAQM) to tackle the problem of air pollution.

### • **Way Forward**

- It is important to Encourage farmers to **adopt alternative farming practices** such as zero tillage, direct seeding, and crop diversification. These practices can reduce the generation of crop residue and minimize the need for stubble burning.
- Promote the use of **modern harvesting machinery** like combine harvesters that can cut crops at a lower height, leaving less stubble behind. This can significantly reduce the need for stubble burning.
- Conduct awareness campaigns to educate farmers about the harmful effects of stubble burning and the available alternatives. Engage with

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farmer groups, agricultural universities, and local communities to disseminate information effectively.

- **Chhattisgarh model**
- A **gauthan** is a dedicated 5-acre plot, held in common by each village.
- Here, all the unused parali (paira in Chhattisgarhi) is collected through parali daan (people's donations) and converted into organic fertiliser by rural youth.

### **GRAP**

- **Graded Response Action Plan (GRAP)** is a **set of emergency measures** that kick in to prevent further deterioration of air quality once **it reaches a certain threshold** in the Delhi-NCR region. It was approved by the Supreme Court in 2016 after the Supreme Court's order in the matter of **C. Mehta vs. Union of India (2016)** and notified in 2017.
- **Implementation:**
  - From 2021 onwards, the GRAP is being implemented by the
    - Till 2020, the Supreme Court-appointed **Environment Pollution (Prevention & Control) Authority (EPCA)** used to order States to implement GRAP measures.
  - The EPCA was dissolved and replaced by the **Commission for Air Quality Management (CAQM)** in 2020.
  - CAQM relies on air quality and **meteorological forecasts** by the **Indian Institute of Tropical Meteorology (IITM)** and the **India Meteorological Department (IMD)**.
- **Revision:**
  - **Stage I (Poor Air Quality - AQI 201-300):** Enforce NGT / Hon'ble SC's order on over aged diesel / petrol vehicles.
  - **Stage II (Very Poor- AQI 301-400):** Targeted actions to **combat air pollution at identified hotspots** in the region. Regulated operations of DG (Diesel Generators) have been set across all sectors in the NCR.
  - **Stage III ("Severe"- AQI 401-450):** Impose strict restrictions on **BS III petrol** and **BS IV diesel four-wheelers** in certain areas and may suspend physical classes in schools for primary grade children up to Class 5.
  - **Stage IV (Severe Plus- AQI greater than 450):** When the AQI exceeds 450, four-wheelers registered outside Delhi, except for electric vehicles, CNG vehicles, and BS-VI diesel vehicles and vehicle carrying essential commodity, **will not be allowed to enter the city**.
- Note: An **AQI** is a number used by **government agencies** to measure

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the **air pollution levels and communicate** it to the population. As the AQI increases, it means that a **large percentage of the population will experience severe adverse** health effects.

- **Initiatives to Combat Air Pollution**
- **Graded Response Action Plan (Delhi)**
- **Polluter Pay principle**
- **Smog Tower**
- **Tallest Air Purifier**
- **National Clean Air Programme (NCAP)**
- **BS-VI vehicles**
- **New Commission for Air Quality Management**
- **Turbo Happy Seeder (THS)**
- **Air Quality and Weather Forecasting and Research (SAFAR)**
- **Dashboard for Monitoring Air Quality**
- **National Air Quality Index (AQI)**
- **Air (Prevention and Control of Pollution) Act, 1981**
- **Pradhan Mantri Ujjwala Yojana (PMUY)**

### **CRYPTOBIOSIS**

- Cryptobiosis is the condition of inactive metabolic activity during adverse environmental conditions. In this state, the organism can live for a longer period until the conditions are favourable again. Reproduction, development and repair stop due to the inactivation of the metabolic activities.
- Cryptobiotic desiccation is the most common. For eg; nematodes, brine shrimp, yeast, tardigrades, etc. It explains the two potential states of life. Many organisms cannot exhibit this phenomenon because freezing or drying disrupts their membranes, which allows the leakage of small molecules or denatures the proteins.
- **Types of Cryptobiosis**
- **Anhydrobiosis**
- Anhydrobiosis means “life without water”. It refers to the ability of some organisms to survive extreme water stress. This has been observed in lichens, cyanobacteria, yeast, mosses, algae, etc. This state is induced by desiccation.
- **Anoxybiosis**
- This situation occurs during lack of oxygen when the organism becomes turgid by taking in water and immobilising.
- **Chemobiosis**

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- It is the suspension of metabolic activities in response to high levels of metabolic toxins. Tardigrades exhibit chemobiosis.
- **Cryobiosis**
- This type of cryptobiosis occurs during reduced temperatures. When the water surrounding the organism freezes, cryobiosis is initiated and all the metabolic activities of the organisms are paused.
- **Osmobiosis**
- It occurs in response to increased solute concentration of the solution in which the organism lives. However, less is known about this type.
- **Examples Of Animals Exhibiting Cryptobiosis**
- **Brine shrimp**
- These are crustaceans that are found in salty lakes all over the world. They produce cysts known as “dormant eggs”, during unfavourable conditions. The cyst is metabolically inactive and can survive in dry and anaerobic conditions. These can survive boiling temperatures and temperatures below freezing point.
- **Yeast**
- The active dry yeast is commonly used in baking as a leaving agent. The live yeast is encapsulated in a thick, dry jacket of dead cells with some growth medium. Yeast can be stored at room temperature, or in the refrigerator or freezer for a very long time.
- **Tardigrades**
- These are microscopic organisms found in water. A matured tardigrade is 0.5 mm long with eight legs. They have the ability to suspend their metabolism and undergo cryptobiosis for almost 10 years. Due to this nature, they are able to survive extreme temperatures, pressure, desiccation, and radiation.
- **Bacteria**
- During environmental stress, the bacteria form dormant, tough, non-reproductive structures known as endospores. They help the bacteria to survive when the conditions are not favourable for survival. They are resistant to radiation, drying, temperature, chemical disinfectants, and starvation.
- **Cryptobiosis in Humans**
- Cryptobiosis in humans is known as suspended animation. Researchers have devised ways to save lives through cryptobiosis. Doctors in the US

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have been working on a technique known as Emergency Preservation and Resuscitation. In this, the blood in the body is replaced with cold saline fluid, which would decrease the body temperature to 10°C. This chills the body and the brain and there is very less requirement for oxygen by the body. This reduces the chances of brain damage. By doing this they can get ample time to cure severe injuries such as those caused by accidents and gunshots. Soon after the treatment, the saline is replaced with blood and the body rewarms gradually. The process has successfully experimented on pigs.

### **PYQs**

**1] Consider the following: [2022]**

**Carbon monoxide**

**2. Nitrogen oxide**

**3. Ozone**

**4. Sulphur dioxide**

**Excess of which of the above in the environment is/are the cause(s) of acid rain?**

1, 2 and 3

b) 2 and 4 only

c) 4 only

d) 1, 3 and 4

### **Explanation**

- Acid rain is a term that refers to a mixture of **wet** and **dry deposition** from the atmosphere containing higher than normal amounts of **nitric** and **sulfuric acids**. The primary causes of acid rain are emissions of **sulfur dioxide** (SO<sub>2</sub>) and **nitrogen oxides** (NO<sub>x</sub>), which react with the water molecules in the atmosphere to produce acids.
- **Carbon monoxide** (CO) is a colorless, odorless, and toxic gas, but **it does not contribute to acid rain**. It is primarily a concern because it can be harmful to human health, particularly in enclosed spaces.
- **Nitrogen oxides** (NO<sub>x</sub>), including nitrogen dioxide (NO<sub>2</sub>) and nitric oxide (NO), are significant contributors to acid rain. They react with water, oxygen, and other chemicals in the atmosphere to form nitric acid, which can then fall to the ground in precipitation, contributing to the acidification of ecosystems.
- **Ozone** (O<sub>3</sub>) is a molecule composed of three oxygen atoms. It is not a direct contributor to acid rain. Ozone at ground level is a harmful air pollutant and a key component of smog, but **it does not form acidic compounds**

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**that lead to acid rain.**

- **Sulfur dioxide** (SO<sub>2</sub>) is a gas that is produced by volcanic eruptions and industrial processes, particularly the combustion of coal and oil at power plants and the smelting of mineral ores that contain sulfur. In the atmosphere, SO<sub>2</sub> can oxidize to form sulfuric acid (H<sub>2</sub>SO<sub>4</sub>), which is a major component of acid rain.
- Therefore, the correct answer is **“2 and 4 only”** because nitrogen oxides and sulfur dioxide are the pollutants that contribute to acid rain, while carbon monoxide and ozone do not.

**2] In the context of WHO Air Quality Guidelines, consider the following statements: [2022]**

**1. The 24-hour mean of PM 2.5 should not exceed 15 µg/m<sup>3</sup> and annual mean of PM<sub>2.5</sub> should not exceed 5 µg/m<sup>3</sup>.**

**2. In a year, the highest levels of ozone pollution occur during the periods of inclement weather.**

**3. PM 10 can penetrate the lung barrier and enter the bloodstream.**

**4. Excessive ozone in the air can trigger asthma.**

**Which of the statements given above are correct?**

- a) 1, 3 and 4
- b) 1 and 4 only
- c) 2, 3 and 4
- d) 1 and 2 only

**Explanation**

- The **World Health Organization (WHO)** provides guidelines for air quality that set recommended limits for the concentration of pollutants in the air. These guidelines are designed to protect human health from the adverse effects of air pollution.
  - The 24-hour mean of **PM<sub>2.5</sub>** should not exceed 15 µg/m<sup>3</sup> and annual mean of PM<sub>2.5</sub> should not exceed 5 µg/m<sup>3</sup>.  
This statement is incorrect according to the latest WHO Air Quality Guidelines (2021). The WHO recommends that the 24-hour mean of PM<sub>2.5</sub> should not exceed 15 µg/m<sup>3</sup>, but the annual mean should not exceed **5 µg/m<sup>3</sup>**.
  - In a year, the highest levels of **ozone pollution** occur during the periods of inclement weather.  
This statement is incorrect. Ozone pollution tends to be higher during sunny periods with high temperatures and stagnant air

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conditions. Inclement weather, which often involves rain and wind, can help disperse pollutants and reduce ozone levels.

- **PM10** can penetrate the lung barrier and enter the bloodstream.

This statement is partially correct. While PM10 (particulate matter with a diameter of 10 micrometers or less) can penetrate deep into the lungs, it is the smaller PM2.5 particles that are more likely to penetrate the lung barrier and enter the bloodstream.

- Excessive **ozone** in the air can trigger asthma.

This statement is correct. Ozone is a powerful respiratory irritant, and high levels of ozone can trigger asthma attacks and exacerbate other respiratory conditions.

- Based on the analysis above, **the correct statements are 1 (with the corrected values for PM2.5) and 4**. Therefore, the correct answer is “**1 and 4 only**” if we correct the values in statement 1 to align with the WHO guidelines.

### **3] Consider the following statements: [2020]**

**1. Coal ash contains arsenic, lead and mercury.**

**2. Coal-fired power plants release sulphur dioxide and oxides of nitrogen into the environment.**

**3. High ash content is observed in Indian coal.**

**Which of the statements given above is/are correct?**

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

- **Explanation**

- Coal ash, the residue left after coal is burned, contains a variety of heavy metals, including **arsenic**, **lead**, and **mercury**. These substances are harmful to human health and the environment. If not properly managed, they can contaminate water sources and soil.
- When coal is burned in power plants, it releases various pollutants into the atmosphere. Among these pollutants are **sulfur dioxide (SO<sub>2</sub>)** and **nitrogen oxides (NO<sub>x</sub>)**. SO<sub>2</sub> contributes to acid rain and respiratory problems, while



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NO<sub>x</sub> plays a significant role in the formation of ground-level ozone and smog, also contributing to respiratory issues.

- Indian coal is known for its high ash content, often ranging from 30% to 45%. This ash content is significantly higher than that found in coal from many other parts of the world. The high ash content poses challenges for combustion and pollution control in power plants. It also requires more sophisticated handling and disposal methods to manage the large volumes of ash produced.

#### **4] Consider the following statements: [2019]**

**The Environment Protection Act, 1986 empowers the Government of India to**

**1. State the requirement of public participation in the process of environmental protection, and the procedure and manner in which it is sought**

**2. Lay down the standards for emission or discharge of environmental pollutants from various sources**

**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

#### **Explanation**

- The Environment Protection Act, 1986 is an important legislation enacted by the Government of India to protect and improve the environment. It empowers the central government to take necessary measures to protect and improve the environment and to prevent and control environmental pollution.
- The Act empowers the government to state the requirement of public participation in the process of environmental protection and the procedure and manner in which it is sought. This means that the central government can involve the public in the decision-making process related to environmental protection. This is important because it ensures that the public's concerns and opinions are taken into account while making decisions related to the environment.
- The Act also lays down the standards for emission or discharge of environmental pollutants from various sources. This means that the central

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government can set limits on the amount of pollutants that can be emitted or discharged by industries, vehicles, and other sources. This is important because it helps to control the amount of pollution in the environment and protect the health of people and wildlife.

- In conclusion, **both the statements given in the question are correct.**

The Environment Protection Act, 1986 empowers the Government of India to state the requirement of public participation in the process of environmental protection and the procedure and manner in which it is sought. It also lays down the standards for emission or discharge of environmental pollutants from various sources.

**5] In the cities of our country, which among the following atmospheric gases are normally considered in calculating the value of the Air Quality Index? [2016]**

- 1. Carbon dioxide**
- 2. Carbon monoxide**
- 3. Nitrogen dioxide**
- 4. Sulphur dioxide**
- 5. Methane**

**Select the correct answer using the code given below.**

- 1, 2 and 3 only
- 2, 3 and 4 only
- 1, 4 and 5 only
- 1, 2, 3, 4 and 5

- **Explanation**

- The Air Quality Index is acquired by measuring emissions of eight major pollutants present in the air: **Particulate matter (PM<sub>2.5</sub> and PM<sub>10</sub>), Ozone (O<sub>3</sub>), Carbon Monoxide (CO), Nitrogen Dioxide (NO<sub>2</sub>), Sulphur Dioxide (SO<sub>2</sub>), Lead (Pb) and Ammonia (NH<sub>3</sub>) emissions.**
- Readings are **noted every hour**. Each country has their air quality indexes based on its air quality standards.
- The government agencies are responsible for communicating to the public about the health hazards and how to keep a check on them.
- Under the **Swachh Bharat Abhiyan, the National Air Quality Index was launched in September 2014 in New Delhi to measure India's air quality index.**

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- **National Air Quality Index:** Launched in **2014** with outline ‘**One Number – One Color -One Description**’ for the common man to judge the air quality within his vicinity.
- The **Central Pollution Control Board (CPCB)** has formed an expert group of medical professionals, air quality experts, academia, advocacy groups, and SPCBs. Also, a technical study was awarded to IIT Kanpur.
  - In 2014, the **IIT Kanpur** and the expert group recommended an AQI scheme for India.
- Six cities of India- **New Delhi, Kolkata, Mumbai, Pune, and Ahmedabad** have a continuous monitoring system that records data in real-time.
- **There are six categories of AQI:**
  - Good (0-50)
  - Satisfactory (50-100)
  - Moderately polluted (100-200)
  - Poor (200-300)
  - Very Poor (300-400)
  - Severe (400-500)
- **The colour-coded AQI index** was launched in India in 2014, and it helps the public and the government understand the condition of the air and what subsequent measures are to be taken to combat the situation, based on its severity.
- Therefore, the correct answer is **“2, 3 and 4 only”**.

**6] With reference to ‘fly ash’ produced by the power plants using the coal as fuel, which of the following statements is/are correct? [2015]**

- 1. Fly ash can be used in the production of bricks for building construction**
- 2. Fly ash can be used as a replacement for some of the Portland cement contents of concrete**
- 3. Fly ash is made up of silicon dioxide and calcium oxide only, and does not contain any toxic elements.**

**Select the correct answer using the code given below**

- a) 1 and 2
- b) 2 only
- c) 1 and 3

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d) 3 only

- **Explanation**

- Fly ash is a byproduct of burning coal in power plants. It is a fine, powdery substance that is carried away by the flue gases and collected by electrostatic precipitators or bag filters. Fly ash has several uses, some of which are discussed below.
- Fly ash can be used as a raw material in the production of bricks for building construction. The addition of fly ash in brick making can improve the quality of bricks by reducing their permeability, increasing their strength, and enhancing their durability. Fly ash bricks are also cheaper than traditional clay bricks.
- Fly ash can be used as a partial replacement for Portland cement in the production of concrete. Portland cement is the primary binding agent in concrete, but it has a high carbon footprint as it requires a lot of energy to produce. By replacing a portion of Portland cement with fly ash, the carbon footprint of concrete can be reduced. Fly ash also improves the workability and durability of concrete.
- Fly ash is composed of various elements, including silicon dioxide, calcium oxide, aluminum oxide, iron oxide, magnesium oxide, and sulfur trioxide. The exact composition of fly ash varies depending on the type of coal burned and the conditions of the combustion process. While fly ash does contain trace amounts of some heavy metals, such as arsenic, cadmium, and lead, they are present at levels that are lower than those considered harmful to human health and the environment.
- In conclusion, fly ash is a versatile material that has several uses, including brick production and as a partial replacement for Portland cement in concrete. Fly ash is composed of various elements, including silicon dioxide and calcium oxide, and while it does contain trace amounts of some heavy metals, they are present at levels that are not harmful.

Therefore, the correct answer is **“1 and 2”**.

**7] Lead, ingested or inhaled, is a health hazard. After the addition of lead to petrol has been banned, what still are the sources of lead poisoning? [2012]**

**1. Smelting units**

**2. Pens and pencils**

**3. Paints**

**4. Hair oils and cosmetics**

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Select the correct answer using the codes given below:

- a) 1,2 & 3 only                                      b) 1 and 3 only  
c) 2 & 4 only                                        d) 1,2,3 & 4

- **Explanation**

- Lead, when ingested or inhaled, is a health hazard. Although the addition of lead to petrol has been banned, there are still sources of lead poisoning.

These sources include:

- Smelting Units Smelting units, where metals like lead and zinc are extracted from ores, are a significant source of lead pollution. The fumes and dust generated during the smelting process contain high levels of lead, which can lead to lead poisoning in nearby communities.
  - Paints Lead was commonly used as a pigment in paints, especially in older buildings. When these buildings are renovated or demolished, lead particles can become airborne and pose a risk of lead poisoning.
  - Pens and Pencils Some older pens and pencils may contain lead in their ink or graphite. When children chew on the ends of these writing instruments, they may inadvertently ingest lead.
  - Hair Oils and Cosmetics Some traditional hair oils and cosmetics, particularly those imported from other countries, may contain high levels of lead. When these products are applied to the skin, lead can be absorbed into the body.
- Therefore, the correct answer is “**1 and 3**”.

**8] Consider the following: [2011]**

- 1. Carbon dioxide.**
- 2. Oxides of nitrogen.**
- 3. Oxides of Sulphur**

**Which of the above is/are the emission/emissions from coal combustion at thermal power plants?**

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

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- **Explanation**
- The main emissions from coal combustion at thermal power plants are Carbon dioxide (CO<sub>2</sub>), Nitrogen oxides (NO<sub>x</sub>), Sulfur oxides (SO<sub>x</sub>), Chlorofluorocarbons (CFCs), carbonaceous material (soot), and air-borne inorganic particles such as fly ash, also known as suspended particulate matter (SPM) and other trace gas species. Carbon dioxide, nitrous oxide, and chlorofluorocarbons are greenhouse gases. Evidence accumulated by the Inter-governmental Panel on Climate Change (IPCC) suggests that emissions of these greenhouse gases might be responsible for climate change, a global concern.

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## 9. PLASTICS, IMO - PPP 100 - 6

### Plastics

The word plastic is derived from the Greek word **plastikos**, meaning “**capable of being shaped or moulded.**”

Plastic refers to a **wide range of synthetic or semi-synthetic materials** that use **polymers** as a main ingredient with their defining quality being their **plasticity** – the ability of a solid material to undergo permanent deformation in response to applied forces.

This makes them extremely adaptable, capable of being shaped as per requirement. Most modern plastics are derived from **fossil fuel-based chemicals** like natural gas or petroleum.

However, recently, variants made from renewable materials, such as corn or cotton derivatives have also emerged.

Around **70 per cent of global plastic production** is concentrated in **six major polymer types** – referred collectively as **commodity plastics**.

- **These include:** Polyethylene terephthalate or PET, High-density polyethylene or HDPE, Polyvinyl chloride or PVC, Low-density polyethylene or LDPE, Polypropylene or PP, and Polystyrene or PS.
- Each of these have different properties and can be identified by their **resin identification code (RIC)** denoted by symbols found on plastic products.

- **Types of Plastics**

- Overall, there are about 45 unique types of plastics and each type has dozens of different variations. Manufacturers can change the physical structure just slightly to benefit the application for which they are using it. When manufacturers change or modify things like the molecular weight distribution, the density, or the melt indices, they alter the effectiveness and create plastics with many specific properties - and therefore many different uses. There are two main types of plastics: thermoset plastics and thermoplastics.

- **Thermoplastics**

- Thermoplastics may take on amorphous or crystalline structures.
- In thermoplastics the long chain molecules exist in the form of linear bonding but are also bonded to each other by secondary Van Der Waals forces

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(secondary bonds).

- At a high enough heat the excitation of the molecular chains is enough to overcome this binding force and they are free to move over one another thereby creating a viscous liquid. The secondary bonds can be envisaged to have melted. The glass transition ( $T_g$ ) temperature can be envisaged as the temperature at which the secondary bonds melt.
- When the polymer is cooled the secondary forces once again dominate and the molecular chains revert back to a restricted state. This means that thermoplastics can be melted and remelted allowing them to be easily recycled.

- **Thermosets**

- In thermosetting plastics the long chain molecules exist in an amorphous network with cross-linked bonding. This means that the long molecular chains are attached to each other by covalent bonds. The formation of these cross-links is known as curing.
- Cross-linking sets the molecular chains in place and therefore means that a thermosetting plastic cannot be remelted but will instead decompose upon being heated to a temperature above the  $T_g$ .
- Cross-linking inhibits molecular arrangement into an ordered crystalline structure meaning that thermosetting polymers only exist in the amorphous state.

- **Elastomers**

- In elastomers the long molecular chains exist in the form of amorphous linear bonding with occasional cross-linking.
- At room temperature the level of excitation of the chains has already overcome the secondary Van Der Waals bonds, however, the cross-links that exist in the structure act to revert the elastomer back to its original form following deformation.

- **Types of Plastics**

- **1 – Polyethylene Terephthalate (PET or PETE or Polyester)**

- PET is also known as a wrinkle-free fiber. It's different from the plastic bag that we commonly see at the supermarket. PET is mostly used for food and drink packaging purposes due to its strong ability to prevent oxygen from getting in and spoiling the product inside. It also helps to keep the carbon dioxide in carbonated drinks from getting out.
- Although PET is most likely to be picked up by recycling programs, this type of plastic contains antimony trioxide—a matter that is considered as a carcinogen—capable of causing cancer in a living tissue.
- The longer a liquid is left in a PET container the greater the potential for the



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release of the antimony. Warm temperatures inside cars, garages, and enclosed storage could also increase the release of the hazardous matter.

### • **2 – High-Density Polyethylene (HDPE)**

- Also known as HDPE or LDPE, it is one of the most common forms of plastics. New formations of it make it possible for this plastic to be flat. Its initial uses were for electrical wires but it is now found in many disposable products, including gloves and garbage bags. It is also used in other film applications such as wraps, as well as in bottles.
- Quite special compared to the other types, HDPE has long virtually unbranched polymer chains which makes them really dense and thus, stronger and thicker from PET. HDPE is commonly used as the grocery bag, opaque milk, juice container, shampoo bottles, and medicine bottle.
- Not only recyclable, HDPE is relatively more stable than PET. It is considered as a safer option for food and drinks use, although some studies have shown that it can leach estrogen-mimicking additive chemicals that could disrupt human's hormonal system when exposed to ultraviolet light.

### • **3 – Polyvinyl Chloride (PVC)**

- Commonly known as Saran, this plastic is used in wraps to cover food. It is impermeable to odors from food and can be drawn into various films.
- PVC is typically used in toys, blister wrap, cling wrap, detergent bottles, loose-leaf binders, blood bags and medical tubing. PVC or vinyl used to be the second most widely used plastic resin in the world (after polyethylene), before the manufacture and disposal process of PVC has been declared as the cause of serious health risks and environmental pollution issues.
- In the term of toxicity, PVC is considered as the most hazardous plastic. The use of it may leach a variety of toxic chemicals such as bisphenol A (BPA), phthalates, lead, dioxins, mercury, and cadmium.
- Several of the chemicals mentioned may cause cancer; it could also cause allergic symptoms in children and disrupt the human's hormonal system. PVS is also rarely accepted by recycling programs.

### • **4 – Low-Density Polyethylene (LDPE)**

- As said before, Polyethylenes are the most used family of plastics in the world. This type of plastic has the simplest plastic polymer chemical structure, making it very easy and very cheap to process.
- LDPE polymers have significant chain branching including long side chains making it less dense and less crystalline (structurally ordered) and thus a generally thinner more flexible form of polyethylene.
- LDPE is mostly used for bags (grocery, dry cleaning, bread, frozen food bags, newspapers, garbage), plastic wraps; coatings for paper milk cartons and hot &

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cold beverage cups; some squeezable bottles (honey, mustard), food storage containers, container lids. Also used for wire and cable covering.

- Although some studies have shown that LDPE could also cause unhealthy hormonal effects in humans, LDPE is considered as a safer plastic option for food and drink use. Unfortunately, this type of plastic is quite difficult to be recycled.
- **5 – Polypropylene (PP)**
- Stiffer and more resistant to heat, PP is widely used for hot food containers. Its strength quality is somewhere between LDPE and HDPE. Besides in thermal vests, and car parts, PP is also included in the disposable diaper and sanitary pad liners.
- Same as LDPE, PP is considered a safer plastic option for food and drink use. And although it bears all those amazing qualities, PP isn't quite recyclable and could also cause asthma and hormone disruption in human.
- **6 – Polystyrene (PS)**
- Commonly known as Styrofoam, it is one of the less ideal options today for environmental reasons. However, it is very lightweight, easy to mold and it works as an insulator. That is why it is heavily used in furniture, cabinetry, glasses and other impact-resistant surfaces. It is also commonly added with a blowing agent to create foam insulation.
- Polystyrene (PS) is the styrofoam we all commonly used for food containers, egg cartons, disposable cups and bowls, packaging, and also bike helmet.
- When exposed with hot and oily food, PS could leach styrene that is considered as brain and nervous system toxicant. It could also affect genes, lungs, liver, and immune system. On top of all of those risks, PS has a low recycling rate.
- **7 – Other**
- Number 7 is for all plastics other than those identified by number 1-6 and also plastics that may be layered or mixed with other types of plastics, such as bioplastics.
- Polycarbonate (PC) is the most common plastic in this category, isn't used as much in recent years due to it being associated with bisphenol A (BPA). PC is also known by various name: Lexan, Makrolon, and Makroclear.
- PC is typically used for baby bottles, sippy cups, water bottles, water gallon, metal food can liner, ketchup container, and dental sealants. Due to its toxicity, several countries have banned the use of PC for baby bottles and infant formula packaging.
- The BPA that contained inside PC have been linked to numerous health problems including chromosome damage in female ovaries, decreased sperm production in males, early onset of puberty, and various behavioural changes.















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- It has also been linked to altered immune function, sex reversal in frogs, impaired brain and neurological functions, cardiovascular system damage, adult-onset (Type II) diabetes, obesity, resistance to chemotherapy, increased risk of breast cancer, prostate cancer, infertility, and metabolic disorders.
- It has very low recycle rate quality.

# Which plastics are recyclable?

Summary of plastic polymer groups, their common uses, properties and recyclability.

Numerical coding (from 1-7) is typically provided on plastic items and gives information of their polymer grouping below. Recyclability is based on common recycling schemes but can vary between countries as well as regionally within countries; check local recycling guidelines for further clarification.

Symbol	Polymer	Common Uses	Properties	Recyclable?
 PETE	Polyethylene terephthalate	 Plastic bottles (water, soft drinks, cooking oil)	Clear, strong and lightweight	Yes; widely recycled
 HDPE	High-density polyethylene	 Milk containers, cleaning agents, shampoo bottles, bleach bottles	Stiff and hardwearing; hard to breakdown in sunlight	Yes; widely recycled
 PVC	Polyvinyl chloride	 Plastic piping, vinyl flooring, cabling insulation, roof sheeting	Can be rigid or soft via plasticizers; used in construction, healthcare, electronics	Often not recyclable due to chemical properties; check local recycling
 LDPE	Low-density polyethylene	 Plastic bags, food wrapping (e.g. bread, fruit, vegetables)	Lightweight, low-cost, versatile; fails under mechanical and thermal stress	No; failure under stress makes it hard to recycle
 PP	Polypropylene	 Bottle lids, food tubs, furniture, houseware, medical, rope, automobile parts	Tough and resistant; effective barrier against water and chemicals	Often not recyclable; available in some locations; check local recycling
 PS	Polystyrene	 Food takeaway containers, plastic cutlery, egg tray	Lightweight; structurally weak; easily dispersed	No; rarely recycled but check local recycling
 OTHER	Other plastics (e.g. acrylic, polycarbonate, polyactic fibres)	 Water cooler bottles, baby cups, fiberglass	Diverse in nature with various properties	No; diversity of materials risks contamination of recycling

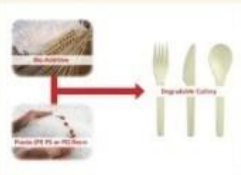
## ENVIRONMENT FRIENDLY PLASTICS

**Bio-plastics:** Materials bio-sourced or biodegradable or both and are made from renewable biomass resources (e.g., corn starch/ sugarcane/ cassava)



**Biodegradable plastic:** plastics (other than compostable plastics) which undergo complete degradation by biological processes under ambient environment.

**Compostable plastics:** Plastics that undergo degradation by biological processes during composting to yield CO<sub>2</sub>, water, inorganic compounds and biomass.



**Oxo-degradable:** These are conventional plastics such as PE, which include an additive to help them break down into smaller fragments, which could lead to microplastic leakage in the environment.

### **Biodegradable plastics**

Biodegradable plastics are those that can decompose naturally in the environment. The makeup structure of biodegradable plastics makes them easily break down by natural microorganisms, giving a product that is less harmful to the environment. Biodegradable plastics are made in a way that they can breakdown or degrade when exposed to the sun's ultra-violet radiation, enzymes, bacteria, water, or wind abrasion. They are made from renewable raw materials or all-natural plant or animal materials such as orange peels, corn oil, switchgrass, soybeans, microorganisms, or starch

The industrial processing of biodegradable plastics is like the manufacture of ordinary plastic, only that the materials used differ, and for bio-degradable plastics; they are the materials that can easily break down or decompose. They are mainly categorized into two:

**Bioplastics;** are purely made from natural substances such as corn starch.

Examples of those made from corn starch. In their manufacturing process, they save energy and emit less carbon as the plants used already have the same

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amount of carbon.

**Biodegradable plastics;** made from traditional petrochemicals but designed to break down faster. They have additives that speed up their rate of decay or breakdown in the presence of oxygen and light.

The presence of moisture also accelerates the breakdown process. Mainly, they get a breakdown in the presence of the sun's UV light with some only breaking down at high industrial-scale temperatures.

The most common examples include polybutyrate adipate terephthalate (PBAT), polybutylene succinate (PBS), polyvinyl alcohol (PVOH/PVA), and polycaprolactone (PCL).

### **Advantages of Using Biodegradable Plastics**

Biodegradable Plastics are easy to Recycle

They Consume less energy during their manufacture

Biodegradable plastics are a better choice as they are broken down easily and can be absorbed by the soil or converted into compost.

Composting bioplastic products can make the soil fertile, thereby enhancing soil fertility.

Since fossil fuels are not required in the manufacturing process of such nature-friendly, biodegradable plastic products, carbon dioxide emissions are also curtailed.

The use of biodegradable plastic products instead of traditional plastics lessens the amount of greenhouse gas emissions

### **Disadvantages of Biodegradable Plastics**

Need for Costly Equipment for Both Processing and Recycling

Risk of Contamination due to confusion differentiating between

Bio-degradable and Non-Biodegradable Plastics


Biodegradable Plastics may produce Methane in landfills

There is a need for more crops and croplands to produce Biodegradable Plastics.

## THE CHEMISTRY OF BIODEGRADABLE PLASTICS

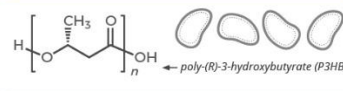
### COMMON BIOPOLYMERS & SOURCES

#### POLYLACTIC ACID (PLA)



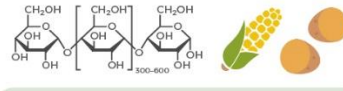
Obtained from fermented plant starch from corn, cassava, sugar cane or sugar beet.

#### POLYHYDROXYALKANOATES (PHAs)




Extracted from bacteria, which produce it via the fermentation of sugar or lipids.

#### THERMOPLASTIC STARCHES (TPS)




Starches from plant materials are heated with water, then mixed with plasticisers or other polymers.


### EVERYDAY USES OF BIOPOLYMERS




Biodegradable coffee cups are paper cups with a PLA lining to make the paper waterproof.



PLA has the second largest production volume of any biopolymer (behind TPS). It is also used in plastic films, bottles, and food containers.




PLA and TPS both find use in the manufacture of plastic cutlery that's biodegradable.



TPS is also used in food waste bags and some magazine wrappers. PHAs have fewer uses, but have medical uses such as in surgical sutures.


### ADVANTAGES AND DISADVANTAGES

#### GLOBAL PLASTIC PRODUCTION




Use of bioplastics is increasing, but they still account for less than 1% of the global plastics market (as of 2018).

#### CONDITIONS FOR BIODEGRADING



Compostable plastics need specific conditions to break down – and take much longer to do so completely if they go to landfill instead of being recycled. However, they still break down faster than conventional plastics.



Biodegradable plastics are more expensive than plastics derived from fossil fuels on weight basis, and require land to grow raw materials. However, the greenhouse gas emissions associated with their production are lower.

- **Concerns**

- **Plastic pollution** – It includes **plastic waste that is mismanaged** (e.g. open-burned and dumped in uncontrolled dumpsites) and **leakage and accumulation of plastic objects** and particles that can adversely affect humans and the living and non-living environment
- **Slow decomposition rate:** Plastics are hard to eradicate due to their **slow decomposition rate** in natural ecosystems.
  - Decomposition rate refers to the **rate at which a material breaks down into its constituent** parts through chemical processes – plastics are remarkably durable in this sense.
- **Microplastics:** Plastics break down into their smaller units called **microplastics** – officially defined as plastics **less than five millimetres in diameter**.
  - These microplastics find their way across the planet, from the depths of the Pacific Ocean to the heights of the Himalayas.
  - According to the most recent global estimates, **an average human consumes at least 50,000 microplastic particles annually** due to contamination of the food chain, potable water, and air.
- **Effect on Human Health:** Notably, microplastics contain a number of toxic chemicals which pose severe risks to human health. The biggest health risk associated is with the **chemical BPA or Bisphenol A**, which is **used to harden the plastic**.

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- BPA contaminates food and drinks, causing **alterations in liver function, insulin resistance, foetal development in pregnant women, the reproductive system and brain function.**
- **Marine pollution:** The largest collection of plastics and microplastics in the ocean is in the **Great Pacific Garbage Patch** – a collection of marine debris in the North Pacific Ocean. Also known as the **trash vortex**, it is located between **California and Japan**, and formed due to converging ocean currents.
  - As per estimates, the GPGP covers a surface area of 1.6 million sq km – **roughly half the size of India!** There are other, **smaller such garbage patches in other oceans.**
  - It floats on the sea surface and ends up **clogging the marine animals.**
- **Plastisphere:** Plastics are becoming part of the Earth’s fossil record and a marker of the Anthropocene, our current geological era. They have even given their name to a new **marine microbial habitat called the “plastisphere”.**
  - Anthropocene is defined as a period of time during which human activities have impacted the environment enough to constitute a distinct geological change.
- **Climate change:** Plastic, which is a petroleum product, also contributes to **global warming.** If plastic waste is incinerated, it releases **toxic fumes and carbon dioxide into the atmosphere**, thereby increasing carbon emissions.
- **Tourism and Economy:** Plastic waste **damages the aesthetic value of tourist destinations**, leading to decreased tourism-related incomes and major economic costs related to the cleaning and maintenance of the sites.

### • **Bisphenol A (BPA)**

- Bisphenol A (BPA) is a chemical that is mainly used in combination with other chemicals to manufacture plastics and resins.
- It is produced by the condensation of phenol and acetone.
- This type of plastic is used to make some types of beverage containers, compact disks, plastic dinnerware, impact-resistant safety equipment, automobile parts, and toys.
- Generally, BPA acts on the hormonal level by distorting hormonal balance and inducing estrogenic effects through binding with estrogen-related receptors (ERR).

### • **Global Efforts To Tackle it**

- **The 1972 Convention** on the Prevention of Marine Pollution by Dumping Wastes and Other Matter (or the London Convention)

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- **The 1996 Protocol to the London Convention** (the London Protocol)
- **The 1978 Protocol** to the International Convention for the Prevention of Pollution from Ships (MARPOL).
- **The United Nations Environment Program (UNEP)** considers plastic marine debris and its ability to transport harmful substances as one of the main emerging issues affecting the environment.
- **GloLitter Partnerships (GLP):** It is a project launched by the International Maritime Organization (IMO) and the Food and Agriculture Organization of the United Nations (FAO) and initial funding from the Government of Norway.
- **Clean Seas Campaign:**
  - The United Nations Environment Programme launched the Clean Seas Campaign in 2017
  - **Aim:** The goal was to galvanize a global movement to turn the tide on plastic by reducing the use of unnecessary, avoidable and problematic plastics including single-use plastics and phasing out intentionally added microplastics.
- **Greenpeace:** It is an environmental NGO that is dedicated to conserving the oceans and marine life across the globe. Its grassroots efforts have resulted in the ban of destructive fishing practices, companies changing their fishing policies, and the creation of whale sanctuaries.
- **United Nations resolution:** 124 countries which are party to the United Nations Environment Assembly including India signed a resolution to draw up an agreement which will in the future make it legally binding for the signatories to address the full life of plastics from production to disposal, to end plastic pollution.

- **Intergovernmental Negotiation Committee (INC)**
- The INC was established in February 2022, at the **5<sup>th</sup>session** of the **United Nations Environment Assembly (UNEA-5.2)**.
  - UNEA is the governing body of the **UN Environment Programme**.
- A historic resolution (5/14) was adopted to develop an international legally binding instrument on plastic pollution, including in the marine environment with the ambition to complete the negotiations by the end of 2024.
  - The first session of the INC-1 was held in **Uruguay in 2022**.
- **Need:**



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- The **rapidly increasing levels of plastic pollution** represent a serious global environmental issue that negatively impacts the environmental, social, economic and health dimensions of sustainable development.
- In the absence of necessary interventions, the amount of plastic waste entering aquatic ecosystems could nearly triple from some 9–14 million tonnes per year in 2016 to a projected 23–37 million tons per year by 2040.
- **Objective:**
  - Under the **legally binding agreement**, countries will be expected to develop, implement and update national action plans reflecting country-driven approaches to contribute to the objectives of the instrument.
  - They will be expected to promote national action plans to work towards the prevention, reduction and elimination of plastic pollution and to support regional and international cooperation.

- **India's Efforts In Tackling Plastic Waste**

- **Ban on single-use plastics:** India has banned the production, use, and sale of single-use plastics such as bags, cups, plates, cutlery, and straws in many states.
- **Extended Producer Responsibility (EPR):** The Indian government has implemented EPR, making plastic manufacturers responsible for managing and disposing of the waste generated by their products.
- **Plastic Waste Management Rules:** India introduced the Plastic Waste Management Rules in 2016, which provide a framework for managing plastic waste through various measures, including recycling and waste-to-energy initiatives.
- **Plastic Waste Management (Amendment) Rules, 2022:**
  - The guidelines on EPR(Extended Producer Responsibility) coupled with the prohibition of identified single-use plastic items.
  - It banned the manufacture, import, stocking, distribution, sale and use of carry bags made of virgin or recycled plastic less than seventy-five micrometers.
- **Swachh Bharat Abhiyan:** The Indian government launched the Swachh Bharat Abhiyan, a national cleanliness campaign, which includes the collection and disposal of plastic waste.

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- **Plastic Parks:** India has set up Plastic Parks, which are specialized industrial zones for recycling and processing plastic waste.
- **Beach clean-up drives:** The Indian government and various non-governmental organizations have organized beach clean-up drives to collect and dispose of plastic waste from beaches.
- **Awareness campaigns:** India has launched awareness campaigns to educate people about the harmful effects of plastic pollution and encourage them to use sustainable alternatives.
- **India is a signatory to MARPOL (International Convention on Prevention of Marine Pollution).**
- **The “India Plastic Challenge – Hackathon 2021**
  - It is a unique competition calling upon start-ups /entrepreneurs and students of Higher Education Institutions (HEIs) to develop innovative solutions to mitigate plastic pollution and develop alternatives to single-use plastics.

- **Plastic Overshoot Day**
- Earth Action (EA) announced 28 July as “Global Plastic Overshoot Day”, the date when the amount of plastic produced worldwide surpasses all combined international efforts to manage it effectively.
- **Key findings of 2023 Plastic Overshoot Day Report:**
- Nearly 68,642,999 tonnes of **additional plastic waste** will end up in nature this year.
- **India is among the 12 countries**, along with China, Brazil, Indonesia, Thailand, Russia, Mexico, the United States, Saudia Arabia, the Democratic Republic of Congo, Iran and Kazakhstan, which are **responsible for 52 per cent of the world’s mismanaged plastic waste.**
- Under current scenarios, despite pledges and increased waste management capacity, increased **production of plastics** will lead to **global plastics pollution tripling** by 2040.
- Of the **159 million tonnes of plastics** (which can be used only for a short time) to be produced globally in 2023, **43 per cent** (68.5 million tonnes) will end up **causing pollution.**
- **Plastic Overshoot Day:**
- **Plastic Overshoot Day** sheds light on a **critical aspect of the world’s plastic consumption.**

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- **Short-life plastics**, encompassing plastic packaging and single-use plastics account for **approximately 37 per cent of the total plastic commercialised** annually.
  - They pose a **higher risk of leakage to the environment**.
- **Overshoot Day for India**, or the date when the amount of plastic waste outweighed the country's ability to manage it, was January 6, 2023.
- **Plastic Overshoot Day** is determined based on a **country's Mismanaged Waste Index (MWI)**.
  - The **gap in waste management** capacity and plastic consumption is called **MWI**.
- **Plastic consumption on a per-person basis:**
- When it comes to **plastic consumption on a per-person basis**, the **world's worst offender is Iceland**, with annual **consumption of 128.9 kg per person**.
  - This is **24.3 times higher** than the yearly consumption **per person of 5.3 kg in India**.
  - The **global average consumption** of plastic per person per year is 20.9 kg.
- **Root Cause of Plastic Pollution:**
- The **imbalance between the volumes of plastic** that are **produced and used**, as well as the world's **ability to manage** those volumes when **they become waste**.
- **Three countries** (followed by India) with **the highest mismanaged waste** belong to Africa.
- **India ranks fourth in the MWI**, with **98.55 per cent of generated waste being mismanaged** and fares poorly in the management of plastics waste.
- **Waste sponges:**
- The countries were categorised into **10 archetypes to carry out the analysis**: The **transactors**, the **self-sustainers**, the **strugglers**, the **overloaders**, the **toxic exporters**, the **waste saviours**, the **waste sponges**, the **selective exporters**, the **exporting polluters** and the **small-scale inward polluters**.
  - **Plastic pollution** particularly **impacts developing countries** without mature waste management systems, including India.

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- Waste sponges are trying to address the **global waste crisis by absorbing waste** from other countries but are struggling to manage their own waste.
- They have a **low plastic consumption** yet a **high level of plastic pollution**.
- **Concerns:**
- The expected **mismanaged waste in India** in 2023 will be 7,300,752 tonnes of plastic.
  - The country will also be responsible for releasing an average of 3,30,764 tonnes of **microplastics into waterways**.
- The **total primary plastic production** in the country is 20 million metric tonnes, of this **43 per cent is single-use in nature**.
  - This means that roughly **8.6 million tonnes of single-use plastic waste** is generated in the country.

### • **Way Ahead/Suggestions**

#### • **Individual efforts**

- **Try a Zero-Waste Lifestyle:** Become a zero-waste champion. Invest in sustainable, ocean-friendly products- reusable coffee mugs, water bottles and food wraps. Consider options like menstrual cups, bamboo toothbrushes and shampoo bars.
- **Travel Sustainably:** On holiday one can try to watch single-use plastic intake. Refuse miniature bottles in hotel rooms, take your own reusable drinking bottle and use reef-safe sunscreen, without microplastics.
- **Dress Sustainably:** The fashion industry produces 20 percent of global wastewater and 10 percent of global carbon emissions. That's more than all international flights and maritime shipping combined. One should consider sustainable clothing lines, vintage shops and repair your clothes when possible.
- **Choose plastic-free personal care products:** Personal care products are a major source of microplastics, which get washed into the oceans straight from our bathrooms. Look for plastic-free face wash, day cream, makeup, deodorant, shampoo and other products.
- **Government and community efforts**
- **Designing a Product:** Identifying plastic items that can be replaced with non-plastic, recyclable, or biodegradable materials is the first step.
  - Find alternatives to single-use plastics and reusable design goods by working with product designers. Countries must embrace circular and sustainable economic practices throughout the plastics value chain to

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accomplish this.

- **Technologies and Innovation:** Developing tools and technology to assist governments and organisations in measuring and monitoring plastic garbage in cities.
- **Municipal and community actions:** Beach and river clean-ups, public awareness campaigns explaining how people’s actions contribute to marine plastic pollution (or how they may solve it) and disposable plastic bag bans and levies.
- **Multi-stakeholder collaboration:** Government ministries at the national and local levels must collaborate in the development, implementation and oversight of policies, which includes participation from industrial firms, non-governmental organisations and volunteer organisations.

### **IMO Green Voyage2050 Project**

**Maritime countries** upgraded their **Greenhouse House Gas (GHG) emissions strategy** to reach **net zero “by or around” 2050** without specifying a definite year and taking into account different national circumstances, at the conclusion of the summit of the **United Nations International Maritime Organization (IMO)** in **London** on **July 7, 2023**.

- The **Marine Environment Protection Committee (MEPC) — 80th session** was held at the **IMO headquarters (London)** from July 3-7.
- **IMO Greenhouse Gas Strategy 2023:**
- The **2023 IMO GHG Strategy** adopted calls for the international shipping industry **“to reduce the total annual GHG emissions from international shipping by at least 20%, striving for 30%, by 2030, compared to 2008.”**
- The **draft document** agreed upon by member nations says to **peak GHG emissions from international shipping “as soon as possible.”**
- This is **to limit the global temperature increase to well below 2 degrees Celsius** as outlined in the **2015 Paris Agreement**.
- It also urged the industry **“to reduce the total annual GHG emissions from international shipping by at least 70%, striving for 80%, by 2040, compared to 2008.”**
- The **near-zero emission technologies, fuels, and energy sources** should **“represent at least 5%, striving for 10%, of the energy used by international shipping by 2030.”**
- **Biofuels:**
  - The **IMO** adopted interim guidance which said that **internationally**

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**certified biofuel and bio-blends can be used in the shipping**

**industry.** This resolution was **backed aggressively by India** at the conference.

- The **carbon intensity of international shipping** should **decline to reduce CO2 emissions “per transport work”**, on average by **at least 40 per cent** by **2030**, compared to **2008** baseline levels.
- **Just transition:**
  - The **IMO document**, for the first time, spoke about implementing measures to b and other maritime workforce “that leaves no one behind.”
- **Carbon emission from maritime shipping sector:**
  - Maritime shipping is responsible for three per cent of global anthropogenic GHG emissions and these emissions are continuing to grow rapidly.
  - A business-as-usual scenario would see **shipping emissions increase more than five-fold by 2050** if the shipping industry fails to act now.
- **International Maritime Organisation (IMO):**
- It is the **United Nations specialized agency** and the **global standard-setting authority** for the safety, security and environmental performance of international shipping.
- It was established through the **UN Convention in Geneva** in **1948** having its headquarters in **London**.
- It currently has **174 Member States** constituting its Assembly which **meets biennially**.
- The Assembly elects **40 Member States** to constitute the Council which acts as a governing body.
- **Roles :**
  - Its main role is **to create a regulatory framework for the shipping industry** that is fair and effective, universally adopted and universally implemented.
  - It **does not have an implementation mechanism**.
  - It is also involved in **legal matters**, including liability and compensation issues and the facilitation of international maritime traffic.
  - IMO has **adopted measures to reduce air pollution from ships as well as energy efficiency measures** including the Energy Efficiency Design Index, which is mandatory for new ships, and the requirement for a Ship

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Energy Efficiency Management Plan, for all ships.

- **Key IMO Conventions:**
  - **SOLAS(1974)**- International Convention for the Safety of Life at Sea.
  - **MARPOL(1973)**- International Convention for the Prevention of Pollution from Ships.
  - **STCW**- International Convention on Standards of Training, Certification and Watchkeeping for Seafarers.
- **Marine Environment Protection Committee (MEPC):**
- The **Marine Environment Protection Committee (MEPC)** addresses **environmental issues under IMO's remit**.
- This includes the control and prevention of **ship-source pollution** covered by the **MARPOL treaty**, including **oil, chemicals** carried in bulk, sewage, garbage and emissions from ships, including **air pollutants and greenhouse gas emissions**.
- Other matters covered include ballast water management, anti-fouling systems, ship recycling, pollution preparedness and response, and identification of special areas and particularly sensitive sea areas.

### • **REDUCTION OF GHG - IMO**

#### • **Selective Catalytic Reduction (SCR)**

- Selective Catalytic Reduction (SCR) is an effective technology used to reduce NO<sub>x</sub> emissions, which are major contributors to air pollution and smog formation.
- It is a post-combustion treatment system that is typically installed in the exhaust system of diesel engines or power plants.
- SCR works by injecting a reducing agent into the exhaust stream, which reacts with NO<sub>x</sub> over a catalyst to convert it into harmless nitrogen (N<sub>2</sub>) and water (H<sub>2</sub>O).
- Ammonia is commonly used as the reducing agent in SCR systems. It is typically injected as an aqueous solution called Diesel Exhaust Fluid (DEF) or AdBlue.
- The reducing agent reacts with NO<sub>x</sub> in the presence of a catalyst, usually consisting of metals such as platinum, palladium, or rhodium.
- The chemical reaction that takes place in SCR can be represented as follows:
- $4\text{NO} + 4\text{NH}_3 + \text{O}_2 \rightarrow 4\text{N}_2 + 6\text{H}_2\text{O}$

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- **Benefits of SCR:**
  - Selective Catalytic Reduction offers several benefits, including:
    - Significant reduction in NOX emissions: SCR can achieve NOX emission reductions of up to 90%.
    - Improved air quality: By reducing NOX emissions, SCR helps to improve air quality and reduce the impact of pollutants on human health and the environment.
    - Compliance with emission regulations: Many countries have strict emission regulations for diesel engines and power plants. SCR enables compliance with these regulations.
- Selective Catalytic Reduction (SCR) is hence an effective method for reducing air pollution and ensuring compliance with emission regulations.
- **Scrubbers**
- According to **GlobalData**, a data and analytics company, there has been a huge increase in the use of **open-loop scrubbers in ships** in just last one year, even as a debate about their viability in mitigating sulphur emissions from ships has also escalated.
- There are currently 3,756 vessels with scrubbers installed, compared to just 767 in 2018. Out of these, only 65 have closed-loop, rest are all open-loop.
- The **International Maritime Organisation's (IMO)** adopted **the International Convention for the Prevention of Pollution from Ships (MARPOL)** Annex VI in 2008 that **regulates the prevention of air pollution from ships and prohibits deliberate emissions of ozone-depleting substances such as sulphur oxides and nitrous oxides.**
- Following the adoption, **exhaust scrubbers have become one of the most preferred ways of reducing sulphur exhaust** as they 'scrub' pollutants out of emissions.
- There are two types of exhaust scrubbers- **open and closed.**
- While **closed-loop scrubbers retain the sulphur emissions for safer disposal at port, open-loop scrubbers release pollutants back in the sea after turning the sulphur dioxide into sulphuric acid.**
- However, uncertainty around the **sustainability of open-loop scrubbers** continues to escalate in the shipping industry.
- **International Convention for the Prevention of Pollution from Ships (MARPOL):**



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- The Convention was adopted on 2 November 1973 at IMO.
- It includes regulations aimed at preventing and minimizing pollution from ships – both accidental pollution and that from routine operations.
- All ships flagged under countries that are signatories to MARPOL are subject to its requirements, regardless of where they sail and member nations are responsible for vessels registered on their national ship registry.
- **Slow steaming**
- Slow steaming refers to the practice whereby the (operational) speed of the ship is reduced. It basically means that the ship's engine is not used at full power, thus saving fuel, reducing CO<sub>2</sub> and air pollutant emissions.
- Reducing ship speed by 10% will lead to a 27% reduction of the ship's emissions. Overall, if all ships were to slow-steam, the available capacity on the market would be reduced (more ships would be needed to carry out the same transport work). If the additional emissions of building and operating these new ships were considered in the equation, then reducing the fleet's speed by 10% would lead to overall CO<sub>2</sub> savings of 19%.
- Reducing the (operational) speed of ships multiplies the positive effects of an energy efficiency index, as it results in burning less fuel and therefore emitting less CO<sub>2</sub> and other greenhouse gases. It also contributes to significantly lower emissions of air pollutants such as NO<sub>x</sub> and PM, with benefits greatly outweighing costs. Slow-steaming is often regarded as the most cost-effective way to reduce CO<sub>2</sub> emissions as it can be done at almost no cost while translating into operational savings.

### **G20 Summit: Countries welcome Chennai principles for ocean-based economy**

- The G20 Environment and Climate Sustainability Working Group (ECSWG) and Environment and Climate ministers meeting that concluded recently adopted a series of “Chennai High-Level Principles” for a sustainable and resilient blue economy.
- These principles shall serve as a guiding framework globally to drive the transition to a sustainable and resilient blue economy.
- Blue economy refers to advocating sustainable use of ocean resources for economic growth, improved livelihoods, and jobs while preserving the health of ocean ecosystems.

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- The Environment ministry said the adoption of these nine principles will not only help conserve ocean biodiversity but also address the consequences of climate change on ocean-based economies in the G20.
- 9 High Level Principles on Blue Economy:
- The 9 key principles that have been adopted on the blue economy are as follows:
- **Addressing Coastal and Marine Pollution:** The principle aims to tackle pollution in coastal and marine environments caused by various sources, including plastics, air pollutants, and other persistent pollutants, including those derived from the maritime sector.
- **Sustainable Exploitation:** This principle focuses on promoting sustainable use of ocean resources to ensure economic growth, improved livelihoods, and job opportunities while also preserving the health of ocean ecosystems.
- **Illegal Activities:** The principle addresses the need to combat illegal activities that negatively impact the marine environment.
- **Acknowledging Ocean-Climate Interlinkages:** This principle emphasizes the recognition of links between the ocean and climate, encouraging ocean-based economies to understand the opportunities for climate change mitigation and adaptation through sustainable ocean-based actions.
- **Protection and Restoration of Coastal and Marine Ecosystems:** This principle emphasizes the importance of protecting and restoring coastal and marine ecosystems as part of climate change mitigation and adaptation efforts.
- **Harnessing Low and Zero Greenhouse Gas (GHG) Emissions:** The principle focuses on utilizing low and zero greenhouse gas emissions sources in ocean-based economic activities.
- **Research on Ocean-Based Carbon Dioxide Removal and Sequestration:** This principle highlights the importance of research on safe and effective methods of removing and sequestering carbon dioxide from the ocean.
- **Promoting Social and Inter-Generational Equity and Gender Equality:** The principle advocates for transparent and inclusive approaches that empower women, communities, and Indigenous Peoples to participate in planning, decision-making, and implementation processes related to the sustainable blue/ocean-based economy.
- **Support for the Global '30 by 30' Goal:** The principle reiterates the G20's commitment to the global '30 by 30' goal, which aims to ensure that at least 30 percent of degraded terrestrial, inland water, and marine and coastal ecosystems are under effective restoration, and at least 30 percent of terrestrial

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and inland water areas, and of marine and coastal areas, are effectively conserved and managed by 2030.

- Blue Economy
- The World Bank defines “blue economy” as “sustainable use of ocean resources for economic growth, improved livelihoods and jobs, while preserving the health of the ocean ecosystem”.
- Activities: Seafood harvesting (fishing and aquaculture), extraction and use of marine non-living resources (such as minerals and oil and gas), generation of renewable energy (such as offshore wind), and commerce and trade are examples of activities that could count towards a blue economy.
- 14th SDG Goal: Developing a blue economy is also linked to the 14th Sustainable Development Goal.
- It aims to protect “life below water”, which involves the conservation and sustainable use of the oceans, seas and marine resources for development.
- Sustainable Blue Economy Finance Principles: In 2018, the United Nations Environment Programme (UNEP) had laid out the Sustainable Blue Economy Finance Principles.
- It is a framework that investors can use to fund ocean-based industries.
- Financiers can use it as a reference point to see how marine investment can impact livelihood and poverty eradication.
- Global Biodiversity Framework: Targets set out in the Global Biodiversity Framework of COP15 focus on reducing the rate of loss of biodiversity, ensuring the fair and equitable sharing of benefits arising from the use of genetic resources, and restoring degraded ecosystems. It serves as a blueprint for countries to work together and make progress in addressing the global biodiversity crisis.
- India and Blue Economy
- India envisions a blue economy that will contribute to food security, poverty alleviation, the mitigation of and resilience to the impacts of climate change, enhance trade and investment, enhance maritime connectivity, boost diversification, job creation and socio-economic growth.
- Facilitate Economic Growth: India is the third largest fish producing country, contributing 8% to the global fish production and ranks second in aquaculture production.
- With 12 major ports and 187 non-major ports, handling about 1,400 million tonnes of cargo, 95% of India’s trade by volume transits by sea.
- India’s Exclusive Economic Zone is rich in living and non-living resources and

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holds significant recoverable resources of crude oil and of recoverable natural gas.

- Marine Biotechnology and Food Security: Fish, being an affordable and rich source of animal protein, is one of the healthiest options to mitigate hunger and malnutrition in India.
- Aquaculture & Marine Biotechnology programme was initiated during 1988-89 to support R&D projects towards development of useful products and process from the marine resources.
- Fisheries as a Commercial Enterprise: Having commenced as a purely traditional activity, India's fisheries are being transformed into a commercial enterprise.
- The sector has shown steady growth and has become a major contributor of foreign exchange. India is among the top 5 fish exporting countries in the world.
- Generation of Jobs: Fisheries provide livelihood to about 15 million fishers and fish-farmers at the primary level in India.
- This sector also generates almost twice the number of jobs, along the value-chain — in transportation, cold-storages, and marketing.
- Marine Tourism: Marine tourism is also a sector that has been one of the fastest growing globally and in India. Particularly in coastal states like Kerala, Karnataka, and Tamil Nadu, coastal tourism has contributed largely to both the state economies and livelihood creation.
- Challenges in Building India's Blue Economy
- Lack of Investment: There is lack of investment in India's Deepwater fleet. Indian fishing vessels do not venture into rich fishing grounds and most of the fishing is being undertaken in coastal waters.
- Consequently, Indian fishermen have to compete with those of neighbours, Sri Lanka and Pakistan, in restricted fishing grounds.
- Fishing vessels often drift into foreign waters leading to apprehension by navies/coast guards and prolonged imprisonment of the crew.
- Lack of Infrastructure: Since Independence, India's marine fishery has been dominated by the "artisanal sector" i.e. poor, small-scale fishers who can afford only small sailboats or canoes to fish for subsistence.
- India's artisanal fishers deliver only 2% of marine fish to the market, while 98% is caught by mechanised and motorised craft.
- The rich resources in India's Exclusive Economic Zone remain underexploited. Much of the catch from India's fishing grounds is taken away by the better

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equipped fishing fleets of other Indo-Pacific countries.

- These countries also indulge in Illegal, Unregulated, and Unreported (IUU) fishing which has serious security and environmental implications.
- Low Level Value Addition: Currently, most of India's fisheries exports are at a low level of value addition in frozen and chilled form, without going for higher-order "ready-to-eat" or "ready-to-cook" marine products.
- Stress on Coastal Ecosystem: India needs to curb uncontrolled and unplanned tourist activities that cause stress on the carrying capacity of coastal ecosystems, especially those on fragile island territories.
- Environmental Issues: The increase in human activity, trade and commerce and the construction of large-scale infrastructure around these areas, pose a significant threat to the sustainability of these zones.
- Lack of Skilled Human Resource: Shipping and ports require skilled manpower, but to meet the growing and changing demands in this sector India would require re-skilling and upskilling in the future.
- India's Initiatives for Blue Economy
- Pradhan Mantri Matsya Sampada Yojana: Launched in 2020 for sustainable development of India's fisheries sector with an estimated investment of Rs 20,000 crores over the next five years.
- Draft Blue Economy Policy: It envisages optimal utilisation of all sectors of the maritime domain, from living and non-living resources to tourism and ocean energy for sustainable development of coastal areas. The 7 key areas are shown in the image:
- Sagarmala Initiative: A Union Government's initiative that aims to promote port-led direct and indirect development and provide infrastructure to transport goods to and from ports quickly, efficiently and cost-effectively.
- Fisheries and Aquaculture Infrastructure Development Fund (FIDF): It was launched by the Union Government in 2018 with a total fund size of Rs 7522.48 crore with the aims to achieve a sustainable growth of 8-9%, in a move to augment the country's fish production to the level of about 20 million tonnes by 2022-23.
- Way Forward
- India needs to evolve a long-term vision for its fishing industry with focus on four areas:
- Mechanisation and modernisation of fishing vessels by providing communication links and electronic fish-detection devices, with artisanal fishers being funded for this.

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- Developing deep-water fishing fleets, with bigger, sea-going vessels equipped with refrigeration facilities.
- A DWF fleet will have to be built around the “mother ship” concept, wherein a large vessel would accompany the fleet to provide fuel, medical and on-board preservation/processing facilities.
- Development of modern fishing harbours with adequate berthing and post-harvest facilities, including cold storage, preservation, and packaging of fish.

### **1. Why is there a great concern about the ‘microbeads’ that are released into environment? (2019)**

- (a)** They are considered harmful to marine ecosystems.
- (b)** They are considered to cause skin cancer in children.
- (c)** They are small enough to be absorbed by crop plants in irrigated fields.
- (d)** They are often found to be used as food adulterants

**Ans: (a)**

- **Explanation**
- Microbeads are small, solid, manufactured plastic particles that are less than 5mm and do not degrade or dissolve in water.
  - Mainly made of polyethylene, microbeads can also be prepared from petrochemical plastics such as polystyrene and polypropylene. They may be added to a range of products, including rinse-off cosmetics, personal care and cleaning products.
- Microbeads, because of their small size pass unfiltered through the sewage treatment system and reach the water bodies. The untreated microbeads in the water bodies are taken up by the marine animals, thus producing toxicity and causing harm to the marine ecosystem.
  - In 2014, Netherland became the first country to ban cosmetics microbeads.
- Therefore, option (a) is the correct answer.

### **2. What is blue carbon? (2021)**

- (a)** Carbon captured by oceans and coastal ecosystems
- (b)** Carbon sequestered in forest biomass and agricultural soils
- (c)** Carbon contained in petroleum and natural gas
- (d)** Carbon present in atmosphere

**Ans: (a)**

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- **Explanation**
- Blue carbon is the term for carbon captured by the world's ocean and coastal ecosystems.
- The coastal ecosystems of mangroves, tidal marshes and seagrass meadows contain large stores of carbon deposited by vegetation and various natural processes over centuries. These ecosystems sequester and store more carbon – often referred to as 'blue carbon' – per unit area than terrestrial forests. The ability of these vegetated ecosystems to remove carbon dioxide (CO<sub>2</sub>) from the atmosphere makes them significant net carbon sinks.

### **3. Bisphenol A (BPA), a cause of concern, is a structural/key component in the manufacture of which of the following kinds of plastics? (2021)**

- (a) Low-density polyethylene
- (b) Polycarbonate
- (c) Polyethylene terephthalate
- (d) Polyvinyl Chloride

**Ans: (b)**

- **Explanation**
- Bisphenol A is a synthetically obtained **colourless**, crystalline **organic compound** that occurs in the solid phase belonging to the **diphenylmethane group**. It is **soluble in organic solvents** but poorly dissolves in water
- **Uses of Bisphenol A:**
  - Bisphenol A (BPA) is commonly **used to coat the insides of food cans, bottle tops, and water supply lines**, and was once a component of baby bottles.
  - **Bisphenol A (BPA) is a chemical produced in large quantities for use primarily in the production of polycarbonate plastics and epoxy resins.** Specifically, it is used for packaging foods and beverages, baby bottles, thermal papers (i.e., receipts), and dental sealants.
  - BPA polycarbonate plastics are very sturdy in nature and are used to make large variants of **microwave-proof utensils**.
  - It is used as a material for **safety glasses, bulletproof windows and helmets**.
  - It is used in many **medical devices** such as heart-lung machines, incubators, artificial kidneys, dental fillers, and sealants.
  - It is also used as **eyewear glasses**, due to their optical clarity.

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- **Environmental impacts of Bisphenol A:**
  - BPA can enter the environment directly through the **leaching of chemicals or degradation of materials** containing bisphenol A and may render the **land infertile and barren** making it unsuitable for **agriculture**.
  - It affects the **growth and reproduction of marine life**.
  - It causes endocrine effects in **fish, amphibians, and reptiles**.
- **Adverse effects of Bisphenol A on human health:**
  - When ingested, the chemical **disrupts the endocrine system** by interfering with the hormones and **affecting the brain and prostate gland** of **foetuses, infants, and children**.
  - It can cause **high blood pressure, diabetes and cardiovascular disease** in adults.
  - BPA is a xenoestrogen and **mimics estrogen** present in the body, thus exhibiting hormone-like properties.
  - It can indirectly aid in the **spread of vector-borne diseases** in humans and animals.

### **4. What is Bisphenol A (BPA)? (2008)**

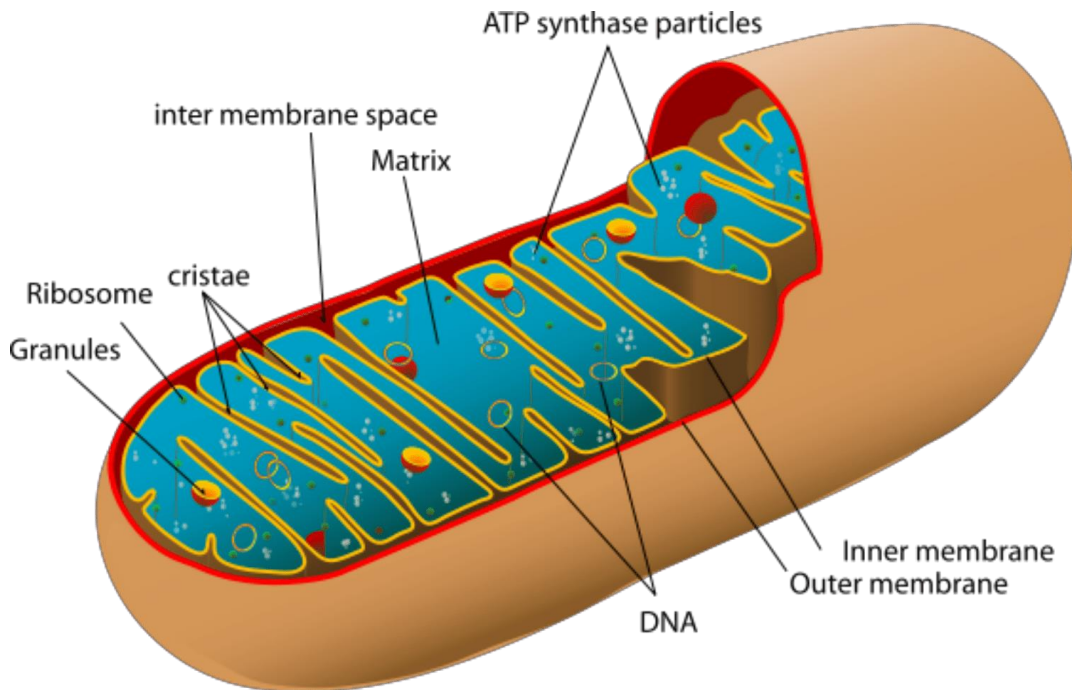
- (a)** A medical test for detecting cancer
- (b)** A test for testing the use of drugs to improve performance by athletes
- (c)** A chemical used for the development of food-packaging materials
- (d)** A special type of alloy steel

**Ans: (c)**

- **Explanation**
- Bisphenol A (BPA) is a synthetic chemical compound used in a wide range of consumer products and is classed by the Government of Canada as a hormone disruptor. Bisphenol A is found in many everyday products including food cans, plastic water containers and baby bottles. A study in the US found that 95% of people tested had been exposed to BPA.



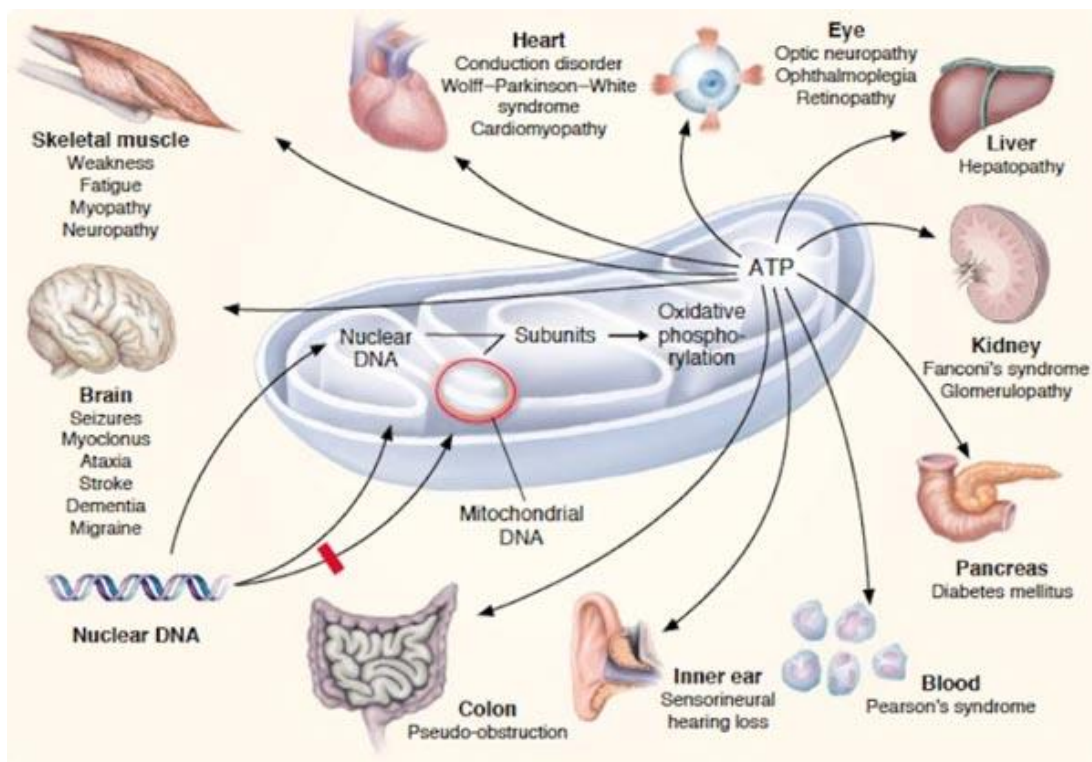
## 10. Mitochondrial Replacement Techniques - PPP 100



- Mitochondria are organelles that are a part of almost every cell in the human body. Their function is to ensure the proper performance of the cell by supplying it with energy that we get, like with the food we eat. In case of mitochondrial failure, our cells do not receive the power to operate properly, which leads to damage in bigger systems, like organs.
- Mitochondria are present in the eggs, too — they help them to work right to be suitable for fertilization and then grow into a healthy fetus. If there is any type of mitochondrial damage in the egg, the fetus is at risk of developing mitochondrial diseases. To prevent mitochondrial disease with donations, donor eggs are used to get a healthy environment for the genetic material of the parents.
- Mitochondrial disease
- Mitochondrial diseases belong to severe medical disorders that can be inherited, meaning that the transmission of mitochondrial DNA (mtDNA) from the mother to the child is quite likely. In the case of mitochondrial disease, genetic mutations take place and lead to the inability of mitochondria to derive energy from oxygen and food.

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- In other words, the risk of passing the disease from the mother to the child translates to the risk of the child's organelles being unable to perform mitochondrial functions. This causes cell damage and even death.
- The presence of mutated mtDNA in the body leads to illnesses and, therefore, poor quality of life. And in the case of severe mitochondrial disease, one may go through organ and system failures, eventually dying at a young age.
- One of the ways to treat mitochondrial diseases is with genetic research and the donation of biomaterials.



### Mitochondrial donation

- Mitochondrial donation is a type of assisted reproductive technology performed by a fertilization and embryology authority to prevent mitochondrial disease in the fetus. It is performed as a part of the in vitro fertilization (IVF) cycle. Most often, it is recommended to introduce mitochondrial DNA donation to couples where mothers have the disease and, therefore, pose a risk of passing them to the child.
- Mitochondrial donation techniques imply that a healthy woman donates an egg for the couple going through IVF to use for conception. The fertilization and embryology experts then perform a procedure of removing the mitochondrial DNA mutations from the egg that will be placed in the patient's uterus to prevent the transmission of the disease.

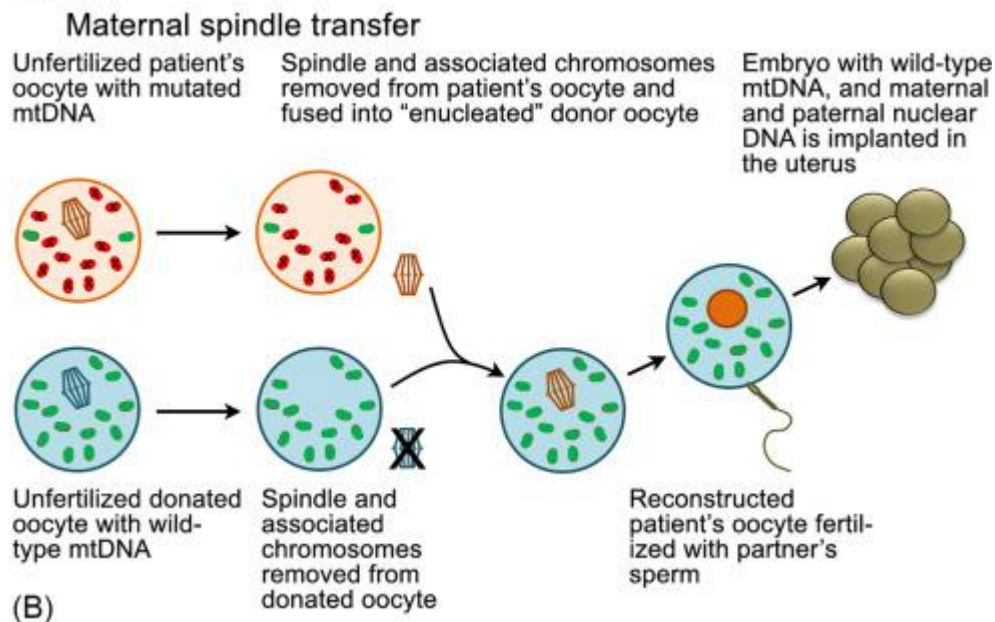
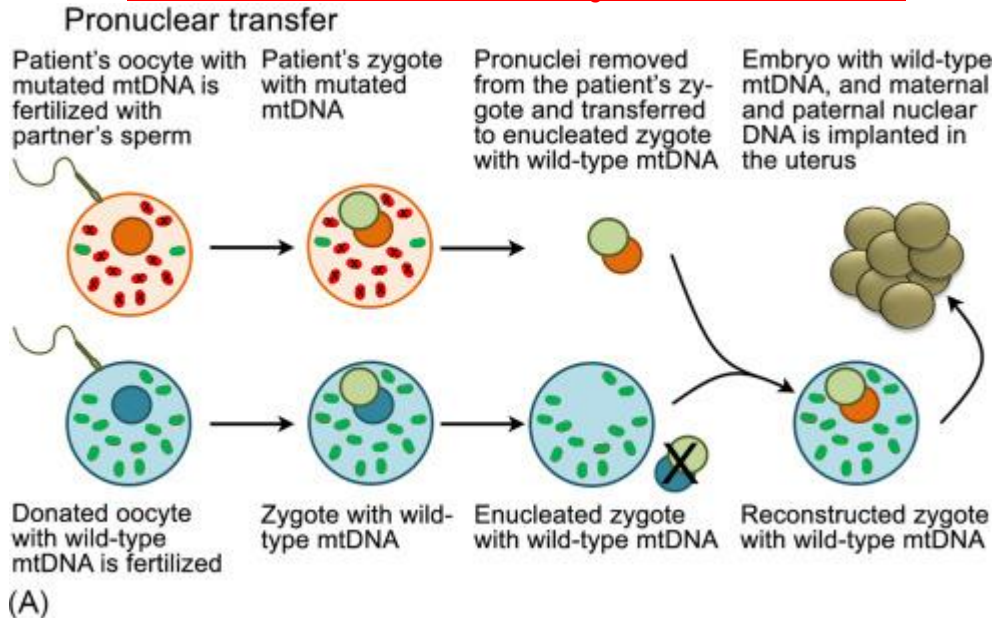
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- In such a way, the woman gets a healthy egg with unhealthy mitochondria removed and fertilized with mitochondrial genes from the donated egg. This is the method used to avoid mitochondrial disease transmission from the mother to the child with assisted reproductive technology.

#### Mitochondrial Replacement Techniques

- MRT is an in vitro fertilization (IVF) technique that involves removing an intended mother's nDNA from her oocyte or zygote, which contains mutated mtDNA, and transferring it into a female provider's oocyte or zygote, which contains nonpathogenic mtDNA and from which the nDNA has been removed.<sup>2</sup> The woman providing oocytes would have no personal or family history or genetic evidence of having mutated, pathogenic mtDNA. In this report, the term “MRT” encompasses both the transfer of the nuclear genetic material and the accompanying fertilization procedure that is necessary to produce a human embryo. These techniques could allow intended mothers to produce a child that would share their nDNA without passing on their pathogenic mtDNA. Three such techniques are most advanced in development: maternal spindle transfer (MST); pronuclear transfer (PNT); and, most recent, polar body transfer (PBT).

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### *A. Maternal Spindle Transfer (MST)*

In this technique, the nuclear chromosomes, which are grouped in a spindle formation, would be removed from both an oocyte provided by a woman with nonpathogenic mtDNA and the intended mother's oocyte. The intended mother's oocyte, containing mutated mtDNA, would be discarded. The intended mother's nuclear chromosomes would be inserted into the provided oocyte, which would contain nonpathogenic mtDNA. The oocyte would then be fertilized with the intended father's or another man's sperm. Following fertilization, the embryo would be grown in culture and subjected to diagnostic testing to ensure its quality and viability; the testing would include preimplantation genetic diagnosis (PGD) to confirm that the embryo had acceptably low or undetectable levels of the pathogenic mtDNA molecules. The resulting embryo(s) would be frozen until test results confirmed suitability for

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transfer and then transferred into the uterus of the intended mother (or gestational carrier, if needed).

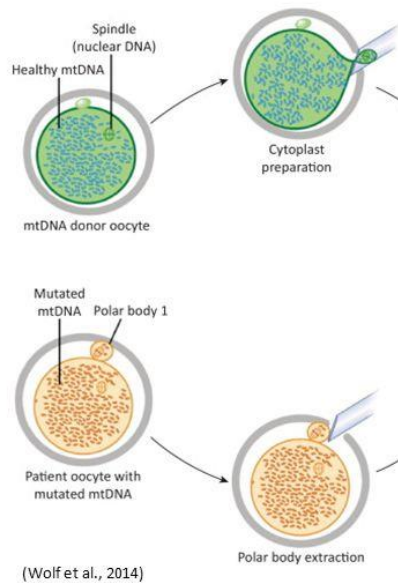
#### *B. Pronuclear Transfer (PNT)*

In this technique, both an oocyte provided by a woman with nonpathogenic mtDNA and the intended mother's oocyte would be fertilized with sperm in vitro, creating two zygotes. The maternal and paternal pronuclei, which contained the nDNA, would be removed from both zygotes. The intended mother's enucleated zygote, containing pathogenic mtDNA, would be discarded. The pronuclei from the intended mother's zygote would be inserted into the enucleated zygote created with the provided oocyte and the intended father's (or another man's) sperm, which would contain nonpathogenic mtDNA. The resulting embryo(s) would then be grown, tested, and transferred as detailed above for MST.

#### *C. Polar Body Transfer (PBT)*

There are two versions of PBT. In polar body 1 transfer (PB1T), the intended mother's first polar body, which is a by-product of oogenesis, containing her nDNA and very little mtDNA, would be transferred to an oocyte provided by a woman with nonpathogenic mtDNA from which the nDNA had been removed. The reconstructed oocyte would then be fertilized, grown, tested, and transferred as detailed above for MST. In polar body 2 transfer (PB2T), both the intended mother's oocyte and an oocyte provided by a woman with nonpathogenic mtDNA would be fertilized. The intended mother's second polar body, containing nDNA and very little mtDNA, would be transferred to the zygote of the woman who provided the oocyte, from which the pronuclei had been removed. The resulting embryo(s) would then be grown, tested, and transferred as detailed above for MST.

## Polar Body 1 Transfer (PB1T)



(Wolf et al., 2014)

1. The chromosome spindle is removed from the donor egg and discarded.
2. The 1<sup>st</sup> polar body is removed from the intending mother's egg and transferred to the enucleated donor egg; the intending mother's egg is discarded.
3. The reconstructed oocyte contains the intending mother's nuclear DNA and donor's mitochondrial DNA.
4. The reconstructed egg is fertilized with the intending father's sperm.
5. The embryo develops in vitro (PB2 extruded) and is transferred to the womb of the woman who will carry the child.

### *D. Germinal Vesicle Transfer (GVT)*

The germinal vesicle is the large nucleus present in immature (primary) oocytes. Primary oocytes remain arrested in prophase 1, with the nucleus as germinal vesicle within the ovary, for years until they are stimulated in successive menstrual cycles, after puberty. GVT consists in transplanting the germinal vesicle from a patient's primary oocyte to a donor oocyte in which the germinal vesicle has also been extracted. Since these are immature oocytes, the resulting transplanted oocyte will be subjected to a maturation process in vitro to complete the meiosis. After that, it will be fertilized and implanted.

### **Issues with mitochondrial donation**

- Since **mitochondrial research on donation** is relatively recent and continues, there are still some uncertainties associated with it. There 3 main areas of concern are ethical, social and legal.
- *Ethical issues*
- One of the ethical concerns regarding assisted reproductive technology methods to avoid mitochondrial disease transmission implies that mitochondrial replacement therapy involves working with human embryos. Since they are considered morally significant, the changes in the mutated mitochondrial DNA performed on the embryos are, therefore, a major concern in the debate.
- Another ethical issue related to the donation of mitochondrial

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material is that humans get involved in the natural processes. While the long-term goal is to improve national health, the fact that there's human interference and genetic modification makes it an ambiguous practice in terms of ethics.

### *Social issues*

- One of the biggest social issues related to introducing mitochondrial donation techniques is the effects it may have on humanity as a whole. Since the history of mitochondrial donation is not that long, the consequences of mitochondrial transfer on future generations are unknown in terms of people's physical health and relationships, as well as changes in their genetic material.
- Another concern is caused by the fact that a third person is involved in the process and implies the ambiguity of their role in the future family. The way things will stand will be uncertain if the child is eager to start a relationship with the person who participated in the donation of mitochondrial DNA.
- Lastly, one more social concern is that gene therapy is not accessible to everyone — only social groups that are economically forward can use it. The cost of the practice and access to medicine, in general, is a privilege that not all individuals have.

### *Legal issues*

- As for the legal issues that are associated with the prevention of mitochondrial diseases, these are also related to the use of human biomaterial and the involvement of the people who donate mitochondrial DNA. For example, the issue with using human eggs for donation implies that egg trade may occur, which poses a risk to the rights, freedom and safety of people.
- At the same time, the problem with involving a third person creates an ambiguous situation in terms of the right the person gains on the child and the child's right to reach out to the donor. Even if the donor agrees to have no interest in the child any time in the future, the issue of information retention comes up because the donor's data still needs to be kept for scientific and medical reasons.

### *Risks of mitochondrial donation*

- There are some risks that the methods of mitochondrial diseases

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transmission prevention pose. One of them is that there is no complete guarantee that it will help prevent the transmission of mitochondrial DNA disorders to the embryo. While the process requires extracting the mtDNA disease and placing it in the healthy egg, there are still chances that all unhealthy organelles are not eliminated from the embryo and enter the embryo.

- The reason is that some faulty organelles can still get stuck to the DNA in the course of the procedure, and there's nothing fertilization and embryology authority representatives can do about it. With this being said, there is no 100% guarantee that the procedure will prevent the mitochondrial disease from transmission to the fetus.
- Then, the extent of mitochondrial DNA diseases will affect the success of the procedure, too. If the unhealthy organelles are still there when an embryo is created, the way they will be balanced with the healthy ones is unpredictable. Sometimes the healthy DNA will prevail, but in some cases, the disease will still be present in the DNA after the procedure and keep the disease active and evolving. This may lead to the occurrence of severe mitochondrial disease in the fetus or even the next generation.
- Lastly, there is a chance of a mismatch between the mitochondrial donor's and mother's DNA. Depending on the origins of the mitochondrial donor and the mother, there may appear a mismatch of the mitochondrial genome haplotypes. While this does not mean that the mitochondrial replacement techniques will be ineffective, there are still potential risks of mitochondrial donation caused by the mismatch.

#### **Advantages of mitochondrial donation**

- While there are certain risks associated with **mitochondrial gene donation**, the **advantages of mitochondrial donation** remain strong. In general, it is one of the most effective methods to avoid mitochondrial diseases in children in case of the mtDNA disease presence in the mother. That's **why patients should have mitochondrial DNA donation** in case of being under threat of transmission.
- Because of the severe consequences of the disease on the person's health and quality of life, the ability of fertilization and embryology specialists to prevent mitochondrial diseases is a significant opportunity. In case of a successful procedure, it is possible to eliminate the present type of mitochondrial diseases in the family and improve national health in the



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long run.

**PYQs**

**1] In the context of hereditary diseases, consider the following statements: [2021]**

**1) Passing on mitochondrial diseases from parent to child can be prevented by mitochondrial replacement therapy either before or after in vitro fertilisation of the egg.**

**2) A child inherits mitochondrial diseases entirely from mother and not from father.**

**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] In the context of recent advances of human reproductive technology, “Pronuclear Transfer” is used for: [2020]**

- (a) Fertilization of egg in vitro by the donor sperm
- (b) Genetic modification of sperm producing cells
- (c) Development of stem cells into functional embryos
- (d) Prevention of mitochondrial diseases in offspring



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## **11. SATAT - PPP 100 - PRELIMS 2024**

### **1. SATAT Scheme (Sustainable Alternative Towards Affordable Transportation)**

- **SATAT Scheme:** The SATAT Scheme, which stands for Sustainable Alternative Towards Affordable Transportation, is an initiative led by the Government of India. Its primary objective is to establish Compressed Biogas production facilities and make this eco-friendly fuel available for automotive use. The government aims to achieve this by inviting expressions of interest from potential investors.

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- Launched in October 2018, the SATAT Scheme is a collaborative effort between the Ministry of Petroleum and Natural Gas and several oil-related public sector units, including Bharat Petroleum Corporation and Hindustan Petroleum Corporation.
- This scheme plays a crucial role in upholding India's commitment to reducing carbon emissions and fulfilling international agreements such as the Paris Agreement.
- **Compressed Biogas (CBG)**
- Compressed Biogas (CBG) is a sustainable and renewable fuel derived from the anaerobic decomposition of organic materials such as agricultural residues, food waste, animal dung, and sewage.
- The anaerobic digestion process involves the breakdown of these organic materials in an oxygen-free environment, resulting in the production of biogas as a byproduct.
- Biogas is primarily composed of methane (CH<sub>4</sub>) and carbon dioxide (CO<sub>2</sub>), with smaller quantities of other gases.
- Following the production of biogas, it can undergo further purification and compression to become Compressed Biogas (CBG), which shares similar properties and applications with Compressed Natural Gas (CNG).
- CBG serves as an alternative fuel suitable for a variety of applications, primarily as a cleaner and more environmentally friendly substitute for conventional fossil fuels.
- *Advantages of Compressed Biogas (CBG)*
- **Renewable Energy Source:** CBG is generated from organic waste materials, making it a sustainable energy source that reduces reliance on fossil fuels and supports the transition to more sustainable energy options.
- **Lower Greenhouse Gas Emissions:** CBG exhibits reduced greenhouse gas emissions compared to traditional fossil fuels like diesel and petrol. It is recognized as a cleaner-burning fuel, resulting in decreased carbon dioxide and other detrimental emissions.
- **Efficient Waste Management:** CBG production promotes efficient waste management by utilizing organic waste materials that might otherwise contribute to environmental pollution. It effectively converts waste into

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a valuable resource.

- **Improved Air Quality:** When used as a fuel, CBG produces fewer pollutants, leading to enhanced air quality and decreased emissions of particulate matter, which can harm human health.
- **Versatile Applications:** CBG can be employed as fuel in various applications, including transportation (buses, cars, trucks), industrial processes, and power generation.
- **Enhanced Energy Security:** By endorsing CBG usage, nations can diminish their dependence on imported fossil fuels, thereby bolstering energy security and curtailing foreign exchange expenditures.
- **Income Opportunities:** CBG production can create additional income avenues for farmers and agricultural communities. Organic waste materials can be repurposed for biogas generation, resulting in improved waste management and nutrient recycling.
- The adoption of Compressed Biogas (CBG) as an alternative fuel aligns with global endeavors to combat climate change, reduce environmental pollution, and promote sustainable development.
- *How is CBG different from Compressed Natural Gas(CNG)?*
- Chemically, CBG is the same as CNG — both are compressed methane — and have the same calorific value.
- But, CNG is a by-product of petroleum, and CBG can be produced from any biomass, be it crop residue, cattle dung, sugarcane press mud, municipal wet waste, or effluents from a sewage treatment plant.
- Hence, this makes CBG a commercially viable option as it can be directly used to replace CNG in transportation fuel. Just like CNG, CBG too can be transported through cylinders or pipelines to retail outlets.
- **Overview of the SATAT Scheme**
- The SATAT scheme is designed with the following key objectives in mind:
- **Utilizing Over 62 Million Metric Tonnes of Waste:** It seeks to harness the potential of more than 62 million metric tonnes of waste generated annually.
- **Reducing Dependence on Imported Fuel:** SATAT aims to reduce India's dependence on imported fuels.
- **Job Creation:** By promoting the alternative fuels industry, the scheme

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aims to create more job opportunities.

- **Cutting Carbon Emissions:** It contributes to the reduction of carbon emissions and pollutants caused by the burning of agriculture and organic waste.
- Biogas is naturally produced through the anaerobic decomposition of waste or other biomass sources. Compressed Biogas, a product of this process, shares similar properties with commercially available natural gas in terms of composition and energy potential. Therefore, it can serve as an alternative energy source for automobiles.
- Given India's abundant biomass resources, Compressed Biogas has the potential to replace natural gas in various industrial and commercial applications.
- **Benefits of the SATAT Scheme**
- The Sustainable Alternative Towards Affordable Transportation, facilitated by Compressed Biogas (CBG), offers several advantages, including:
  - **Responsible Waste Management:** Effective reduction of carbon emissions through responsible waste management.
  - **Additional Income for Farmers:** Creation of additional income streams for farmers by utilizing agricultural waste.
  - **Rural Entrepreneurship and Employment:** Promotion of rural entrepreneurship, economic growth, and employment opportunities.
  - **Supporting Climate Change Goals:** Contribution to national-level climate change mitigation efforts.
  - **Stability Amid Fuel Price Fluctuations:** Providing a buffer against fluctuations in crude oil and natural gas prices.
- **Implementation of SATAT**
- The primary implementation method of SATAT involves entrepreneurs proposing the establishment of Compressed Biogas plants. These plants will produce CBG, which will be transported in cylinders to fuel stations across the country.
- Entrepreneurs will have the opportunity to market other by-products generated by these plants, such as bio-manure and carbon dioxide, to enhance their returns on investment.
- The government has plans to establish approximately 5,000 CBG plants across the country in a phased manner, with the ultimate goal

## **EDITORIAL PAPER – Practice Questions & Answers**

of achieving this by 2025. These plants are expected to produce about 15 million tons of Compressed Biogas annually, generating employment for around 45,000 people.

### **2. Gabon's Debt-for-Nature Swap Initiative**

- In a significant move towards environmental conservation, the central African nation of Gabon has recently made headlines by launching a debt-for-nature swap initiative. This innovative approach has gained popularity in recent times, with Gabon following the footsteps of countries like Ecuador, which previously struck a massive deal of its own. Gabon is the fourth country to partner with TNC on a Blue Bonds project after Seychelles, Belize and Barbados.
- Under the debt-for-nature swap, Gabon has agreed to a deal with the Bank of America, the **US International Development Finance Corporation (USDFC) and The Nature Conservancy (TNC)**, to refinance \$500 million in national debt toward marine conservation efforts in the country. This is the fourth project under **TNC's "Blue Bonds for Ocean Conservation" strategy**.

#### **Understanding Debt-for-Nature Swaps**

- A debt-for-nature swap is a financial mechanism where creditors extend debt relief to developing countries in exchange for their commitment to take significant steps towards preserving the environment. These steps can include initiatives such as decarbonizing the economy, investing in climate-resilient infrastructure, or safeguarding biodiverse ecosystems like forests and reefs. The main goal is to channel the saved resources from debt relief towards conservation efforts.

#### **The Visionary behind Debt-for-Nature Swaps**

- The concept of debt-for-nature swaps was first conceived by the late "godfather of biodiversity," Thomas Lovejoy, in the 1980s. His visionary idea proposed a win-win situation for both countries and conservationists, ensuring that financing supports environmental preservation without compromising economic development.

#### **Boosting Gabon's Conservation Efforts**

- Gabon's decision to embrace a debt-for-nature swap comes as a

### **EDITORIAL PAPER – Practice Questions & Answers**

testament to its commitment to protecting its precious natural resources. Almost one-third of the world's endangered leatherback turtles find their habitat in the nation's beaches and coastal waters. By opting for a debt-for-nature swap, Gabon aims to secure a sustainable financial stream that will aid in the conservation of these vital ecosystems.

#### **The Role of Blue Bonds**

- As part of the debt-for-nature swap, Gabon will receive an eco-friendly blue bond in exchange for at least \$450 million of its government debt. These blue bonds are an innovative financial instrument that aligns with sustainable development objectives, making them an ideal fit for conservation-oriented initiatives.

#### **Learning from Ecuador's Success**

- Before Gabon, Ecuador set a remarkable precedent with the largest debt-for-nature swap deal to date, amounting to a staggering \$1.6 billion. This visionary deal has freed up substantial financial resources, around \$18 million annually for two decades, supporting the conservation efforts of the renowned Galapagos Islands.

#### **Impact and Future Prospects**

- Gabon's debt-for-nature swap has the potential to significantly enhance the nation's environmental resilience while fostering a more sustainable future. By freeing up fiscal resources through debt relief, the government can prioritize conservation projects without compromising on other development priorities.

#### **PYQs**

##### **1. In the context of alternative sources of energy, ethanol as a viable bio-fuel can be obtained from: [2009]**

- (a) Potato
- (b) Rice
- (c) Sugarcane
- (d) Wheat

#### **Explanation**

Ethanol is an alcohol-based fuel that is mostly produced by the fermentation of sugarcane juice and molasses. Because it is a clean, affordable and low-carbon biofuel, sugarcane ethanol has emerged as a leading renewable fuel for the transportation sector. The largest single use of ethanol is as an engine fuel and fuel additive.

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**2. According to India's National Policy on Biofuels, which of the following can be used as raw materials for the production of biofuels? [2020]**

1. Cassava
2. Damaged wheat grains
3. Groundnut seeds
4. Horse gram
5. Rotten potatoes
6. Sugar beet

Select the correct answer using the code given below:

- (a) 1, 2, 5 and 6 only
- (b) 1, 3, 4 and 6 only
- (c) 2, 3, 4 and 5 only
- (d) 1, 2, 3, 4, 5 and 6

**Explanation**

**National Policy on Biofuels 2018**

The Policy categorizes biofuels as "Basic Biofuels" viz. **First Generation (1G)** bioethanol & biodiesel and "**Advanced Biofuels**" -

Second Generation (2G) ethanol, Municipal Solid Waste (MSW) to drop-in fuels, **Third Generation (3G) biofuels**, bio-CNG, etc.

To enable the extension of appropriate financial and fiscal incentives under each category.

Under the **National Policy on Biofuels** 'bioethanol' is defined as **ethanol produced from biomass** such as sugar-containing materials, like sugar cane, **sugar beet**, sweet sorghum, etc.

Starch containing materials such as corn, **cassava, rotten potatoes**, algae, etc.

**Damaged food grains like wheat, broken rice**, etc. are **unfit for human consumption**.

And, cellulosic materials such as bagasse, wood waste, agricultural and forestry residues, or other renewable resources like industrial waste.

For Ethanol Production the following raw materials may be potentially used: B-Molasses, Sugarcane juice, biomass in form of grasses.

**For Biodiesel Production:** Non- edible Oilseeds, Used Cooking Oil (UCO), Animal tallow, Acid Oil, Algal feedstock, etc.

**For Advanced Biofuels:** Biomass, MSW, Industrial waste, Plastic waste, etc.



## 12.5GB1C & Inclusive Conservation Initiative (ICI) - PPP 100

### 1. Methylovimicrobium buryatense 5GB1C

The **bacterial strain Methylovimicrobium buryatense 5GB1C** consumes methane, a potent greenhouse gas.

**Methane is over 85 times more potent than carbon dioxide (CO<sub>2</sub>)** in terms of its global warming potential on a 20-year timescale.

It is responsible for nearly 30% of total global warming.

#### Reduction of Atmospheric Methane

Large-scale harnessing of this bacteria can prevent 240 million tonnes of methane from reaching the atmosphere by 2050.

The study suggests that the **global average temperature rise can be reduced by 0.21-0.22 degrees Celsius through methane removal.**

#### Methanotroph Selection

- Methane-eating bacteria (methanotrophs) are effective, but they grow optimally at methane concentrations around 5,000-10,000 ppm.
- Researchers screened methanotrophs to find strains that effectively consume low methane levels, around 500 ppm.
- Methylovimicrobium buryatense 5GB1C demonstrated the best performance at 500 ppm and even grew well at 200 ppm.
- Methanogens and methanotrophs are microbes that interact with methane, but in different ways. Methanogens are microorganisms that produce methane as a byproduct of their metabolism in anaerobic environments, while methanotrophs are microbes capable of consuming methane as their energy source in aerobic or oxygen-rich environments.
- The CO<sub>2</sub> cycle and the methane cycle are different processes within the global carbon cycle. The CO<sub>2</sub> cycle primarily involves the exchange of carbon dioxide (CO<sub>2</sub>) between living organisms, the atmosphere, and the oceans through processes like photosynthesis, respiration, and carbonate reactions. On the other hand, the methane cycle involves the production and consumption of methane (CH<sub>4</sub>) by various biological and

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geological processes, including methanogenesis, methanotrophy, and methane oxidation, among others.

### **Methanogens vs Methanotrophs**

Methanogens are microorganisms that are capable of generating methane from organic sources.

Methanogens are obligatory anaerobic (Methanogenesis takes place under anaerobic conditions).

Precursors of methanogenesis are hydrogen, carbon dioxide and C-1 compounds.

Methane is the end product of methanogenesis.

Methanogens are used in waste water purification plants in anaerobic digesters and sludge treatment systems, and in bio gas production plants.

Methanotrophs or Methanophiles are microorganisms which are capable of utilizing methane as a source of carbon and energy.

Methanotrophs are aerobic (Methane digestion takes place under aerobic conditions).

Methane is the precursor of methanotroph reactions.

Carbon dioxide and energy are produced during the methane utilization.

Methanotrophs are used in degrading methane based products and methane emissions in industrial reactions.

### **Biomass Production and Utilization**

- **The bacteria produce biomass after consuming methane**, which can be used as feed in aquaculture.
- For every tonne of methane consumed, the bacteria can generate 0.78 tonne biomass dry-weight methane, valued at \$1,600 per tonne.

### **Implementation Strategies**

- Proposed strategies include **designing biofilters containing nutrients for microorganism growth**.
- Genetic modifications can induce desired characteristics in the bacterial strain.

### **Impact and Feasibility**

- Preventing 240 million tonnes of methane emissions could significantly impact global warming.
- Challenges include controlling temperature, as bacterial growth requires specific temperature ranges.
- Economic feasibility and energy balance are crucial considerations when scaling the technology.

### **Future Directions**

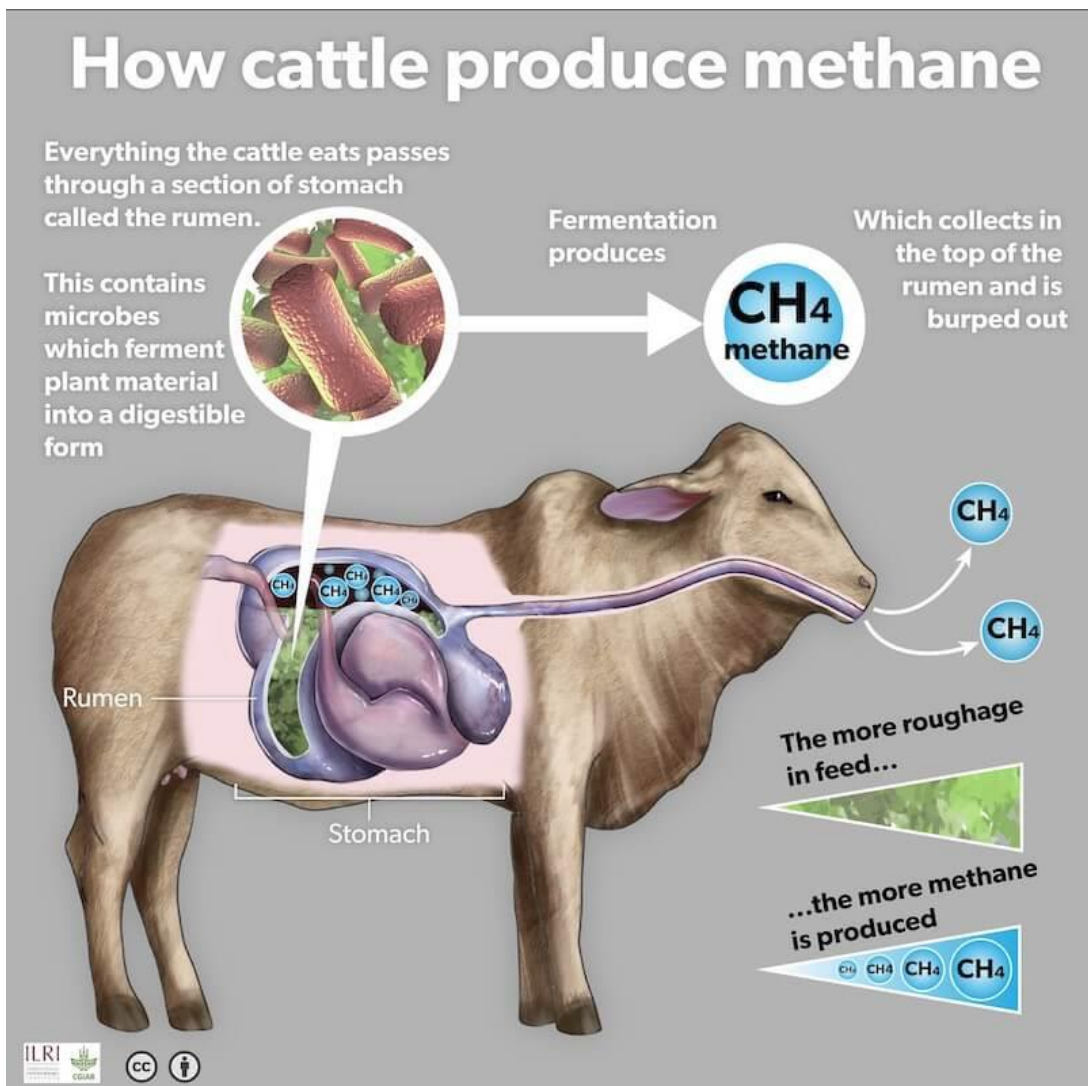
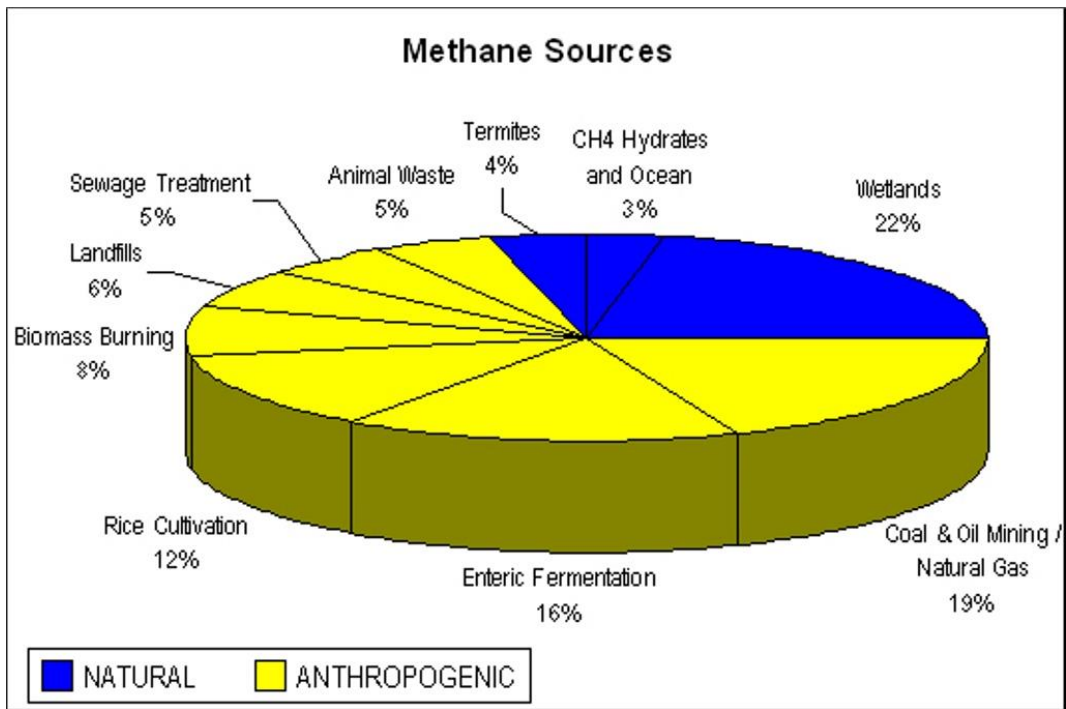
- Field studies are needed to test the technology's feasibility.
- Analyzing the environmental life cycle and techno-economics is necessary to

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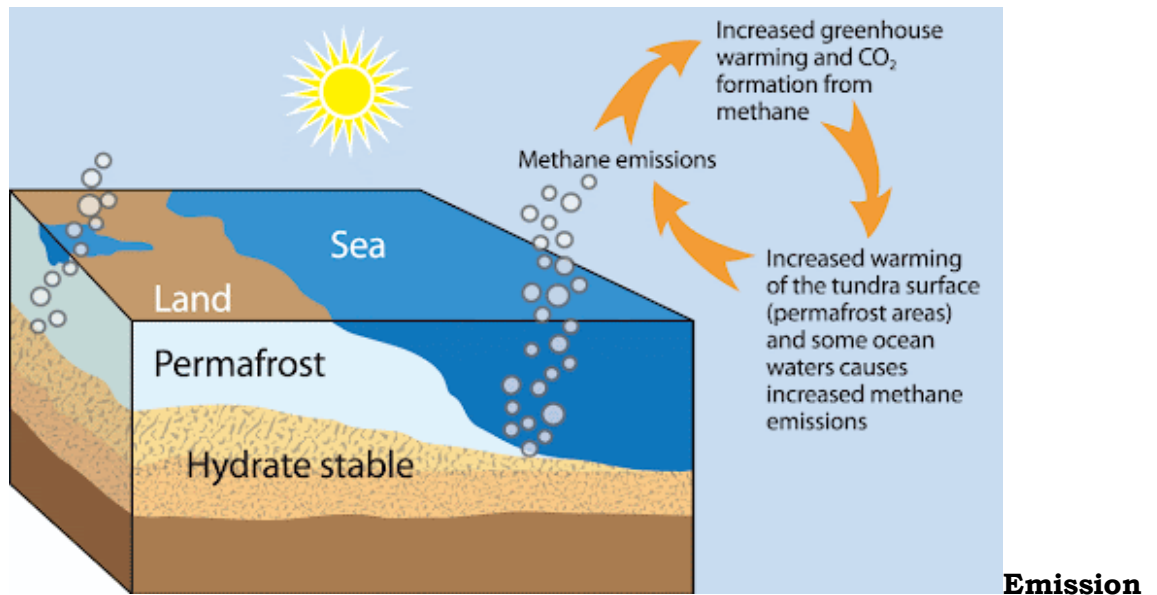
ensure economic viability and environmental benefits.

- **What is Methane?**
- Methane (CH<sub>4</sub>) is the **simplest hydrocarbon**, consisting of one carbon atom and four hydrogen atoms.
- It is a **colorless, odorless, and highly flammable gas**, and the **main component in natural gas**.
- It is an important greenhouse gas because it is such a **potent heat absorber**. The concentration of methane in the atmosphere has risen by about **150% since 1750, apparently largely due to anthropogenic activities**.
- Methane is the second most **abundant anthropogenic GHG after carbon dioxide (CO<sub>2</sub>)**, accounting for about 20 percent of global emissions.
- **Methane release in ruminants**
- Agriculture is the **largest single source of global anthropogenic methane (CH<sub>4</sub>) emissions**, with **ruminants the dominant contributor**.
- Unlike other animals, ruminants have specialized **digestive systems consisting** of stomachs that have **four compartments instead of one**.
- Plant material is initially taken to rumen, the largest compartment in the stomach that is inhabited by microorganisms such as fungi, bacteria, protozoa and archaea.
- These microorganisms break down the otherwise indigestible cellulose-rich plants to release protein and energy for their host animal in exchange for nutrition and shelter.
- But during this process, which scientists call **enteric fermentation**, one particular microbe, the **archaea**, combines CO<sub>2</sub> and hydrogen made by the **cellulose-digesting microbes to create methane**.
- **Other Sources of Methane**
- Agricultural methane doesn't only come from animals. **Paddy rice cultivation**—in which flooded fields prevent oxygen from penetrating the soil, creating ideal conditions for **methane-emitting bacteria** – **accounts for another 8 percent of human-linked emissions**.
- Methane is also emitted during the production and transport of coal, natural gas, and oil. Other agricultural practices, land use and the decay of organic waste in municipal solid waste landfills also contribute to methane emissions.

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- **by India**
- India is currently the world's fourth largest methane emitter after China, the United States and Russia.
- India has the world's largest cattle population and is the second largest rice producer, the agriculture sector emits five times as much methane as the energy sector.
- Agriculture accounts for 61% of total methane emissions, while India's energy sector accounts for 16.4% and waste 19.8%, as per the Global Methane Tracker 2022.
- **How does Methane Emissions affect the Environment?**
- Methane is the primary contributor to the formation of ground-level ozone, a hazardous air pollutant and greenhouse gas, exposure to which causes 1 million premature deaths every year.
- Over a 20-year period, methane is 80 times more potent at warming than carbon dioxide.
- Methane has accounted for roughly 30 percent of global warming since pre-industrial times and is proliferating faster than at any other time since record keeping began in the 1980s.
- **How much methane can we really cut?**
- CO<sub>2</sub> stays in the atmosphere for centuries, methane breaks down quickly and most is gone after a decade, meaning action can rapidly reduce the rate of global warming in the near-term.
- Human-caused methane emissions could be reduced by as much as 45 percent within the decade. This would avert nearly 0.3°C of global warming by 2045, helping to limit global temperature rise to 1.5°C and putting the planet on track to achieve the Paris Agreement targets.

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- Every year, the subsequent reduction in ground-level ozone would also prevent 260,000 premature deaths, 775,000 asthma-related hospital visits, 73 billion hours of lost labour from extreme heat and 25 million tonnes of crop losses.
- UNEP is at the front in support of the Paris Agreement goal of keeping the global temperature rise well below 2°C and aiming - to be safe - for 1.5°C, compared to pre-industrial levels. To do this, UNEP has developed a Six-Sector Solution roadmap to reducing emissions across sectors in line with the Paris Agreement commitments and in pursuit of climate stability. The six sectors are Energy; Industry; Agriculture and Food; Forests and Land Use; Transport, and Buildings and Cities.

### **Global Methane Pledge**

- The Global Methane Pledge was established during the UN COP26 climate meeting in Glasgow. Over 90 countries have signed the pledge, which is led by the United States and the European Union.
- The goal of this project is to reduce worldwide methane emissions.
- The Pledge seeks to catalyse global action and improve support for current international methane emission reduction programmes in order to develop technical and policy work that will serve as the foundation for Participants' domestic measures.
- Participants who sign the Pledge promise to take voluntary activities to contribute to a collaborative effort to cut global methane emissions by at least 30% from 2020 levels by 2030, potentially avoiding more than 0.2 degrees Celsius of warming by 2050.
- This is a worldwide aim, not a national one.
- How would the project be beneficial - If adopted globally, it would reduce global warming by 0.2 degrees Celsius by the 2040s as compared to expected temperature increases.
- The Earth is currently 1.2 degrees Celsius hotter than it was before the Industrial Revolution.
- India, the third-largest producer of methane emissions, is currently not a signatory.
- **Significance**
- The **Global Methane Pledge** aim has the potential to have a massive influence on climate change, akin to the whole global transportation industry adopting net zero emission technology.
- Action will be especially critical in the period leading up to 2030 since dramatic reductions in methane emissions can provide a net cooling impact in a very short period of time.

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- This might keep the door open to a 1.5 °C stability in global average temperatures as the world pursues long-term CO<sub>2</sub> reductions.
- The **Global Methane Pledge** has brought together several key international parties, including large consumers such as the European Union, Japan, and Korea, as well as big producers like Iraq and Saudi Arabia.
- For other nations, the **Global Methane Pledge** is the first substantial policy commitment on methane, either domestically or internationally.
- The Pledge also recognises and appreciates the critical contributions that the corporate sector, development banks, financial institutions, and philanthropy play in supporting the Pledge's implementation.
- ***Why is dealing with methane crucial for climate change?***
- Methane is the second-most prevalent greenhouse gas in the atmosphere after carbon dioxide, therefore efforts to reduce its emissions are crucial.
- According to the most recent **Intergovernmental Panel on Climate Change** study, methane is responsible for over half of the 1.0 degree Celsius net rise in global average temperature from the pre-industrial period.
- Rapidly lowering methane emissions is supplementary to action on carbon dioxide and other greenhouse gases, and is seen as the single most effective option for reducing global warming in the short term and keeping the goal of limiting warming to 1.5 degrees Celsius within reach.
- According to the **International Energy Agency (IEA)**, while methane has a significantly shorter atmospheric lifespan (12 years versus millennia for CO<sub>2</sub>), it is a lot more effective greenhouse gas simply because it absorbs more energy when in the atmosphere.
- The UN emphasises in its methane fact sheet that methane is a formidable pollutant with a global warming potential 80 times that of carbon dioxide, around 20 years after it is released into the atmosphere.
- Significantly, the average methane leak rate of 2.3% "erodes much of the climate advantage gas has over coal."
- According to the IEA, more than 75% of methane emissions may be reduced with current technology, and up to 40% of this can be accomplished at no additional cost.
- **India Refused to Sign The Methane Pledge**
- India refused to sign the "Global Methane Pledge," a proposal by the United States and the European Union to reduce global methane emissions by 30% by 2030 compared to 2020 levels.
- The administration recently explained in detail to Parliament why it declined to sign the methane promise.

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- **In India, methane emissions are survival emissions**
- Methane emissions are fundamentally survival emissions, not "luxury" emissions, as in the case of the West.
- In India, the two main sources of methane emissions are:
  - Enteric fermentation (methane from animal intestines)
  - rice agriculture (from standing water).
- These emissions are the product of agricultural operations carried out by small, marginal, and medium farmers across India, whose livelihoods are jeopardised by the aforementioned pledge.
- This can have an influence on agricultural productivity, particularly paddy yield, in addition to farmers' revenue. India is one of the world's major rice producers and exporters.
- In contrast, industrial agriculture dominates agriculture in wealthy countries.
- As a result, this pledge. has the potential to have an impact on India's trade and economic prospects.
- **Agriculture is not included in India's emission intensity target**
- According to India's pre-2020 voluntary pledges, agriculture is not included in the emission intensity objective.
- **Indian cattle contribute little to global methane emissions**
- Furthermore, India boasts the world's biggest cow population, which provides a living for a substantial portion of the people.
- Because Indian livestock consume huge amounts of agricultural byproducts and unusual feed material, their contribution to the world pool of enteric methane is quite modest.
- **Methane Pledge Outside of the UNFCCC and the Paris Agreement**
- While India is a signatory to the United Nations Framework Convention on Climate Change (UNFCCC) and the Paris Agreement, the government claims that the Methane Pledge falls beyond the scope of the UNFCCC and its Paris Agreement.
- **Indian Efforts to Reduce Methane Emissions**
- The Indian Council for Agricultural Research's (ICAR) National Innovations in Climate Resilient Agriculture (NICRA) initiative has created numerous technologies with the potential to reduce methane emissions.
- **System for Rice Intensification:** It has the ability to increase rice output by 36-49 percent while using about 22-35 percent less water than traditional transplanted rice.
- **Direct seeded rice:** It minimises methane emissions since it eliminates the



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need for nurseries, puddling, and transplanting. Unlike transplanted paddy farming, this approach does not retain standing water.

- **Crop Diversification Programme:** Methane emissions are reduced by shifting rice to other crops such as pulses, oilseeds, maize, cotton and agroforestry.
- **Seaweed-Based Animal Feed:** The Central Salt & Marine Chemical Research Institute (CSMCRI) created a seaweed-based animal feed additive formulation that seeks to minimise methane emissions from cattle.
- **Harit Dhara:** The Indian Council of Agricultural Research (ICAR) developed an anti-methanogenic feed additive called "Harit Dhara" (HD), which can reduce cow methane emissions by 17-20%.

### **2. Inclusive Conservation Initiative (ICI)**

- The International Day of the **World's Indigenous Peoples** is observed on **9 August** each year to raise **awareness and protect the rights** of the world's indigenous population.
- This event recognizes the **achievements and contributions** that indigenous people make to improve world issues such as environmental protection.
- ***Inclusive Conservation Initiative (ICI)***
- It aims to **support indigenous peoples** and local communities in their continuing efforts **to safeguard Earth's natural ecosystems**, recognizing their historical roles in nature conservation.
- It **works inclusively with IPs and LCs**, their regional and local organizations, governments, NGOs, civil society and others to strengthen the conservation of globally significant biodiversity and ecosystems.
- ***Key highlights of the report:***
- There are evidences on the potential of Indigenous Peoples and local communities in improving conservation, in total, donors have directed **less than 1% of climate change mitigation and adaptation funding** to IPs and LCs.
- The world seeks to realise the **rights and priorities of IPs and LCs**, significant scaling is needed.
- Indigenous Peoples own or manage an estimated **25% of the world's land surface**, including **40% of terrestrial protected areas** and 37% of ecologically intact landscapes.
- **Only 7%** of \$1.7 billion in pledged funding is **going directly to Indigenous groups**.
- IPs and LCs are severely **impacted by climate change and environmental degradation**.
- They have advocated for loss and damage funding but have had few opportunities

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to engage with decision-makers.

- Local efforts are the **central source of conservation funding**, in Latin America, for example, although national and local non-governmental organisations (NGO) implement 26% of disbursements, 41% of all funding are ascribed to Indigenous Peoples' organisations.
- **Suggestions:**
- The **leadership of Indigenous communities** is required to reach global goals on marine and landscape protection.
- The ICI **should encourage other funders and governments** to adopt more inclusive approaches.
- A **Global Biological Framework Fund (GBFF)** will be launched in the upcoming **7th Global Environment Facility (GEF) Assembly** in Vancouver, Canada.
- **Subsidiary Bodies 58 (SB 58) conference:**
- It was held in **Bonn, Germany**.
- Indigenous Peoples' groups from around the world, including India, called **for representation on the Transitional Committee (TC)** for the establishment of a **Loss and Damage Fund (LDF)**.
- The committee is composed of **24 members**.
  - **10 members** are from developed countries and **14 are from developing countries**.
- They want representation so that their **views on losses and damages** can be taken into account by the TC in the recommendations for the full operationalisation of LDF.
- **Indigenous-led Initiatives**
- Inclusive Conservation Initiatives (ICIs) represent a critical advancement for Indigenous Peoples (IPs) and Local Communities (LCs), aiming to preserve and enhance their stewardship over approximately 7.6 million hectares of landscapes and seascapes. These areas are rich in biodiversity and host irreplaceable ecosystems.
- ICIs are operational in nine geographical areas within 12 countries, working in conjunction with partners to oversee high-biodiversity lands traditionally governed by IPs and LCs. These lands may or may not have formal legal recognition.
- The territories governed by ICIs are diverse, encompassing large tracts of tropical forests, mountainous areas, temperate and boreal forests, drylands and grasslands, and marine and coastal ecosystems.
- ICIs acknowledge and continue the historical role of Indigenous Peoples and Local Communities in protecting natural ecosystems.

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- To bolster these efforts, ICIs are providing direct financial aid to 10 Indigenous and locally led initiatives in Africa, Central and South America, and Asia and the Pacific.
- ***Why Inclusive Conservation Matters?***
- Indigenous peoples are custodians of approximately 25% of the Earth's land surface, which encompasses 40% of terrestrial protected areas and 37% of ecologically intact landscapes.
- Indigenous peoples and local communities currently oversee more than one-third of the world's remaining irrecoverable carbon. This highlights their crucial role in managing this valuable resource.
- Research suggests a strong correlation between linguistic and biological diversity in biodiversity hotspots and high biodiversity wilderness areas.
- Lands and waters overseen by Indigenous Peoples and Local Communities help preserve biodiversity and aid in carbon sequestration.
- This stewardship also supports local livelihoods, sustains cultures, and protects valuable traditional knowledge. This knowledge is key for maintaining local ecosystems and contributing to global environmental benefits.
- A study was conducted in 14 countries rich in forests. The study found that areas inhabited by Indigenous Peoples and Local Communities have less deforestation and subsequently, lower carbon emissions.
- These areas have been recognized and protected by their governments. This protection plays a vital role in reducing deforestation and limiting the impacts of climate change.
- Research shows that Indigenous people's ways of managing land often reduce deforestation as much as, or more than, protected areas managed by the state.
- The Global Assessment by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) points out that Indigenous Peoples (IPs) and Local Communities (LCs) often have better local knowledge about biodiversity and environmental changes than scientists.
- This assessment also recognized the important contributions of men and women in IPs and LCs to biodiversity conservation at different levels.
- The latest report from the Intergovernmental Panel on Climate Change (IPCC) underlines that including groups like women and IPs and LCs improves decision-making about climate.
- Indigenous Peoples (IPs) and Local Communities (LCs) have knowledge and skills valuable for managing natural resources.
- IPs and LCs are facing increasing harassment and violence while trying to protect their lands and environments.

Decision-making processes at national, regional, and global levels often fail to

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incorporate the full participation of IPs and LCs. This exclusion leads to decisions and programs that do not consider IPs and LCs' perspectives or priorities, undermining their conservation capabilities.

- Funding to IPs and LCs is insufficient. Most project executions are done by globally accredited institutions, while projects led significantly by Indigenous peoples are a minority.
- The Inclusive Conservation Initiative (ICI) aims to inspire other funders and governments by demonstrating that traditional approaches can be modified to include IP and LC leadership, innovation, and governance.
- ICI offers both practical and global experience, supporting IPs and LCs in crafting and demonstrating an inclusive conservation model. This helps the world envision conservation in a new way.

#### ***Global Environment Facility (GEF)***

- The Global Environment Facility (GEF) is an international organization that was created in 1992, right before the Rio Earth Summit. Its purpose is to act as an environmental catalyst, making strategic investments with partners to address the most pressing environmental issues worldwide.
- The GEF stands out due to its unique partnership model encompassing 18 agencies. These consist of United Nations agencies, multilateral development banks, national entities, and international NGOs, working collectively with 183 countries.
- It has established a broad network with civil society organizations and maintains a close working relationship with the global private sector. In addition, it benefits from the ongoing insights of an independent evaluation office and a top-tier scientific panel.
- The GEF serves as a financial conduit for five key international environmental conventions: the ***Minamata Convention on Mercury***, the ***Stockholm Convention on Persistent Organic Pollutants (POPs)***, the ***United Nations Convention on Biological Diversity (UNCBD)***, the ***United Nations Convention to Combat Desertification (UNCCD)***, and the ***United Nations Framework Convention on Climate Change (UNFCCC)***.

### 13. Implementation of Citizenship Amendment Act (CAA) Rules

#### Citizenship (Amendment) Act (CAA), 2019

- The subject "citizenship" comes under the part-2 of the Indian Constitution.
- The part-2 of Indian Constitution extends between article 5 to 11.
- Indian Constitution gives single citizenship while America gives double citizenship to their countrymen.
- Citizenship shows the relationship between individual and state and Article-11 empowers Parliament to make any provision for the acquisition and termination of citizenship.
- Citizenship is inserted in the Union List under the Constitution and therefore it is under the control of Parliament.
- As Citizenship is on the Union List of the Seventh Schedule of the Constitution, it doesn't need any federal structure or states' approval at all.

**Article 25** guarantees the freedom of conscience, the freedom to profess, practice and propagate religion to all citizens.

The above-mentioned freedoms are subject to public order, health and morality.

This article also gives a provision that the State can make laws:

That regulates and restricts any financial, economic, political or other secular activity associated with any religious practice.

That provides for the social welfare and reform or opening up of Hindu religious institutions of a public character to all sections and classes of Hindus. **Under this provision, Hindus are construed as including the people professing the Sikh, Jaina or Buddhist religions and Hindu institutions shall also be construed accordingly.**

People of the Sikh faith wearing & carrying the kirpan shall be considered as included in the profession of the Sikh religion.

#### Key Features of the CAA, 2019

- **Eligibility:**
  - It amended the **Citizenship Act of 1955** to make illegal migrants who are **Hindus, Sikhs, Buddhists, Jains, Parsis and Christians** from **Afghanistan, Bangladesh and Pakistan**, eligible for Indian citizenship.
- **Who are illegal migrants?:** An illegal immigrant enters India without valid travel documents or stays beyond the permitted time, potentially

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facing prosecution, deportation, or imprisonment.

- Those from these communities who entered India on or before **December 31, 2014**, would not be treated as illegal immigrants, providing a path to **naturalisation**.
- However, it exempts the **Muslim** community.
- **Relaxation:**
  - The amendment relaxed the residency requirement **from 11 years to 6 years** for these communities to acquire Indian citizenship by naturalization.
  - It exempts members of these communities from prosecution under the **Foreigners Act of 1946 and the Passport Act of 1920**.
  - Applicants are exempt from being considered "illegal immigrants".
- **Exception:**
  - The amendments for illegal migrants will not apply to certain tribal (under Sixth Schedule) areas in **Assam, Meghalaya, Mizoram, and Tripura**, as well as states regulated by the "**Inner Line**" permit under the Bengal Eastern Frontier Regulations 1873.
- **Consequences of acquiring citizenship:** It states that acquiring citizenship will result in (i) such persons being deemed to be citizens of India from the date of their entry into India, and (ii) all legal proceedings against them in respect of their illegal migration or citizenship being closed.
- **Grounds for cancelling OCI registration:**
  - The 1955 Act allows the central government to cancel OCI registrations on various grounds, with the amendment adding a new ground for cancellation if the **OCI violates a government-notified law**.
- **Arguments in Support of CAA**
- Cross-border migration between India, Pakistan, Afghanistan, and Bangladesh has been a longstanding issue, especially for minorities. Before India's partition in 1947, millions from undivided India, representing various religious communities, resided in Pakistan and Bangladesh.
- However, the constitutions of these countries, with state religions, led to persecution and fear among minorities. Consequently, many sought

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refuge in India, even with expired or incomplete travel documents.

- The failure of the **Nehru-Liaquat pact**, aimed at protecting minorities' rights post-partition, paved the way for the Citizenship Amendment Act, which grants citizenship to persecuted religious minorities from these countries, addressing their plight.
- **Humanitarian grounds:** The CAA provides a life of dignity and rights to religious minorities facing persecution on grounds of their faith in the theocratic neighbouring states.
- **Civilizational ethos:** India has been a natural home for persecuted minorities, and the CAA is in line with the nation's civilizational ethos.
- **Reasonable classification:** It differentiates based on religion, but only to accommodate persecuted religious minorities, which is a reasonable restriction under Article 14.
- **National interest:** It will deter illegal immigration into India in the future from these specific communities. It will also act as a bulwark against infiltration from designated Muslim-majority nations.
- **Criticism on CAA, 2019**
- Critics argue that the law is discriminatory and conflicts with the secular values given in the **preamble**. They assert that citizenship shouldn't depend on faith, as it opposes the core principles of equality and non-discrimination in the Constitution. These principles ensure equal treatment under the law regardless of religious beliefs. Consequently, the CAA 2019 has faced criticism on multiple fronts:
- **Exclusionary nature:** The Act selectively includes six persecuted religious minorities from specific countries, causing arbitrary and unfair inclusion of **Ahmadiyyas and Hazaras in Pakistan and Afghanistan, Rohingyas in Myanmar, and Tamils in Sri Lanka**.
- **Violation of Article 14:** By differentiating on religious grounds for citizenship, the law violates the **fundamental right to equality** and constitutes anti-secular state action.
- **Date of entry criteria:** The differentiation between migrants who entered India before or after December 31, 2014, lacks rationale.
- **Excessive discretion to government:** The Act grants wide discretionary powers to the central government regarding the cancellation of OCI registration.
- **CAA Rules, 2024**
- Though with more than a 4-year delay, The Ministry of Home Affairs has notified the Citizenship Amendment Rules, 2024 that would enable

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the implementation of the Citizenship Amendment Act 2019. Key provisions are:

- **The process:** The rules require eligible refugees to submit applications with affidavits confirming statements, character vouchers from Indian citizens, and a declaration of familiarity with a scheduled Indian language for citizenship.
- **E-application to the district-level committee:** The rules mandate electronic application submission to a district-level committee for document verification and administration of the oath of allegiance. Failure to appear in person may lead to application rejection by the empowered committee after review by the district committee.
- **Supporting documents:** Applicants must submit a passport, birth certificate, identity documents, land records, or proof of ancestry from Pakistan, Afghanistan, or Bangladesh to support their citizenship application.
- **Verification of entry date:** Applicants must provide proof of entry before Dec 31, 2014, through the listed 20 documents like FRRO registration, Census slip, government IDs (Aadhaar, ration card, license), marriage certificate issued in India etc.
- **Digital certificate:** Approved applicants will receive a digital citizenship certificate.
- **Impact of CAA, 2019**
  - The CAA of 2019 has triggered various impacts and implications, sparking debates and concerns across India.
  - **Social polarisation:** It has ignited debates on religious lines due to its exclusionary nature, raising concerns about communal tensions and divisions within the social fabric of the country.
  - **Global censure:** Major global bodies and democracies have criticized the law as violating international conventions on human rights and statelessness. It also generated diplomatic reactions from neighbouring countries like Bangladesh and Pakistan.
  - **Violent protests:** The enactment of CAA resulted in widespread protests across the country. Largely peaceful protests against the CAA turned violent in areas of Delhi, resulting in casualties.
  - **CAA Vs Assam Accord:** The CAA's provisions granting citizenship to persecuted minorities have sparked fears of violating the **Assam Accord 1985**, which aimed to detect and deport illegal immigrants in Assam after **March 25, 1971**.
  - **Risk of discrimination:** Many poor Indian citizens, unlike many



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developed nations, do not have citizenship papers or residency proof. CAA coupled with NRC result in the poorest Indians losing or gaining temporary citizenships until they obtain the necessary documents.

- The **National Register of Citizens (NRC)** comprises individuals who can substantiate their arrival in the state before March 24, 1971, the day preceding Bangladesh's declaration of independence.
- **Disadvantage to native citizens:** The CAA granting citizenship to illegal migrants raises concerns among native citizens about potential demographic shifts impacting their employment and land ownership dynamics.
- **Federalism and State Responses:** The sharp opposition to CAA from multiple states further escalated the law into a major federalism issue amidst accusations of violating the constitutional scheme of power sharing.
  - For instance, West Bengal, and Tamil Nadu issued statements declining any implementation of the CAA within their jurisdictions on constitutional grounds.
- However, the **Supreme Court** is considering **petitions** challenging the constitutionality of the CAA, citing concerns over religious discrimination and immigration implementation challenges, with the main argument being that using religion as a criterion violates Article 14 of the Indian Constitution.

#### **States have no say in CAA**

- According to Article 246, states can legislate on subjects listed under the 'State List', while the Centre can enact legislation on matters under the 'Union List'. However, on matters in the 'Concurrent List', both states and the Centre can legislate.
- Citizenship, falling under the 'Union List', allows the Centre to enact laws on it. Moreover, Article 11 of the Indian Constitution explicitly grants the power to make laws on citizenship to the Centre.
- Additionally, the CAA Rules, 2024 ensure that committees at the district and state/UT level, responsible for verifying documentation and deciding on citizenship, are predominantly composed of central government officers, with minimal representation from the state/UT concerned.
- Dominance of Central Government Officers- Each committee's quorum is two, including the Chair, allowing them to verify applications and decide on citizenship without mandatorily involving the states. The EC is chaired by the director (census operations) of the state/UT concerned, while the DLC operates under the senior superintendent or superintendent of posts. The director (census operations) reports to the office of the census commissioner and

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Registrar General of India, under the purview of the home ministry. All members of the EC and DLC, except one invitee from the state/UT government, are central government officers.

- The CAA rules, by design, leave no room for states to independently process and decide citizenship pleas, reinforcing a centralized approach to citizenship matters in India.
- The Indian Constitution mandates that states comply with directions given in the exercise of the Union’s executive power. Article 365 states, “Where any State has failed to comply with or to give effect to any directions given in the exercise of the executive power of the Union under any of the provisions of this Constitution, it shall be lawful for the President to hold that a situation has arisen in which the Government of the State cannot be carried on in accordance with the provisions of this Constitution.”
- Given all these constitutional provisions, it is nearly impossible for states to deny the implementation of the CAA, except by challenging the law in court.

### ▪ Constitutionality Check

- The challenge may rest primarily on the grounds that the law violates Article 14 of the Constitution that guarantees that no person shall be denied the right to equality before law or the equal protection of law in the territory of India.
- The Supreme Court has developed a Two-Pronged Test to examine a law on the grounds of Article 14.
  - First, any differentiation between groups of persons must be founded on “intelligible differentia”
  - Second, differentia must have a rational nexus to the object sought to be achieved by the Act
- Simply put, for a law to satisfy the conditions under Article 14, it has to first create a “reasonable class” of subjects that it seeks to govern under the law.
- Even if the classification is reasonable, any person who falls in that category has to be treated alike.

### ▪ Impact on Assam and Assam Accord

- *Intersection with Section 6A*: The CAA intersects with Section 6A of The Citizenship Act, 1955, which determines citizenship criteria in Assam.
- *Assam Accord*: Section 6A, linked to the Assam Accord, sets criteria for determining citizenship in Assam, posing potential conflicts with the CAA’s provisions.
- *Base Cut-off Date and Regularization*: The Assam Accord establishes a base cut-off date for identifying and regularizing foreigners in Assam, impacting the implementation of the CAA in the state.

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- Way forward
- India is a constitutional democracy with a basic structure that assures a secure and spacious home for all Indians. Now, when the government has notified the rules and with challenge to the constitutionality of CAA pending in the SC, the following should be the way ahead:
- **Allay the fears of Muslim Community**-The government must allay the fears of a nationwide NRC among the Muslim community, which they feel can deprive them of their citizenship rights in case of failure to provide the requisite documents.
- **SC Verdict on Constitutionality of the Act**-The SC must provide its verdict on the petitions challenging the Act as done in the recent contentious cases of Electoral Bonds and Art 370.
- **Assurance to international community and neighbouring countries**-Government should assure its neighbours about the effective implementation and no discrimination against Muslims regarding CAA provisions.
- **Inclusion of other persecuted minorities**-Other persecuted minorities like Tamil Hindus in Sri Lanka, the Rohingya in Myanmar, or minority Muslim sects like Ahmadiyyas and Hazaras in Pakistan, Afghanistan should be gradually included in the Act.
- **Federal Cooperation**-The central government must assuage the fears of the North-eastern states like Assam regarding the impact of CAA on their cultural and ethnic identity.

#### 14. CLONING - PPP 100 - 11

- Cloning simply means creating **exact replicas or copies**. Cloning in biotechnology refers to the process of creating identical copies of either DNA fragments, cells or organisms. The organism which has the identical genetic make-up and the morphological attributes of the source organism is called a **clone**, while the process is called **cloning**.
- **Types of Cloning**
- Based on the origin of the process, we can have two main types of cloning, i.e. natural cloning and artificial cloning:
- **Natural Cloning:** Reproduction through asexual and vegetative means result in the development of clones, and thus are examples of natural cloning methods.
  - a. Plants generally produce clones by vegetative means, while some lower organisms and bacteria reproduce asexually to produce clones.
  - b. Few examples of asexual reproductive methods are fission, budding, reproduction by asexual spores, fragmentation, etc.
  - c. Few examples of vegetative reproductive methods are reproduction by rhizomes, runner, corms, bulbs, tubers, offset, stolon, etc.
  - d. In all these methods/ways, the new organisms (offsprings) formed are the clones of the parent.
- **Artificial Cloning:** Artificial cloning primarily refers to the biotechnological process of creating clones of either DNA fragments or genes or cells or organisms for various purposes. Various techniques have been developed and used based on the entity to be cloned.
- **Types of Natural Cloning**
- **Reproductive Cloning in Horticulture:** Cloning of an entire organism is known as **reproductive cloning**.
  - a. In plants, this happens naturally by vegetative methods.
  - b. Grapevine propagation by cuttings is an age-old example of organism cloning in horticulture.
  - c. Apomixis is another natural way of creating genetically identical organisms.
  - d. Apomixis is defined as reproduction without fertilization.

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e. Replacement of seeds by plantlets and replacement of flowers by bulbils are considered types of apomixis.

f. Some vascular plants like dandelions and some grasses form seeds asexually by apomixis and form clonal populations which are genetically identical to the parent plant.

- **Organism Cloning by Parthenogenesis:** Natural organism cloning exists in nature in some animals which reproduce by parthenogenesis.

a. Parthenogenesis is the development of an organism without fertilization of gametes.

b. Such organisms that develop through parthenogenesis are genetically identical to the mother.

c. Few examples of animals where reproduction by parthenogenesis takes place are insects like honeybees, wasps, some crustacean species, nematodes, and lizards (komodo dragon).

- **Cellular Cloning:** Creating a population of cells from a single-parent cell is referred to as cellular cloning.

a. Unicellular organisms like bacteria and yeast exhibit the simplest form of cellular cloning, and in this case, just a single-cell inoculation is required into the nutrient medium.

- **Types of Artificial Cloning**

- **Molecular Cloning: It is also referred to as gene cloning or DNA cloning.**

a. The branch of biology that deals with such molecular cloning is called **genetic engineering** or **recombinant DNA (rDNA) technology**.

b. A fragment of DNA or gene is replicated into a number of identical copies.

c. DNA fragments containing whole genes or part of genes or other regulatory elements such as promoters are amplified.

d. The cloned products are used in genetic engineering, from sequencing the fragments to protein production.

e. There are two approaches to perform molecular cloning.

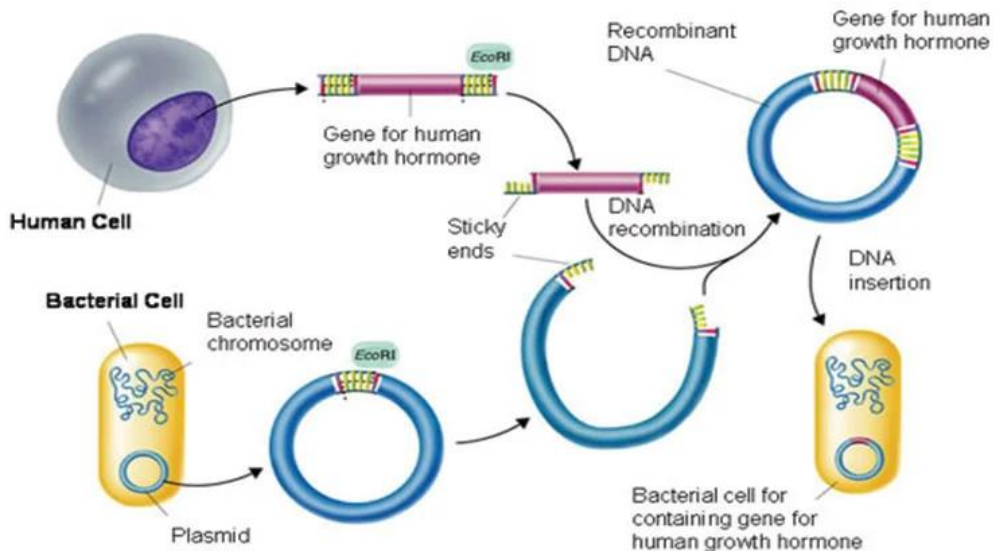
f. One approach uses live organisms like bacteria and plasmids. DNA fragments are inserted into natural or artificial cloning vectors, and then these vectors are replicated in host organisms like bacteria, animal or plant

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cells.

g. Another approach of amplifying the DNA fragments is more techno-chemical and does not need living organisms.

h. The **polymerase chain reaction (PCR)** is the most common technique used for molecular cloning, and it relies on the thermal cycling of DNA fragments and enzyme driven DNA replication.



**Recombinant DNA technology (RDT)**, often referred to as **Genetic Engineering**, is an in-vitro (lab) method of manipulating genes (DNA fragments) by using a set of tools and techniques. The primary aim of RDT is to produce “Transgene (recombinant DNA) and its product (recombinant protein), to be applied across different fields of biotechnology.

The RDT is a continuously evolving technology due to the advancement in its tools and techniques, such as the discovery of the CRISPR-Cas9 gene editing tool.

**Tools of Recombinant DNA Technology**

The following are the tools employed in the process involved in Recombinant DNA Technology:

<b>Tools</b>	<b>Utility</b>	<b>Examples</b>
<b>Vector</b>	They are used as <b>carriers</b> to introduce foreign DNA into a host cell	- <b>Plasmids</b> (for example, pBR322, Ti Plasmid), - <b>YAC</b> (Yeast Artificial Chromosomes), - <b>BAC</b> (Bacterial Artificial Chromosomes), - Viruses (Phages), etc.
<b>Restriction Enzymes</b>	It recognises specific DNA sequences and cleaves the DNA at the precise location	- EcoRI, HindIII, BamHI, etc - <b>CRISPR Cas9</b> ( used primarily nowadays) - <b>Zinc-Finger Nuclease (ZFN)</b>
<b>DNA Ligase</b>	It joins together DNA fragments	- T4 DNA Ligase
<b>Selectable markers</b>	To distinguish transformed cells from non-transformed ones	- Antibiotic resistance genes, herbicide resistance genes, etc

**Process involved in Recombinant DNA Technology**

- Recombinant DNA technology undergoes through the following steps:
- **Isolation of Genetic Material:** The extraction of genetic material is performed from the source organism's DNA, such as bacteria, plants, or animals.
- **Selection of a Suitable Cloning Vector:** Vectors are carrier molecules used to introduce rDNA into a host organism.
  - **Plasmids**, which are small, circular DNA molecules, are commonly used vectors. They can replicate independently within a host cell, allowing for the propagation of the foreign DNA.
  - The vectors can also be **non-self replicating** (for example, viral

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vectors).

- **Cutting of DNA at Specific Locations:** It uses the specialized enzymes known as **restriction endonucleases (RE)** or **restriction enzymes**, which recognize specific DNA sequences (recognition sites) and cleave the DNA at those precise locations.
  - The RE cuts the **target DNA as well as Plasmid**, producing "sticky ends" that are complementary to each other.
- **Joining of DNA Fragments by Ligation:**
  - The isolated DNA fragments are combined with a vector, which is typically a plasmid or a viral genome modified to accept foreign DNA.
  - DNA ligase is used to catalyze the formation of phosphodiester bonds, effectively sealing the gaps and fusing the DNA fragments with the vector.
  - Now the rDNA is ready for gene transfer (for in-vivo gene cloning) or for the PCR.
- **Gene Transfer:** There are several methods which are employed in the process of Gene Transfer- physical, chemical, and biological. RDT uses the biological means of gene transfer.
  - **Physical methods:** **Gene gun** or **Biolistics**, **Electroporation**, **Microinjection**, etc., which make the direct entry of the rDNA into the host's cell.
  - **Chemical methods:** Using **Lipofection**, **calcium phosphate**, etc. make it easier for the rDNA to enter into the host's cell.
  - **Biological methods:** This is an indirect method of gene transfer, using vectors (for example, bacteria) as a means.
- **Gene Cloning:** Once inside the host, the rDNA replicates itself independently (due to self-replicating **plasmid**). This is called Gene Cloning. It can also be done using the PCR method for amplifying a gene of interest.
- **Polymerase Chain Reaction (PCR):** PCR is a tool that allows for the amplification of the target DNA sequences outside the cell. It needs much less time than the traditional cloning methods.
- **Selection and Screening of Transformed Cells:** This step involves identifying and isolating cells that have successfully taken up the **recombinant DNA**.
  - **Selectable markers**, such as **antibiotic resistance genes** carried by the vector, are often used to distinguish transformed cells from non-transformed ones.
- **Validation of Recombinant DNA Integration:** To ensure that the



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recombinant DNA has integrated into the host genome as intended, various techniques may be employed.

- For example, **nucleic acid hybridization, blue-white screening**, etc.
- **Applications of Recombinant DNA Technology**
- Recombinant DNA Technology stands as a cornerstone of modern science with far-reaching applications across numerous fields.
- **Advancement in Medicine:**
  - It enables the production of vital **biopharmaceuticals**, particularly **therapeutic proteins** like **insulin**, growth hormone, and clotting factors.
  - **Customized Therapeutics** enables the production of personalised medicines tailored to an individual's genetic makeup, leading to more effective and targeted treatments.
- **Gene Therapy:**
  - It offers the potential to treat genetic disorders by replacing or repairing **faulty genes**.
  - It is helpful in treating a wide range of diseases, like **cystic fibrosis, muscular dystrophy**, and certain types of **cancer**.
- **Recombinant Vaccines:** RDT can be used to develop **vaccines** for a variety of diseases, using vectors like bacteria, yeasts, viruses (phage), etc.
- **Immunotherapy:** RDT contributes to the development of **immunotherapies** for example, **T-cell therapy**, which harnesses the body's own immune system to target and **destroy cancer cells**.
- **Agricultural Advancements:**
  - It is used to cultivate **Genetically modified (GM) crops** that have transformed agriculture. Example: **BT cotton**.
  - These crops possess traits like **pest resistance, drought tolerance**, and improved **nutritional content**.
- **Bioremediation and Environmental Protection:**
  - Environmental biotechnology indicates that **Genetically-modified** microbes such as bacteria, yeast and filamentous fungi can **remove heavy metals** from aqueous solutions.
  - For example, **Escherichia coli strain JM109** has the ability to **remove mercury** from contaminated water or soil.
- **Targeted Drug Delivery:**
  - It enables the design and production of drug-delivery systems that can precisely target specific tissues or cells within the body.
  - This increases the effectiveness of treatments while minimizing side

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effects.

- **Molecular diagnosis (RDT plus PCR):**
  - It plays a critical role in diagnostic techniques, allowing for the detection of specific DNA sequences associated with diseases or pathogens.
  - It is helpful in early detection and monitoring of various conditions.
- **Industrial Applications:**
  - It is used in the production of recombinant enzymes to produce **sugar, cheese**, biofuels, important chemicals, etc.

### **2. Reproductive Cloning**

- a. When the whole organism is cloned, it is referred to as **reproductive cloning**.
- b. An identical copy or clone of an entire multicellular organism is made in this process.
- c. Breakthrough in reproductive cloning came when Dolly was cloned using a technique called **somatic cell nuclear transfer (SCNT)**.
- d. To explain this technique briefly, the nucleus from a somatic cell of an adult donor is removed and inserted into an enucleated (whose nucleus has been removed) egg cell or early blastocyst cell.
- e. Once the nucleus is inside the egg cell or blastocyst cell, the cell is stimulated with mild electric current for division.
- f. As the cell divides, it develops into an embryo. This cloned embryo is a genetically identical copy of the original organism.
- g. Reproductive cloning has been successfully performed in a number of species.
- h. Few examples of organisms where reproductive cloning is successful are tadpole, zebrafish, pig, cat, rat, mice, mule, horse, dog, Pashmina goat, macaque monkey, etc.

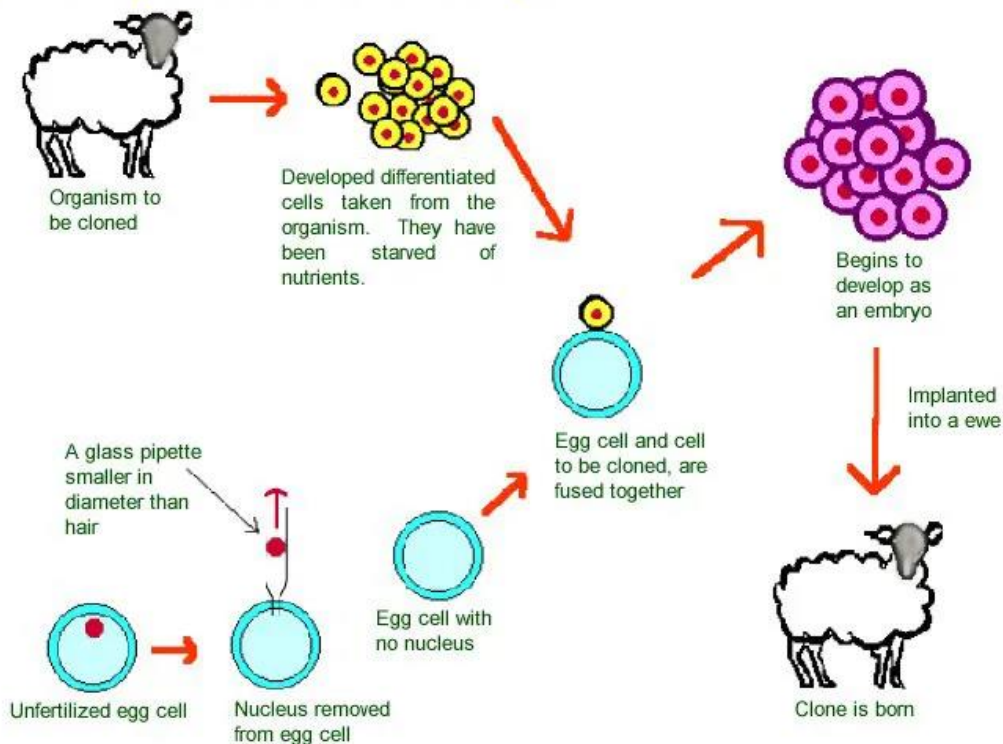
- Early experiments on reproductive cloning began some 40 years ago through a process known as embryo splitting. In this procedure, a single two-celled stage embryo was split manually into two cells, and then each cell was grown as an identical embryo. In 1924, Hans Spemann and his student Hilde Mangold performed some experiments of somatic cell nucleus transfer (SCNT) in amphibian embryos. This was considered the first step towards animal cloning.
- In 1996, Ian Wilmut and his team announced the successful cloning of a sheep, Dolly. This was a major breakthrough. Dolly was cloned using the same technique of somatic cell nuclear transfer (SCNT). The cloning of Dolly

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was significant because she was the first mammal to be cloned successfully using an adult somatic cell. The birth of Dolly was also significant because it demonstrated that a nucleus could be dedifferentiated and redesigned to develop into a new organism.

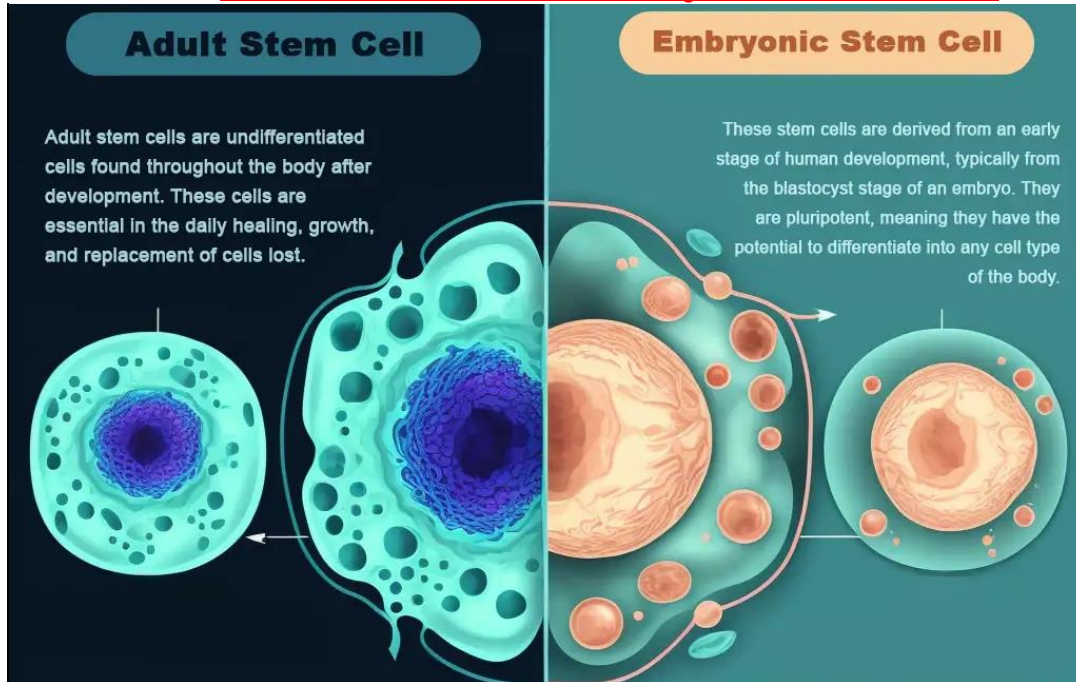
- Ian Wilmut developed the cloning technique (SCNT) and successfully cloned the first mammal, a sheep named Dolly.
- Scottish Blackface sheep was the egg cell donor, and 6 -year-old Finn-Dorset sheep was the nuclear cell donor.
- Scottish Blackface sheep was the surrogate mother for the cloned embryo.
- Dolly was born on 5th July 1996 at Roslin Institute in Scotland.

### Cloning Process of Dolly



#### ▪ **Therapeutic Cloning**

- a. Cloned embryos are used to get stem cells from them for research and therapeutic usage.
- b. Stem cells can be dedifferentiated into more than 200 types of cells.
- c. Cloned stem cells are genetically identical to the patient and hence can be grafted in the patient's body without risk of rejection by the immune system.
- d. Embryos are not implanted into the uterus.
- e. Examples of diseases treated with cloned stem cells are Alzheimer's disease, Parkinson's disease, diabetes mellitus, spinal injury, etc.
- f. Cloned stem cells are also used to study normal or abnormal embryo development and to know if drugs are toxic or cause any birth defects.



### **Stem Cell Therapy:**

Stem cell therapy is a **form of regenerative medicine** designed to repair damaged cells within the body by reducing inflammation and modulating the immune system.

This phenomenon makes stem cell therapy a viable treatment option for various medical conditions.

It can be used to treat a variety of medical conditions, such as **autoimmune, inflammatory, and neurological disorders.**

### **Stem cells**

- Stem cells are cells from which all other cells, with their respective specialised functions, are generated.
- The human body, under certain conditions, “divides” stem cells to either create new stem cells or cells with specific functions, such as blood cells, brain cells, bone cells, muscle cells, etc.
- **Sources of Stem cells:**
- **Embryonic Stem Cells (ESCs):** These are derived from early-stage embryos and have the potential to become any cell type in the body.
  - However, their use is ethically controversial and strictly regulated in many countries.
- **Adult Stem Cells:** These are found in specific tissues and organs throughout the body and play a role in tissue maintenance and repair.
  - **For Example:** It includes hematopoietic stem cells (found in bone marrow) and mesenchymal stem cells (found in various tissues like bone, fat, and dental pulp).

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- **Induced Pluripotent Stem Cells (iPSCs):** These are adult cells that have been reprogrammed to behave like embryonic stem cells.

They can be generated from a patient's own cells, reducing the risk of rejection.

### **Applications of Stem Cell Therapy:**

- **Regenerative Medicine:** Repairing or replacing damaged tissues and organs, such as heart muscle, cartilage, or nerve cells.
- **Treatment of Chronic Diseases:** Exploring potential treatments for conditions like diabetes, Parkinson's disease, Alzheimer's disease, and spinal cord injuries.
- **Immune Disorders:** Modifying or enhancing the immune system to fight cancer or autoimmune diseases.
- **Orthopedics:** Treating orthopedic injuries and conditions like osteoarthritis.
- **Cosmetic Procedures:** Using stem cells for procedures like facial rejuvenation.
- **Menstrual Blood Stem Cells**
  - Menstrual blood-derived stem cells (MenSCs), known as **endometrial stromal mesenchymal stem cells**, possess multipotent properties, meaning they can differentiate into various tissue types such as **fat cells, bone cells, and smooth muscle cells.**
  - MenSCs are an ethical source of adult stem cells that can be collected painlessly from women.
    - MenSCs can be collected through a **menstrual cup**, providing a less **invasive alternative** to surgical biopsies.
  - MenSCs can be obtained from women's menstrual blood derived from the **endometrium**(lines the inside of the uterus).
- **Role in Women's Health:**
  - **Regenerative Potential:**
    - MenSCs exhibit multipotent characteristics. This means they can differentiate into various cell types, including neurons, cartilage, fat, bone, heart, liver, and skin cells.

### **Treating Endometriosis:**

- MenSCs offer potential avenues for treating gynaecological disorders such as endometriosis and infertility.
- **Endometriosis** is a disease in which tissue similar to the lining of the uterus (endometrium) **grows outside the uterus.** It can cause severe pain in the pelvis and make it **harder to get pregnant.**
- Endometriosis can start at a person's first menstrual period and last until

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menopause (end of menstrual cycles).

- Common symptoms of endometriosis include **pelvic pain**, especially during menstruation, painful intercourse, infertility, heavy menstrual bleeding, and gastrointestinal issues such as diarrhoea or constipation.
- The cause and ways to prevent endometriosis are unknown. There is no cure, but its symptoms can be treated with **medicines or, in some cases, surgery**.
- The contributing factor to endometriosis is the backflow of menstrual blood into a woman's fallopian tubes.
- This backward flow carries blood into the **pelvic cavity**, a funnel-shaped space between the bones of the pelvis.
- Endometrial stem cells deposited in these areas may prompt the **growth of endometrial-like tissue** outside the uterus, resulting in **painful lesions, scarring, and often infertility**.

### **Broader Therapeutic Applications:**

- Menstrual stem cells have potential therapeutic applications beyond gynaecological diseases.
- Injecting menstrual stem cells into **diabetic mice stimulated** the regeneration of **insulin-producing cells** and improved blood sugar levels.
- Treating injuries with stem cells or their secretions helped heal wounds in mice.
- Menstrual stem cells can be transplanted into humans without adverse side effects.

### **Challenges:**

- Despite the convenience of collecting menstrual stem cells, research in this area represents a tiny fraction of overall stem cell research.
- As of 2020, **menstrual stem cell research** accounted for only **25% of all mesenchymal cell research**, while bone marrow stem cells represented 47.7%.
- Ensuring **consistent and scalable production of MenSCs** for clinical applications remains a challenge.
- Cultural taboos and limited investment in women's health research pose significant challenges in securing funding for menstrual stem cell studies.
- Addressing **gender bias in research funding is crucial to elevate menstrual stem cell research** as a promising frontier in regenerative medicine, beyond its association with menstruation.

## 15. NCAP- PPP 100 - 12

### 1. National Clean Air Programme (NCAP)

- National Clean Air Programme (NCAP), launched in 2019, is India's flagship program for better air quality. It was launched as a long-term, time-bound, national level strategy to tackle the air pollution problem across the country in a comprehensive manner.
- Goal: 20% to 30% reduction in Particulate Matter concentrations by 2024 keeping 2017 as the base year.
- Under NCAP, 132 non-attainment cities have been identified across the country based on the Air Quality data from 2014-2018.
- Non-attainment cities are those that have fallen short of the National Ambient Air Quality Standards (NAAQS) for over five years.
- Nodal Ministry: Ministry of Environment, Forest and Climate Change
- **Features**
- **Objective** - The overall objective of the programme includes comprehensive mitigation actions for prevention, control and abatement of air pollution.
- It also aims to augment the air quality monitoring network across the country and strengthen the awareness and capacity building activities.
- Also, city-specific action plans are being formulated for 102 non-attainment cities that are considered to have air quality worse than the National Ambient Air Quality Standards.
- The Smart Cities programme will be used to launch the NCAP in the 43 smart cities falling in the list of the 102 non-attainment cities.
- **Target** - It proposes a tentative national target of 20%-30% reduction in PM2.5 and PM10 concentrations by 2024, with 2017 as the base year for comparison.
- However, the government has stressed that NCAP is a scheme, not a legally binding document with any specified penal action against erring cities.

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- **Implementation** - NCAP talks of a collaborative, multi-scale and cross-sectoral coordination between central ministries, state governments and local bodies.
- The CPCB will execute the nation-wide programme for the prevention, control, and abatement of air pollution within the framework of the NCAP.
- NCAP will be “institutionalised” by respective ministries and will be organised through inter-sectoral groups that will also include the Ministry of Finance, Ministry of Health, NITI Aayog, and experts from various fields.
- Other features of NCAP include –
  - Increasing the number of monitoring stations in the country including rural monitoring stations
  - Technology support
  - Emphasis on awareness and capacity building initiatives
  - Setting up of certification agencies for monitoring equipment
  - Source apportionment studies
  - Emphasis on enforcement
  - Specific sectoral interventions.
- **Proposed mitigation measures**
  - **Enforcement** - It calls for stringent enforcement through a web-based, three-tier mechanism that will review, monitor, assess and inspect to avoid any form of non-compliance.
  - The experience indicates lack of regular monitoring and inspection as the major reason for non-compliance.
  - Trained manpower and regular inspection drive will be ensured for stringent implementation purpose.
  - It also calls for an “extensive plantation drive” at pollution hotspots and execution.
  - However, it is not made clear how much air pollution this will seek to reduce.
- **Elaborating existing schemes**–While some of the strategies are not new to India, NCAP appears to be targeting effective implementation.



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- For example, it talks of “congestion management” at traffic junctions by the traffic police, solid waste management by municipal corporations, and stringent industrial standards put in place by concerned ministries.
- For power sector emissions, it refers to emission standards set by the Ministry of Environment and Forests for Thermal Power Plants in December 2015 to be implemented within a two-year period.
- It notes that this has since been extended to December 2022.
- For agricultural stubble burning, it highlights the initiatives already in place by way of the central assistance of Rs 1,151 crore for in situ management of crop residue and provides for general action points to be explored.
- **Focus** - NCAP calls for a city action plan that needs to be guided by a comprehensive science-based approach involving source apportionment studies.
- It also advises that state capitals and cities with a million-plus population be taken up on priority.
- PRANA ( Portal for Regulation of Air-pollution in Non-Attainment cities), is a portal for monitoring of implementation of NCAP.
- **Concerns**
- NCAP takes into account available international experiences and national studies.
- It notes that internationally, actions have been “city-specific” rather than country-oriented, and cites examples such as Beijing and Seoul that saw 35%-40% PM2.5 reductions in five years.
- However effective this might have been abroad, reductions by similar levels might leave Indian cities still heavily polluted.
- Delhi’s very severe pollution levels are four times the permissible limits now, and a 30% reduction by 2024 would still leave it very dangerous for health.
- **Varied Progress in Clean Air Target**
- Climate Trends and Respirometer Living Sciences are both involved in the NCAP Tracker, an online hub for updates on India's clean air policy.

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- Climate Trends is a research-based consulting and capacity building initiative that focuses on environment, climate change, and sustainable development.
- Respirer Living Sciences is a climate-tech startup partner to the Government of India. It supported the Centre of Excellence ATMAN on Clean Air Technologies which was established at IIT Kanpur.
- **PM2.5 Reduction Disparities:**
  - Among 49 cities with consistent PM2.5 data over five years, only 27 cities showed a decline in PM2.5 levels, while merely four cities met or surpassed the targeted decline as per National Clean Air Campaign (NCAP) Goals. The NCAP's goal is to reduce average particulate matter (PM) concentrations by 40% by 2026 in 131 cities. Initially aimed for a 20-40% reduction by 2024, the target was later extended to 2026.
- **Mixed Progress Across Cities:**
  - While some cities like Varanasi, Agra, and Jodhpur exhibited significant reductions in PM2.5 levels, others, including Delhi, reported marginal declines (only 5.9%) or even increased pollution loads. Varanasi showed the most substantial reduction with a 72% average decrease in PM2.5 levels and a 69% reduction in PM10 levels from 2019 to 2023.
- **Regional Vulnerabilities:**
  - The Indo-Gangetic Plain (IGP) remains highly vulnerable to elevated particulate matter concentrations, hosting around 18 of the top 20 most polluted cities for PM2.5. Only Guwahati and Rourkela, outside the IGP, were among the 20 most polluted cities for PM 2.5.
- **Monitoring Challenges:**
  - The availability and distribution of continuous ambient air quality monitors significantly influence annual pollutant concentrations. However, many Indian cities lack an adequate number of such monitoring stations. While cities such as Mumbai and Delhi have several such stations, most Indian cities have only a handful. Only four of the 92 cities have more than 10 such stations.

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- **Factors Impacting Pollution:**
  - Variations in pollution levels can be attributed to geographical locations, diverse emission sources, meteorological influences, and the interplay between emissions and Meteorology, requiring further investigation.
  
- Initiatives Taken for Controlling Air Pollution
- **System of Air Quality and Weather Forecasting and Research (SAFAR) Portal.**
- **Air Quality Index:** AQI has been developed for eight pollutants viz. PM<sub>2.5</sub>, PM<sub>10</sub>, Ammonia, Lead, nitrogen oxides, sulphur dioxide, ozone and carbon monoxide.
- **Graded Response Action Plan** (for Delhi).
- **For Reducing Vehicular Pollution:**
  - **BS-VI Vehicles,**
  - **Push for Electric Vehicles (EVs),**
  - **Odd-Even Policy as an emergency measure (for Delhi).**
- **New Commission for Air Quality Management**
- Subsidy to farmers for buying **Turbo Happy Seeder (THS) Machine** for reducing stubble burning.
- **National Air Quality Monitoring Programme (NAMP):** Under NAMP, four air pollutants viz. SO<sub>2</sub>, NO<sub>2</sub>, PM<sub>10</sub>, and PM<sub>2.5</sub> have been identified for regular monitoring at all locations.

## **2. Swachh Vayu Survekshan 2023 and NCAP**

Recently, the awards for **Swachh Vayu Survekshan** (Clean Air Survey) **2023** were announced. The survey was conducted by the **Central Pollution Control Board (CPCB)**.

Every year, the **International Day of Clean Air for Blue Skies** is celebrated on **September** to raise awareness and facilitate actions to improve air quality. It was **declared so by the United Nations General Assembly (UNGA)** in 2019.

Theme for 4th International Day of Clean Air for Blue Skies (Swachh Vayu Diwas 2023) - **“Together for Clean Air.”**

- *Major Components of Assessment*
- solid waste management,
- road dust management,

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- management of construction and demolition waste,
- control of vehicular emissions and industrial pollution.
- 3 best performing cities in each group will be given cash award in the spirit of competitive federalism.
- This Sarvekshan provides a tool to cities to plan their actions in order to improve the air quality. It is not based on the measurement of the air quality parameters to rank the cities. It is based on the actions taken by the cities to improve the air quality in different domains.
- *Key Findings about the SVS 2023*
- Swachh Vayu Survekshan (SVS) is a **new initiative by the Ministry of Environment, Forest and Climate Change** (MoEFCC) to rank cities on the basis of air quality and implementation of activities approved under the **city action plan (NCAP)** in 131 **non-attainment cities**.
- Cities are declared non- attainment if **over a 5-year period they consistently do not meet the NAAQS** for PM10 or NO2.
  - The categorisation of cities has been based on the **2011 population census**.
- **Criteria:** The cities were assessed on eight major points:
  - Control of biomass
  - Municipal solid waste burning
  - Road dust
  - Dust from construction and demolition waste
  - Vehicular emissions
  - Industrial emissions
  - Public awareness
  - improvement in PM10 concentration

#### **Performance:**

- Top 3 cities under **1<sup>st</sup> category (million plus population)**: Indore followed by Agra and Thane.
- **Worst Performers:** Madurai (46), Howrah (45) and Jamshedpur (44)
- **Bhopal** ranked 5<sup>th</sup> and **Delhi** ranked 9<sup>th</sup>
- Top 3 cities under **2<sup>nd</sup> category (3-10 lakhs population)**: Amravati followed by Moradabad and Guntur.
- **Worst Performers:** Jammu (38), Guwahati (37) and Jalandhar (36)
- Top 3 cities under **3<sup>rd</sup> category (<3 lakhs population)**: Parwanoo

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followed by Kala Amb and Angul.

- **Worst Performer:** Kohima (39)
- **Comparison:**
- In SVS 2022, the first three spots (million-plus category) were secured by cities in Uttar Pradesh — **Lucknow (1), Prayagraj (2) and Varanasi (3)**. All three cities have been ranked lower this year.

## **16. Antimicrobial resistance AMR- PPP 100 - 13**

Antimicrobial resistance occurs when microbes (bacteria, viruses, fungi and parasites) become resistant to antimicrobial drugs (such as antibiotics, anti-fungals, antivirals, antimalarials, and anthelmintics). As a result, the medicines become ineffective and infections persist in the body, increasing the risk of spread to others. India has witnessed an increase in antibiotic consumption- about 65 per cent in 2015 compared to 2000, while the rate of consumption increased from 3.2 to 6.5 billion daily defined doses (DDDs) in the same period. Recently, government has banned colistin- a last line of antibiotic in the poultry industry due to rise in cases of antibiotic resistance against it.

- **Various Causes of antibiotic resistance:** Microbes can become resistant to drugs for both biological and social reasons.
- **Microbial behaviour:** As soon as scientists introduce a new antimicrobial drug, there is a good chance that it will become ineffective at some point in time. This is due primarily to changes occurring within the microbes.
- **People's behaviour:** Not following recommendations for the use of some drugs can increase the risk of antimicrobial resistance. The way in which people use antimicrobial drugs is a significant contributing factor. Some individualistic reasons are:
  - **Wrong diagnosis:** Doctors sometimes prescribe antimicrobials “just in case,” or they prescribe broad-spectrum antimicrobials when a specific drug would be more suitable. Using these medications in this way increases the risk of AMR.
  - **Inappropriate use:** If a person does not complete a course of antimicrobial drugs, some microbes may survive and develop resistance to the drug. Also antibiotics recommended by quacks or pharmacist contribute to magnify the issue.
  - **Agricultural use:** Using antibiotics in farm animals can promote drug resistance. Scientists have found drug-resistant bacteria in meat and food crops that have exposure to fertilisers or contaminated water. In this way,

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diseases that affect animals can pass to humans.

- **Hospital use:** People who are critically ill often receive high doses of antimicrobials. This encourages the spread of AMR microbes, particularly in an environment where various diseases are present.

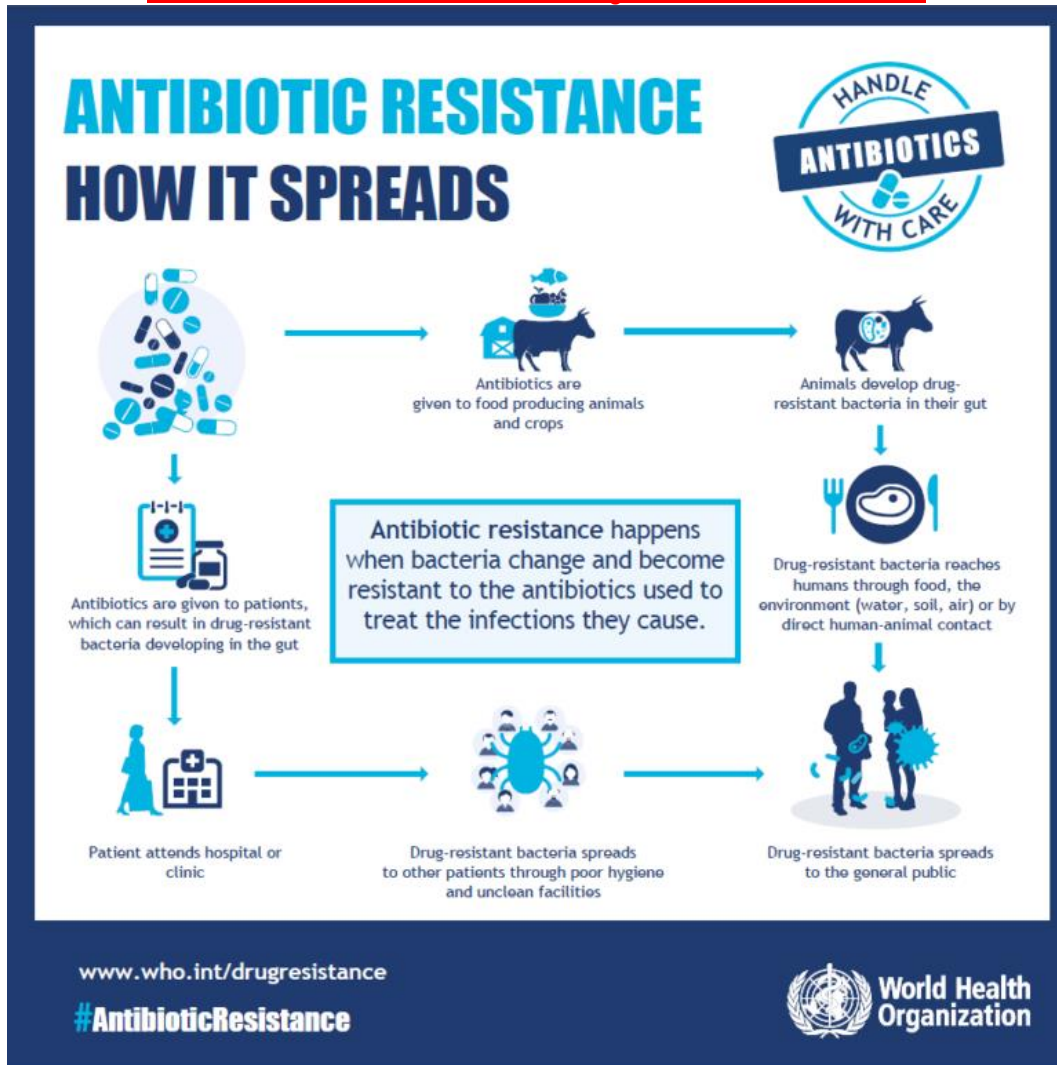
### CAUSES OF ANTIBIOTIC RESISTANCE

Antibiotic resistance happens when bacteria change and become resistant to the antibiotics used to treat the infections they cause.

- Over-prescribing of antibiotics
- Patients not finishing their treatment
- Over-use of antibiotics in livestock and fish farming
- Poor infection control in hospitals and clinics
- Lack of hygiene and poor sanitation
- Lack of new antibiotics being developed

[www.who.int/drugresistance](http://www.who.int/drugresistance)  
**#AntibioticResistance**

World Health Organization



### *Acinetobacter baumannii*

- The U.S. Food and Drug Administration has approved Xacduro as a new treatment for hospital-acquired bacterial pneumonia and ventilator-associated bacterial pneumonia caused by ***Acinetobacter baumannii-calcoaceticus complex (A. baumannii)***.
- ***Acinetobacter baumannii*** is a typically short, almost round, rod-shaped (coccobacillus) **Gram-negative bacterium**- which means it has a protective outer membrane that allows it to resist antibiotics.
- It is named after the bacteriologist Paul Baumann.
- Colloquially, ***baumannii* is referred to as "Iraqibacter"** due to its seemingly sudden emergence in military treatment facilities during the Iraq War.
- **“Red alert” pathogen”**
- ***baumannii*** was acknowledged even a decade ago to be a “red alert” pathogen “primarily because of its exceptional ability to develop resistance to all currently available antibiotics”. This remains the case today.
- **Locomotion**
- Bacteria of this genus lack flagella, whip-like structures many bacteria use for locomotion, but exhibit twitching or swarming motility. This may be due to the activity of type IV pili, pole-like structures that can be extended and retracted.
- **Impact**
- It can be an opportunistic pathogen in humans, **affecting people with**



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**compromised immune systems**, and is becoming increasingly important as a hospital-derived (nosocomial) infection.

- It has been **associated with hospital-acquired infections in India.**
- **Habitat**
- Although occasionally it has been found in environmental soil and water samples, **its natural habitat is still not known.**



<b>Parameter</b>	<b>Gram-positive bacteria</b>	<b>Gram-negative bacteria</b>
<b>Cell Wall</b>	A single-layered, smooth cell wall	A double-layered, wavy cell-wall
<b>Cell Wall thickness</b>	The thickness of the cell wall is 20 to 80 nanometres	The thickness of the cell wall is 8 to 10 nanometres
<b>Peptidoglycan Layer</b>	It is a thick layer/ also can be multi-layered.	It is a thin layer/ often single-layered.
<b>Teichoic acids</b>	Teichoic acids are present.	Teichoic acids are not present.
<b>Lipopolysaccharide</b>	Lipopolysaccharide is not present.	Lipopolysaccharide is present.
<b>Outer membrane</b>	The outer membrane is not present.	The outer membrane is mostly present.
<b>Lipid content</b>	The Lipid content is very low.	The Lipid content is 20% to 30%.
<b>Resistance to Antibiotic</b>	These are very susceptible to antibiotics.	These are very resistant to antibiotics.

### **Government initiative against AMR:**

- India's National Action Plan (NAP) for AMR was released in 2017 by the Union Ministry of Health and Family Welfare. The objectives of the NAP include:
  - Improving awareness and enhancing surveillance measures.
  - Strengthening infection prevention and control.
  - Research and development, promoting investments, and collaborative activities to control AMR.
- On the basis of the NAP, various states have begun the process of initiating their State Action Plans. The challenges in implementation of NAP are as varied perceptions about antibiotic use and AMR among key

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stakeholders, lack of diagnostic facilities, widespread use of antibiotics in various sectors, environmental contamination because of pharmaceutical industry, etc. Thus, inter-sectoral co-ordination between public and private sectors and comprehensive strengthening of the healthcare systems are necessary to achieve the desired forward momentum.

- Muscat Manifesto - At the Third Global High-Level Ministerial Conference on Antimicrobial Resistance held in Muscat, over 30 countries adopted the Muscat Ministerial Manifesto on AMR. The Muscat Manifesto recognised the need to accelerate political commitments in the implementation of One Health Action for controlling the spread of AMR. The conference focused on three health targets
- Reduce the total amount of antimicrobials used in the agri-food system at least by 30-50% by 2030
- Eliminate use in animals and food production of antimicrobials that are medically important for human health
- Ensure that by 2030 at least 60% of overall antibiotic consumption in humans is from the WHO “Access” group of antibiotics
- **Reporting to GLASS**- India plans to strengthen private sector engagement and the reporting of data to the WHO Global Antimicrobial Resistance and Use Surveillance System (GLASS).
- **The National Health Policy 2017**– It has offered specific guidelines regarding use and limiting the use of antibiotics as over-the-counter medications and restricting their usage in livestock. It also called for scrutiny of prescriptions to assess antibiotic usage in hospitals and among doctors.
- **Signing the Delhi Declaration on AMR**: The Delhi Declaration on Antimicrobial Resistance (**AMR**) is an inter-ministerial consensus that was signed by the ministers of the concerned ministries in India.
- The declaration aims to address AMR in a mission mode by involving research institutes, civil society, industry, small- and medium-sized enterprises, and encouraging public-private partnerships.
- **Antibiotic Stewardship Program (AMSP)**: The Indian Council of Medical Research (ICMR) has initiated the AMSP on a pilot project basis in 20

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tertiary care hospitals across India. The program aims to control the misuse and overuse of antibiotics in hospital wards and ICUs.

- **Ban on inappropriate fixed dose combinations (FDCs):** On the recommendations of the ICMR, the Drug Controller General of India (DCGI) has banned 40 FDCs that were found to be inappropriate.
- **Ban on the use of Colistin as a growth promoter in animal feed:** The ICMR, in collaboration with the Indian Council of Agriculture Research, Department of Animal Husbandry, Dairy and Fisheries, and the DCGI, has banned the use of Colistin as a growth promoter in animal feed in poultry.
- **One Health approach:** The government is working on a One Health approach by encouraging interdisciplinary collaboration at the human-animal-environmental interface. The key priority areas include zoonotic diseases, food safety, and antibiotic resistance.
- **Integrated One Health Surveillance Network for AMR:** The ICMR has undertaken a project on an "Integrated One Health Surveillance Network for Antimicrobial Resistance" in collaboration with the Indian Council of Agriculture Research to assess the preparedness of Indian Veterinary laboratories to participate in an integrated AMR surveillance network.
- **Medicines Patent Pool Agreement for Leukaemia**
- Recently, the **Medicines Patent Pool (MPP)**, a **United Nations**-backed group signed sub-licence agreements with three India-based companies to make certain **Cancer Drugs** more accessible and cheaper for patients.
- These agreements **allow the production of generic versions of Novartis' cancer treatment drug** Nilotinib, primarily used for **Chronic Myeloid Leukaemia (CML)**, in several countries.
- The licence covers **India, seven middle-income countries**, and 44 territories, allowing the generic versions of Nilotinib to be supplied, subject to local regulatory authorization.
- Medicines Patent Pool
- MPP is a **United Nations-backed public health organisation** working to increase access to, and facilitate

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the **development of, life-saving medicines** for Low- and Middle-Income Countries (LMIC).

- It was founded in July 2010, based in Geneva, Switzerland.
- MPP partners with civil society, governments, international organisations, industry, patient groups, and other stakeholders, to **prioritise and license needed medicines and pool Intellectual Property** to encourage generic manufacture and the development of new formulations.
- As of now, MPP has signed agreements with **twelve patent holders for thirteen Human Immunodeficiency Virus (HIV) antiretrovirals**, one HIV technology platform, three **hepatitis C** direct-acting antivirals, a **tuberculosis** treatment, a long-acting technology, two experimental oral antiviral treatments for **Covid-19** and a Covid-19 serological antibody technology.
- **Chronic Myeloid Leukaemia (CML)**
- It is one of the types of **Leukemia**, which is a **blood-cell cancer** that affects the **bone marrow and the blood**. Other types are,
  - Acute Lymphoblastic Leukemia (ALL)
  - Acute Myeloid Leukemia (AML)
  - Chronic Lymphocytic Leukemia (CLL).
- It is characterized by the **uncontrolled growth of abnormal white blood cells** called myeloid cells.
- CML typically progresses **slowly, and it is often diagnosed during** the chronic phase.
- **Diagnosis:**

CML is typically diagnosed through a combination of blood tests and bone **marrow examination**.
- **Prevention and control measures:**
- **Individuals:**To prevent and control the spread of antibiotic resistance, individuals should:
  - Only use antibiotics when prescribed by a certified health professional.

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- Never demand antibiotics if your health worker says you don't need them.
- Always follow your health worker's advice when using antibiotics.
- Never share or use leftover antibiotics.
- **Policy makers:** To prevent and control the spread of antibiotic resistance, policy makers should:
  - Ensure a robust national action plan to tackle antibiotic resistance is in place.
  - Improve surveillance of antibiotic-resistant infections.
  - Strengthen policies, programmes, and implementation of infection prevention and control measures.
  - Regulate and promote the appropriate use and disposal of quality medicines.
  - Make information available on the impact of antibiotic resistance.
- **Health professionals:** To prevent and control the spread of antibiotic resistance, health professionals should:
  - Prevent infections by ensuring that their hands, instruments, and environment are clean.
  - Only prescribe antibiotics when they are needed, according to current guidelines.
  - Report antibiotic-resistant infections to surveillance teams.
- **Agriculture sector:** To prevent and control the spread of antibiotic resistance, the agriculture sector should:
  - Only give antibiotics to animals under veterinary supervision.
  - Not use antibiotics for growth promotion or to prevent diseases in healthy animals.
  - Vaccinate animals to reduce the need for antibiotics and use alternatives to antibiotics when available.
  - Promote and apply good practices at all steps of production and processing of foods from animal and plant sources.
  - Improve biosecurity on farms and prevent infections through improved hygiene and animal welfare.
- There is need to urgently address antimicrobial resistance through the lens of one (human, animal and environment) health. All countries need to work together to limit the spread of ARGs and antibiotics between humans, animals and the environment in the globalised world where we

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live. Even though national action plans have been laid down by most countries, these plans have yet to move from paper to the ground as antibiotics continue to be freely used.

**PYQ**

**Which of the following are the reasons for the occurrence of multi-drug resistance in microbial pathogens in India? (2019)**

- 1. Genetic predisposition of some people**
- 2. Taking incorrect doses of antibiotics to cure diseases**
- 3. Using antibiotics in livestock farming**
- 4. Multiple chronic diseases in some people**

**Select the correct answer using the code given below.**

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

## 17. Exchange-Traded Funds (ETFs)

In today's fast-paced and dynamic investment landscape, investors are constantly seeking opportunities to optimize their portfolios. One such avenue that has gained significant popularity and transformed the way we invest is Exchange-Traded Funds (ETFs). ETFs have emerged as a versatile and accessible investment vehicle, offering a wide range of benefits to investors. With their unique features and broad market exposure, ETFs have revolutionized the investment landscape and opened up new possibilities for individuals and institutions alike.

- Exchange-Traded Funds (ETFs)
- Exchange-Traded Funds (ETFs) are investment funds that are traded on stock exchanges, similar to individual stocks. They are designed to track the performance of a specific index, commodity, sector, or asset class. ETFs offer investors the opportunity to gain exposure to a diversified portfolio of underlying securities, providing a convenient and cost-effective way to invest in a wide range of assets. By purchasing shares of an ETF, investors effectively own a proportional stake in the underlying assets, allowing for instant diversification and liquidity. ETFs have become increasingly popular due to their flexibility, transparency, and potential for market returns.
- Features of Exchange-Traded Funds
- The following points highlight various features of ETFs, which make ETFs an attractive investment option for individuals seeking flexibility, diversification, transparency, and cost-effectiveness in their investment strategies:
- Exchange-Traded: ETFs are bought and sold on stock exchanges, allowing investors to trade them throughout the trading day at market prices.
- Diversification: ETFs offer investors instant diversification by providing exposure to a basket of underlying securities, such as stocks, bonds, or commodities.
- Tracking Indices: Many ETFs are designed to track specific indices,

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allowing investors to gain broad market exposure without the need to purchase individual stocks.

- **Transparency:** ETFs disclose their holdings on a daily basis, providing investors with transparency regarding the underlying assets they own.
- **Flexibility:** ETFs offer flexibility in terms of investment strategies, asset classes, and sectors, allowing investors to tailor their portfolios to their specific investment goals.
- **Lower Expense Ratios:** ETFs typically have lower expense ratios compared to actively managed funds, making them cost-effective investment options.
- **Intra-day Trading:** ETFs can be bought and sold throughout the trading day, providing investors with the ability to enter or exit positions at their desired price points.
- **Tax Efficiency:** Due to their unique structure, ETFs are often more tax-efficient compared to mutual funds, as they have the potential for in-kind creations and redemptions.
- **Liquidity:** ETFs are generally highly liquid, meaning there is a high level of trading activity, allowing investors to easily buy or sell shares without impacting the market price.
- **Wide Range of Choices:** ETFs provide investors with a wide range of choices, including different investment styles, geographical focuses, and asset classes, allowing for diversified and customized investment portfolios.

#### Popular ETFs in the Indian market:

- **Nifty 50 ETF:** This ETF tracks the performance of the Nifty 50 index, which represents the top 50 companies listed on the National Stock Exchange (NSE) of India.
- **Nifty Bank ETF:** This ETF aims to replicate the performance of the Nifty Bank index, comprising the most liquid and large-cap banking stocks listed on the NSE.
- **Sensex ETF:** This ETF tracks the performance of the Sensex index, which represents the 30 largest and most actively traded stocks on the Bombay Stock Exchange (BSE).
- **Nifty Next 50 ETF:** This ETF follows the Nifty Next 50 index, which includes the 50 companies listed after the Nifty 50 in terms of market capitalization.
- **Gold ETF:** These ETFs invest in physical gold and offer investors an opportunity to gain exposure to the price movement of gold without the need for physical ownership.



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<b>Aspect</b>	<b>ETFs</b>	<b>Mutual Funds</b>
Structure	Traded on stock exchanges like individual stocks	Not traded on exchanges; bought/sold through fund companies
Pricing	Trades at market prices throughout the trading day	Priced at the end of the trading day (NAV)
Flexibility	Can be bought and sold at any time during market hours	Can be bought or sold at the end-of-day NAV
Cost	Generally, lower expense ratios	Expense ratios can vary, and may be higher than ETFs
Transparency	Holdings disclosed daily	Holdings are disclosed periodically, usually quarterly
Investment Options	Can track specific indices, sectors, commodities, etc.	Offer a wide range of investment strategies and asset classes
Trading Efficiency	Potential for intra-day trading and limit orders	Transactions occur at the end of the trading day
Tax Efficiency	Typically more tax-efficient due to in-kind creations	Subject to potential capital gains tax due to fund redemptions
Minimum Investment	Varies, but often lower minimum investment requirements	Minimum investment requirements may be higher

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<b>Aspect</b>	<b>ETFs</b>	<b>Index Funds</b>
Trading	Traded on stock exchanges like individual stocks	Not traded on exchanges; bought/sold through fund companies
Investment Objective	Can track a specific index, sector, commodity, etc.	Primarily designed to replicate the performance of a specific index
Intra-day Trading	Can be bought and sold at any time during market hours	Can be bought or sold at the end-of-day NAV
Expense Ratio	Generally, lower expense ratios	Expense ratios can vary, but typically lower than actively managed funds
Transparency	Holdings disclosed daily	Holdings disclosed periodically, usually quarterly
Flexibility	Can trade throughout the trading day with limit orders	Can only be traded at the end of the trading day
Investment Options	Offer a wide range of investment strategies and asset classes	Primarily focus on replicating the performance of a specific index
Tax Efficiency	Typically more tax-efficient due to in-kind creations	Subject to potential capital gains tax due to fund redemptions
Minimum Investment	Varies, but often lower minimum investment requirements	Minimum investment requirements may vary, typically lower

### **18. Model Code of Conduct (MCC)**

- The **Model Code of Conduct (MCC)** is a **set of guidelines** issued by the Election Commission of India to regulate the conduct of political parties and their candidates in the run-up to elections.
  - These guidelines range from issues related to speeches, polling day, polling booths, portfolios, the content of election manifestos, processions, and the general conduct of the political candidates.
- The **primary objective** of the Model Code of Conduct (MCC) is to ensure that campaigns, polling, and counting proceed in an orderly, transparent, and peaceful manner.

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- The Model Code of Conduct (MCC) **helps** the **Election Commission of India** in fulfilling its mandate, given by **Article 324** of the Constitution, of supervising and conducting **free and fair elections**.
- **Objectives of Model Code of Conduct (MCC)**
- The key objectives of the Model Code of Conduct (MCC) are:
  - To ensure that elections are free, fair, and transparent, maintaining the integrity and credibility of the electoral process.
  - To keep the campaign fair and healthy, and avoid clashes between parties.
  - To provide a level playing field for all political parties.
  - To ensure that the ruling party does not misuse its official position to gain an unfair advantage in an election.
- **Evolution of the Model Code of Conduct (MCC)**
- The Model Code of Conduct (MCC) has evolved with the consensus of political parties to abide by the principles embodied in the said code and to respect and observe it in its letter and spirit. The evolution of the Code, over the years, can be seen as follows:
  - **Origin**
    - The origin of the MCC dates back to 1960 when a small set of Dos and Don'ts for the **Assembly Election in Kerala in 1960**.
  - **Spread**
    - In the 1962 Lok Sabha General Elections, the Commission circulated this code to all the recognized political parties, and the State Governments were requested to secure the acceptance of the Code by the Parties.
    - In 1967, the Code was followed in the Lok Sabha and Assembly elections.
    - In 1968, the Election Commission held meetings with political parties at the State level and circulated the Code of Conduct to observe minimum standards of behavior to ensure free and fair elections
    - In 1971-72, during the General Election to the House of the People/State Legislative Assemblies, the Commission circulated the Code again
    - At the time of general elections to some State Assemblies in 1974, the Commission issued the code of conduct to the political parties in those States.
- **Consolidation**

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- In 1979, the Election Commission, in consultation with the political parties further amplified the code, adding a new Section placing restrictions on the “Party in power” to prevent cases of abuse of a position of power to get undue advantage over other parties and candidates
- In 1991, the code was consolidated and re-issued, which developed and shaped into its present form.
- **Judicial Recognition**
  - The MCC has received **judicial recognition** in the **Union of India Vs. Harbans Singh Jalal and Others case of 2001** wherein the Supreme Court ruled that the Code of Conduct would come into force the moment the Election Commission issues the press release.
    - This ruling laid at rest the controversy related to the **date of enforcement of MCC.**
- **Salient Features of Model Code of Conduct (MCC)**
- The salient features of the Model Code of Conduct lay down how political parties, contesting candidates, and party(s) in power should conduct themselves during the process of elections. They issue necessary guidelines which have been mentioned below:
  - General Conduct during electioneering.
  - Holding meetings and processions.
  - Poll day activities.
  - Appointment of observers.
  - Functioning of the party in power.
  - Election Manifestos.
- **Significant Provisions of Model Code of Conduct (MCC)**
- The Model Code of Conduct (MCC) in India has several significant provisions which include:
  - **General Conduct** – Political Parties and their candidates are prohibited from engaging in activities that may stoke communal tensions or promote hatred between different groups.
    - Criticism of rival parties should be based on their policies, schemes, and past performances, **avoiding personal attacks.**
    - Further, places of worship such as temples, mosques, and churches should not be utilized for election propaganda.
  - **Meetings** – The party or candidate must notify the local police authorities for organizing political meetings and election campaigns for

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proper management and security and to ensure law and order arrangements.

- **Polling Day** – The political party or candidate should collaborate with the polling authorities at the polling booths to ensure the smooth conduct of elections. For example, distribution of food or alcohol near polling stations is prohibited to prevent voter manipulation.
- **Polling Booth** – Only authorized individuals with passes from the Election Commission are allowed inside polling booths, apart from the voters.
- **Observers** – The Election Commission appoints observers to address complaints or issues raised by political candidates or their agents during the election process.
- **Party in Power** – The ruling party is expected to refrain from misusing its official position for electoral advantage, ensuring a level playing field for all candidates.
- **Election Manifesto** – The election manifesto shall not contain anything repugnant to the ideals and principles enshrined in the Constitution, and it shall be consistent with the letter and spirit of other provisions of the Model Code of Conduct.
- **Recent Additions to Model Code of Conduct (MCC)**
  - – **Regulation of Opinion Polls and Exit Polls** – The ECI has regulated opinion polls and exit polls during the period specified by notifying guidelines to ensure fairness and prevent undue influence on voters.
  - – **Prohibition of Advertisements in Print Media** – Advertisements in print media are prohibited on polling day and one day before it unless their contents are screened by screening committees to ensure compliance with election norms.
  - – **Restriction on Government Advertisements** – There is a restriction on advertisements featuring political functionaries during the election period to prevent misuse of public funds for political gains and ensure a level playing field.
- **Enforcement of Model Code of Conduct (MCC)**
- The **Election Commission announces the scheduled elections** in a major press conference a few weeks before the formal process is set in motion. The **Model Code of Conduct (MCC) comes into effect immediately** after this announcement and remains in force until the announcement of election results. Thus, the Code remains in effect throughout the election process.
- **Applicability of Model Code of Conduct (MCC)**

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- **Lok Sabha Elections** – During the General Elections to the House of People (Lok Sabha), the code is applicable **throughout the country**.
- **Legislative Assembly Elections** – During the General Elections to the Legislative Assembly (Vidhan Sabha), the code is applicable in the **entire State**.
- **Bye-Elections** – During the bye-elections, the code is applicable in the **entire district or districts** in which the constituency falls.
- **Activities Prohibited under Model Code of Conduct (MCC)**
- The Model Code of Conduct (MCC) imposes stringent guidelines on ministers, government authorities, and political parties to ensure a level playing field during elections in India. Here's a summary of the restrictions placed on ministers and other authorities as per the MCC:
- Ministers and government authorities are prohibited from announcing any new financial grants, projects, or schemes once the election dates are announced.
- Even the schemes that may have been announced before the MCC came into force, but have yet to take off on the ground, are required to be put on hold.
- The laying of foundation stones for projects or the initiation of any new schemes is barred after the MCC comes into effect. The objective is to prevent any actions that could influence voter opinion unduly.
- The use of official machinery, vehicles, and personnel for campaign purposes is strictly forbidden. This ensures that government resources are not used to benefit the ruling party's electoral prospects.
- Combining official visits with election campaigning activities is not allowed. Ministers must ensure that their official tours and functions are not used as opportunities for electioneering.
- Once the elections are announced, ministers cannot sanction grants or make payments from discretionary funds. This prevents the use of government funds to influence voter behavior.
- Government accommodations and buildings should not be used as campaign offices or for holding election-related public meetings. This rule maintains the neutrality of government spaces during the election period.
- The MCC prohibits the misuse of official mass media channels for partisan coverage or publicity of the ruling party's achievements. This ensures that the media remains unbiased and does not influence the electoral process unduly.

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- Issuing advertisements at the cost of the public exchequer in newspapers and other media platforms for election purposes is prohibited. This prevents the misuse of public funds for electoral gains.
- **Is the Model Code of Conduct Legally Enforceable?**
- The Model Code of Conduct (MCC) has originated and evolved with the consensus of political parties. It does **not have any statutory backing** and hence is **not enforceable by any law**.
- **Parliamentary Standing Committee's Position w.r.t. Legalization of MCC**
- In 2013, the **Standing Committee on Personnel, Public Grievances, Law, and Justice** suggested making the Model Code of Conduct (MCC) legally binding.
- The **arguments** given by the Committee were as follows:
- **Most** of the **provisions** of the MCC are **already** contained **in various laws** and are therefore enforceable.
- **Currently**, there is an **absence of an immediate appeal mechanism** against the decisions of the Returning Officers. The decision can be challenged only after the announcement of election results.
- **Election Commission's Position w.r.t. Legalization of MCC**
- The **Election Commission** has **opposed** making **MCC legally binding** due to practical concerns such as:
- It argues that elections get completed within a short time frame, typically around 45 days. Legal proceedings usually take longer, making it impractical to enforce MCC through the legislative process.
- The decision-making power will go to the judiciary and thus the swiftness in dealing with the cases of violation of MCC will be gone.
- The legal codification of these norms would be a potential nightmare, exposing the entire electoral process to needless litigation.
- The broad objectives of the MCC are best achieved by the oversight of an impartial election watchdog that can conduct free and fair elections.
- **Legal Provisions Aiding Implementation of MCC**
- Though the MCC is not legally enforceable, there are **some existing legal provisions** that align with the principles of the MCC and **aid in its implementation**. Some of such provisions can be seen as follows:
- The **Representation of the People Act (RoPA) of 1951** contains some

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provisions which align with the implementation of the MCC:

- **Section 8** of the Act deals with **disqualification on conviction for certain offenses**.
- **Part VII** of the Act contains provisions related to **Corrupt Practices** and **Electoral Offences**.
- Certain provisions of the Model Code of Conduct (MCC) are mentioned in the existing statutes like the **Indian Penal Code (IPC) 1860, and Code of Criminal Procedure (CrPC) 1973**.
- **Importance of Model Code of Conduct (MCC)**
- The Model Code of Conduct (MCC) holds profound significance in the electoral process, ensuring that elections are conducted in a free, fair, and respectful manner. Its importance can be seen as follows:
- **Ensuring Fair Play** – The MCC acts as a leveler, ensuring that no political party or candidate has an undue advantage over others. It aims to create a fair competitive environment by restricting the misuse of government power, prohibiting the use of official machinery for campaigning, and ensuring that public resources are not diverted for electioneering purposes.
- **Building Confidence in the Electoral Process** – The enforcement of the MCC reassures the electorate that the elections will be conducted impartially, without undue influence from those in power, and that their vote is a crucial and respected component of the democratic process.
- **Promoting Issue-based Campaigning** – The MCC encourages political parties and candidates to focus their campaigns on policies, programs, and their track records rather than personal attacks or unfounded allegations against opponents. This emphasis on issue-based campaigning enlightens voters and helps them make informed decisions.
- **Preventing Exploitation of Sectarian Issues** – By prohibiting the use of caste, religion, or communal sentiments to seek votes, the MCC ensures that elections do not exacerbate social divisions or lead to communal tension. This is vital for the sustenance of secular and pluralistic democracy.
- **Reducing Electoral Violence** – By imposing strict norms on the conduct of political rallies, processions, and gatherings, the MCC helps reduce instances of electoral violence and ensures the safety and security of voters, political workers, and the general public during the



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election period.

- **Promoting Decency and Decorum** – The MCC mandates that political parties and candidates conduct their campaigns with high standards of decency and avoid actions or speech that might incite violence or hatred among different sections of society.
- **Maintaining Public Order** – The MCC plays a crucial role in maintaining public order during the election period by setting guidelines for the conduct of political parties and candidates. It helps prevent clashes between supporters of different parties and ensures that electioneering activities do not disrupt normal public life.
- **Criticism of Model Code of Conduct (MCC)**
  - Some of the key criticisms of the Model Code of Conduct (MCC) are as follows:
    - **Enforcement** – The MCC lacks legal enforceability and relies primarily on moral persuasion, leading to limitations on governance activities and public spending.
    - **Delayed Action and Weak Response** – The Election Commission’s response to inappropriate statements by influential political figures has been slow or inadequate, allowing offenders to flout the Model Code of Conduct with impunity.
    - **Absence of Disqualification Power** – The Election Commission lacks the authority to disqualify candidates engaged in electoral malpractices, limiting its ability to address violations effectively.
    - **Inability to Deregister Political Parties** – The Election Commission cannot deregister political parties for electoral violations, raising concerns about accountability and consequences for misconduct.
    - **Ineffectiveness in Curbing Malpractices** – The MCC has failed to prevent various electoral malpractices, including hate speech, fake news, and voter intimidation, exacerbated by challenges posed by new technologies.
    - **Criticism of Application Timing** – The Election Commission is often criticized for applying the Model Code of Conduct either too early or too late, impacting development initiatives and public welfare programs.
    - **Low Awareness and Compliance** – The MCC is not widely understood or adhered to by voters, candidates, political parties, and government officials highlighting the need for increased awareness and compliance efforts.
- **Way Forward**

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- Some measures for effective implementation of the Model Code of Conduct (MCC) include:
- **Legal Enforcement** – There have been calls to make the MCC legally binding by incorporating it into the Representation of the People Act of 1951. This would provide statutory backing to the MCC and enhance its enforceability.
- **Enforcement through Other Measures** – While the MCC itself may not have legal enforceability, certain provisions can be enforced by invoking corresponding provisions in other statutes such as the Indian Penal Code of 1860, Code of Criminal Procedure of 1973, and Representation of the People Act of 1951. This enables authorities to take action against violations of the MCC using existing legal frameworks.
- **Law Commission Recommendation (2015)** – The Law Commission recommended imposing a ban on government-sponsored advertisements highlighting achievements of the ruling party for up to six months before the expiry of the House/Assembly. This measure aims to prevent the ruling party from gaining an unfair advantage over other parties and candidates.
- **Use of Technology** – Leveraging technology, such as AI-based systems, can help monitor and prevent violations of the MCC, particularly on social media platforms where misinformation and propaganda may be disseminated. Implementing technological solutions can enhance the efficiency of MCC enforcement.
- **Independence of ECI** – Granting greater independence to the Election Commission, similar to the Comptroller and Auditor General (CAG), would empower it to take more stringent actions for the implementation of the MCC. Strengthening the autonomy of the ECI can enhance its ability to ensure fair and transparent elections.
- On July 3, 2018, the EC launched the **C-vigil application** for citizens to report on matters of political misconduct pertaining to violation of the MCC. The report must contain evidence in the form of videos or photographs and must necessarily be geo-tagged. The complaints filed are sent to the district control room, which then sends a surveillance squad with local police officers to investigate the matter.
- **Conclusion**
- The Model Code of Conduct is a cornerstone of democratic elections, ensuring fairness, transparency, and integrity in the electoral process.

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Its success hinges not just on the regulations themselves, but on the collective commitment of political parties, candidates, electoral bodies, and the electorate to uphold the spirit of democracy. As India marches forward on its journey to strengthen democracy, MCC will continue to play a pivotal role. Necessary measures should be taken to give more teeth to this regulation.

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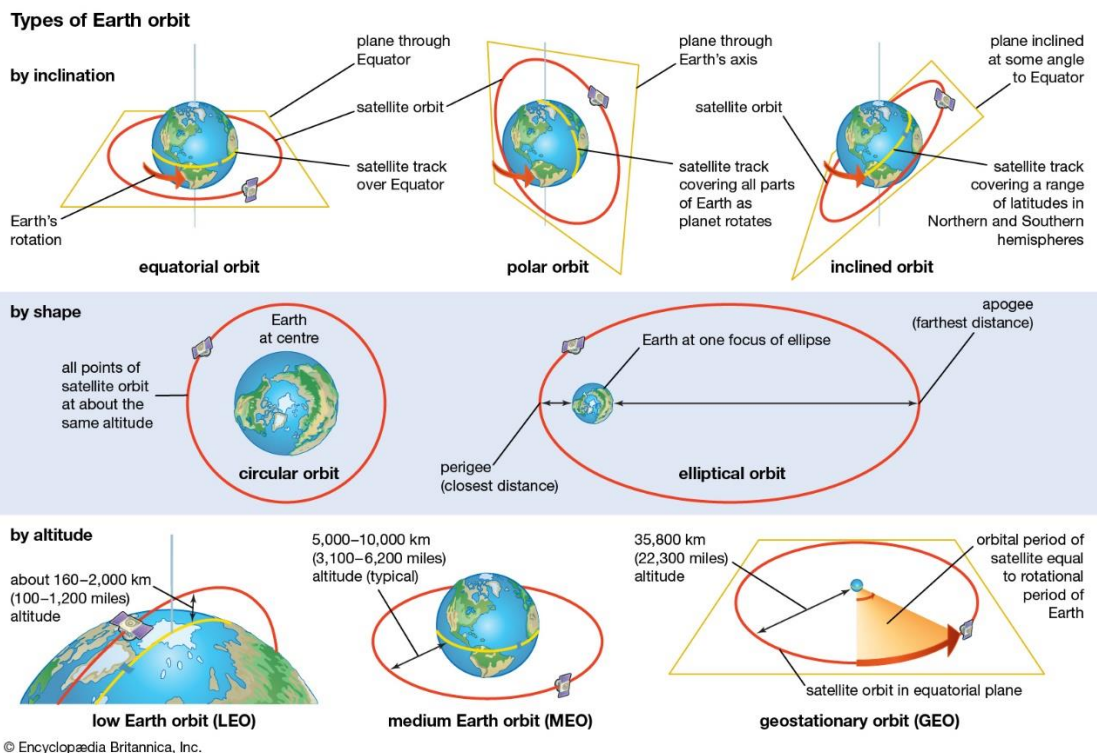
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## 19. Earth Satellite Orbits

- An orbit is a curved, regular, and repeating path that an object in space, such as a star, planet, moon, or spacecraft, takes around another one. An object, natural or artificial, in an orbit is called a satellite. Artificial satellites are placed in different orbits based on their utility and objectives. Orbits can be classified on the basis of altitude and functionality.
- High Earth Orbit, Medium Earth Orbit, and Low Earth Orbit are the types of orbits based on altitude, and geostationary orbit, polar orbit, sun-synchronous orbit, etc. are the types of orbits based on their objectives.
- **Factors Influencing Functional Aspects of Satellites in an Orbit**
- Functional aspects of the satellite are achieved through a combination of factors. These factors essentially govern the movement of the various **types of satellites** and their associated aspects. These factors are:
  - **Altitudes:** The height or altitude of the orbit from the surface of the Earth affects the speed of satellites. The speed of a satellite with respect to earth is inversely proportional to its altitude.
    - Thus, the speed of a satellite placed in Low Earth Orbit will be greater than that of a satellite placed in a High Earth Orbit, due to the higher gravitational force of the Earth acting on the satellite.
    - For example, NASA's Aqua satellite requires about 99 minutes to orbit Earth at about 705 kilometers up (Low Earth Orbit), while a weather satellite about 36,000 kilometers from Earth's surface takes 23 hours, 56 minutes, and 4 seconds to complete an orbit.
  - **Eccentricity (e):** The eccentricity of an orbit indicates the deviation of the orbit from a perfect circle. It governs the **shape of an orbit**.
    - A circular orbit has zero eccentricity, while a highly eccentric orbit is near to 1 (but always less).
    - For example, the **Molniya orbit** has eccentricity (0.722) to maximize viewing time over high latitudes.

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- **Orbital inclination:** It is the angle between the plane of an orbit and the equator.
  - An orbital inclination of  $0^\circ$  is directly above the equator, and  $90^\circ$  crosses right above the pole.
  - **Polar satellites** used for Earth observation and scientific research are inclined nearly 90 degrees to the Earth.
- **Orbital period:** The time taken by a satellite to complete one revolution in its orbit around the Earth is called an orbital period.
  - It varies from around 100 minutes for a near-polar Earth-observing satellite to 24 hours for a geostationary satellite.
- **Rotational direction of the satellites:**
  - **Retrograde motion:** When the direction of orbital or rotational motion of a satellite is opposite to the rotation of its central object (for example, Earth), it is called retrograde motion.
  - **Prograde motion:** When the orbital or rotational motion of an object is in the same direction as its central object, it is called prograde motion.

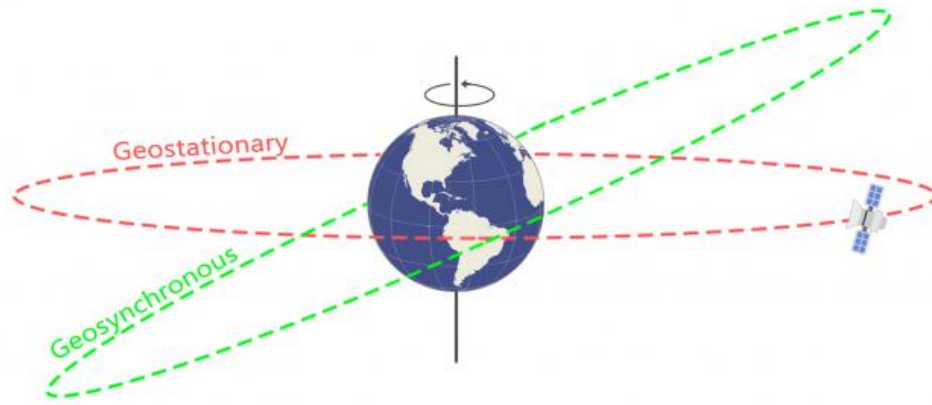


- **Types of Orbit based on Altitude**
- There are three types of orbits based on altitudes - High Earth Orbit, Medium Earth Orbit, and Low Earth Orbit. The speed of a satellite depends upon the height of the orbit from the Earth's surface.
- **High Earth Orbit (HEO)**
- HEO lies **at and beyond 35,786 kilometers** from Earth's surface. It is

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a sort of “sweet spot” in which satellite orbit matches the rotation of the Earth.

- **Application:** A satellite in this orbit seems to stay in place over a single longitude, although it may drift north to south. This special, high Earth orbit is known as geosynchronous orbit.
  - Examples: **GSAT series** of India's indigenously developed communications satellites, used for digital audio, data, and video broadcasting.
- **Medium Earth Orbit (MEO)**
- MEO lies between 2,000 km to 35780 km from the surface of the Earth. Two Medium Earth Orbits are the semi-synchronous orbit and the Molniya orbit. MEO satellites have orbital periods ranging from 2 to 24 hours. Satellites in MEO have an orbital period between 2 to 24 hours.
- **Application:** This is the orbit used by the Global Positioning System (**GPS**) satellites such as **GLONASS** (Altitude of 19,100 kilometers) and **Galileo** (Altitude of 23,222 kilometers).
- **Low Earth Orbit (LEO)**
- LEO has an altitude between **160 km to 1000 km** above the Earth's surface. Satellites in this orbit take approximately **88 - 127 minutes** to circle Earth.
- **Applications:** This orbit is commonly used for satellite imaging, Earth observation, etc., but communicational satellites (in constellations) are also placed in this orbit.
  - The **International Space Station (ISS)** is placed in this orbit, traveling about 16 times around Earth per day.
  - A Constellation of **36 communication satellites of OneWeb (Satellite communications company) has been** placed in LEO by ISRO.
  - **Earth Observatory satellite- RISAT-2B** (Radar Imaging Earth observation satellite) of ISRO was launched in LEO for the application of the Disaster Management System.
- **Types of Orbit based on Functionality**
- Based on the various combinations of the above-mentioned factors (Altitude, Eccentricity, Inclination), the most common functional orbits are Geostationary orbit, Polar orbit, Sun-synchronous orbit, Molniya orbit, etc.



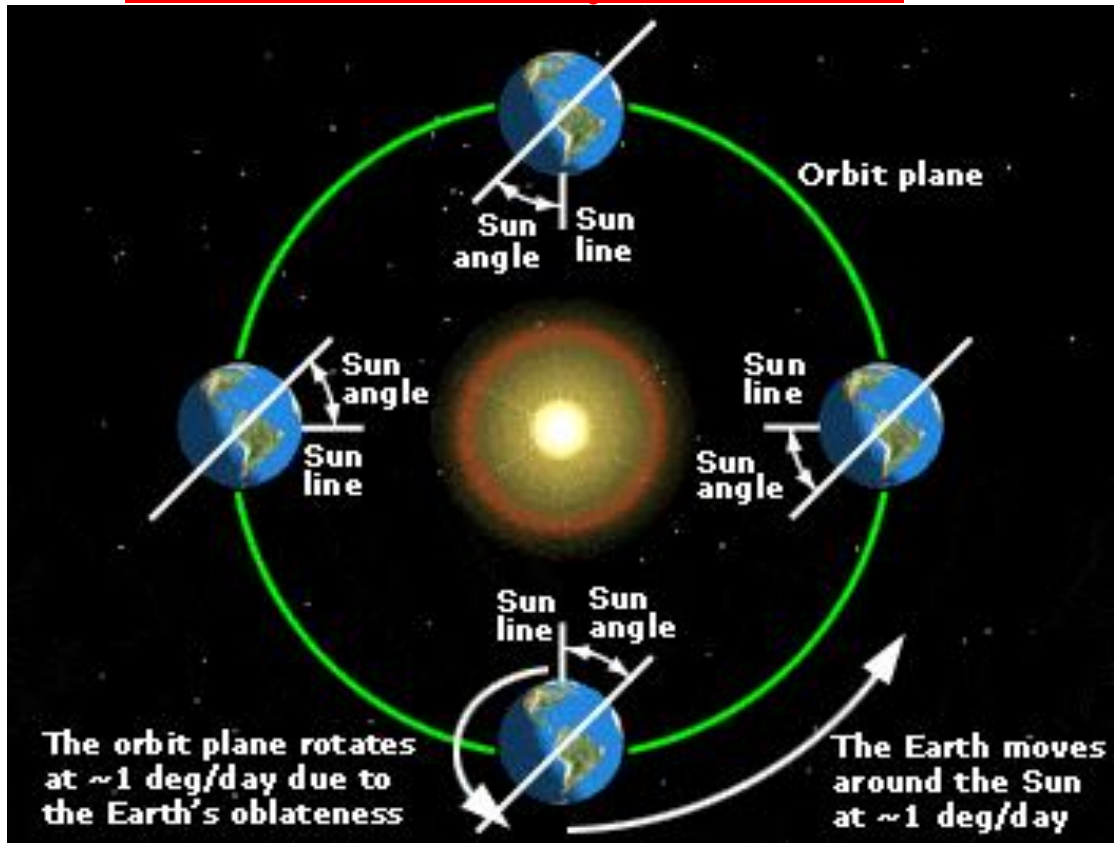
### **Geosynchronous Orbit and Geostationary Orbit**

- A geosynchronous orbit (GEO) is a prograde (in the direction of Earth's rotation), low inclination, High Earth orbit around Earth. A spacecraft in this orbit appears at a constant longitude above the Earth. The geosynchronous orbit is also called the **Clarke orbit**, as it was first popularised by the science fiction author Arthur C. Clarke.
- **Geostationary Orbit:** Geostationary orbit is a particular case of the geosynchronous orbit, with **zero eccentricity** and almost **zero inclination** (latitude), so that the spacecraft in this orbit appears stationary above a point on the Earth.
  - Such maneuvering in orbit is called **station keeping**.
- **Altitude of the Geostationary Orbit:** The Geostationary orbit (or Geosynchronous Orbit) lies exactly 42,164 kilometers from the Earth's center (35,786 kilometers from Earth's surface).
  - At this point, the **orbital period of the satellite exactly matches the rotational period of the Earth** (taking 23 hours 56 minutes, and 4 seconds) as it travels at geosynchronous speed (exactly the same speed as the Earth).
- **Applications: Weather monitoring** satellites must be placed in GEO as they need constant observation of particular areas on the surface of the Earth. Some **communication** and **navigational satellites** are also placed in this orbit.
  - **Meteorological satellites:** INSAT series (ISRO), MeteoSAT (Europe), Geostationary Operational Environmental Satellite (NASA), Geostationary Meteorological Satellite (JAXA), etc.
  - **Communication satellites:** INSAT and GSAT series of India
  - Three of the seven **NavIC** (Indian navigational satellites) satellites are placed in **geostationary orbit** whereas; four are placed in inclined geosynchronous orbit.
  - Many **high Earth-orbiting satellites** monitor solar activity and **track magnetic and radiation levels in space around them**.
- **Polar Orbit**
- Polar orbit is a Low Earth orbit where satellites travel past Earth from north to south.
- **Altitudes:** The altitudes of the polar orbits range between **200 to 1000 km**. Lower altitudes enable satellites to faster revolution. In polar orbits, satellites can complete 15 to 16 revolutions around the Earth.
- **Inclination:** Inclination of the polar orbits around 90 degrees, with a deviation ranging from 20 to 30 degrees.

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- **Eccentricity:** Polar orbit follows a circular shape; hence, eccentricity is close to zero, hence nearly circular shape.
- **Applications:** Polar orbits have specific characteristics that make them useful for various applications, particularly for Earth observation (remote sensing) and scientific research.
  - **Remote sensing:** Such applications generally use nearly polar orbits to attain global coverage. **Example is Cartosat-3.**
  - **Resource management:** Applications such as monitoring crops, forests, and even global security, as done by the **Cartosat series of ISRO.**
- **Sun-synchronous Orbit**
- It is a particular type of **Polar Orbit**, travelling over the polar regions. A typical Sun-synchronous satellite completes 14 orbits a day, and each successive orbit is shifted over the Earth's surface by around 2875 km at the equator.
- **Features:** Satellites in this orbit are **synchronous with the Sun**, i.e. they are always in the 'fixed' position relative to the Sun.
  - Hence, in this orbit, the satellite always visits the **same spot at the same local time**. For example, passing Paris every day at exactly the same time in the afternoon.
  - It has constant sun illumination through inclination and altitude.
- **Altitude:** A satellite in a Sun-synchronous orbit would often be at an altitude of between 600 to 800 km.
- **Applications:** Sun-synchronous can be used for the following purposes:
  - To investigate climate change and **weather patterns**, it enabled scientists to compare images from the same season over several years and deliver consistent information required to study phenomena like **climate change**.
  - To help **predict atmospheric disturbance and extreme events like severe cyclonic storms, etc.** For example, **SARAL** (Satellite with ARGOS and ALTIKA) is placed in the Sun-synchronous orbit for oceanographic studies.
  - Monitoring **emergencies** like forest fires or flood situations.
  - To **accumulate data** on long-term problematic events like deforestation or rising sea levels.
  - **Remote sensing applications** in the management of resources
- **Semi-synchronous orbit**
- Semi-synchronous orbit lies in the medium Earth orbit between LEO and GEO.
- **Altitude:** It is 20,200 kilometers above the surface (about 26,560 km from the center of the Earth). A satellite in this orbit takes around **12 hours** to complete one cycle.
- **Eccentricity:** The semi-synchronous orbit has a **low eccentricity (near-circular orbit)**.
- **Application:**
  - **Global Positioning System** (GPS) and **GLONASS** satellites use this orbit.





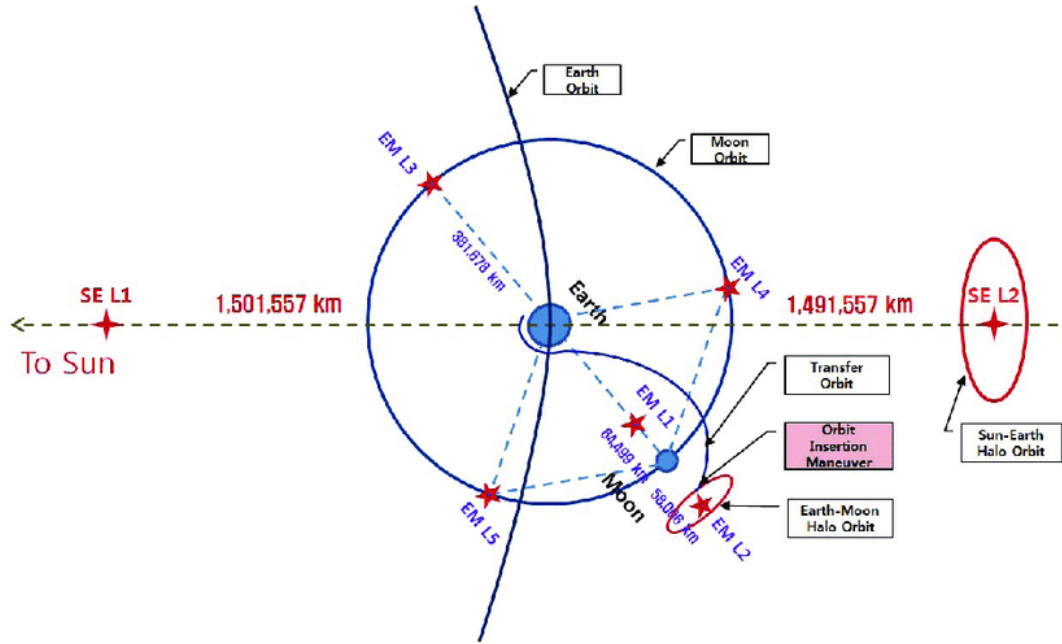
### **Molniya Orbit**

- Molniya Orbit combines **high inclination (63.4°)** with **high eccentricity (0.722)** for better observation and covering larger swaths.
- It is developed as a **high-latitude (for example, polar regions) communication** alternative to geostationary orbits.
- The high-altitude portion of the orbit repeats over the same location every day and night.
- **Applications of Molniya orbit:**
  - **High latitude observation:** Satellites in this orbit have better capability to observe events and associated phenomena in polar regions like the impact of climate change on polar regions.
  - **Meteorological observation of middle and high latitudes:** Meteorological instruments placed on a satellite in a Molniya orbit improve the temporal frequency of observation of high-latitude phenomena such as polar lows.
  - **Communications in the far north or south:** Russian communications satellites and the **Sirius radio satellites** currently use this type of orbit. It is often used by **navigation satellites**, like the European Galileo system.
- **Transfer Orbits**

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- Transfer orbits are intermediate orbits used to shift a satellite from one orbit to another. Satellites are launched from Earth and placed on a transfer orbit before finally being placed in the destination orbit in subsequent stages with the help of their propulsion systems.
- **Polar Transfer Orbit (PTO):** It is an orbit at an altitude of about 100 km below the Polar or Low Earth Orbit. Remote Sensing satellites are launched into this orbit first, and then, using their own propulsion systems, they lift themselves to the desired orbit.
- **Geostationary Transfer Orbit (GTO):** This orbit is located at a height of about 200 km below the geostationary orbit. GSS is first launched in GTO and then lifts itself using its own propulsion system to the desired orbit.
- Hence, this allows a satellite to reach smoothly in two steps more efficiently without actually needing the launch vehicle to go all the way to this altitude. It is like a stepping stone for reaching a high-altitude orbit like GEO.
- In transfer orbits, the payload uses engines to go from an orbit of one eccentricity, a measure of how circular (round) or elliptical (squashed) an orbit is, to another, which puts it on track to higher or lower orbits.
- **Lagrange Points (L-points)/Halo Orbit**
- Lagrange points are five special points of **enhanced regions of attraction and repulsion** between the Sun and the Earth system. It is named after Joseph-Louis Lagrange, an Italian-French mathematician.
- **L1:** Located between the Earth and the Sun, it gives satellites a constant view of the Sun.
  - **Aditya-L1 Mission:** It is the first space-based **observatory-class Indian solar mission to study the Sun. It is placed in a halo orbit around the Lagrangian point (L1).**
- **L2:** It is located behind the Earth. Earth is between the L2 and Sun. It is a significant place to observe the larger Universe. The James Webb Space Telescope is placed at L2.
- **Other points (L3, L4, L5):** L3 is on the other side of the Sun, opposite the Earth. L4 and L5 fall on the apex of two equilateral triangles.

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**20. Electrified Flex Fuel Vehicle, BS-VI, National Policy on Biofuels - PPP - 14**

**1. ELECTRIFIED FLEX FUEL VEHICLE**

- **Flex Fuel Vehicle (FFV)**
- India launched the world's first prototype of the BS 6 Stage II 'Electrified Flex Fuel Vehicle', developed by Toyota Kirloskar Motor.
- *FFV differ from bi-fuel vehicles by the fact that two fuels are stored in the separate tanks and engine runs on one fuel at a time in the latter.*
- **Flexible fuel-** It typically has an internal combustion engine (ICE), but unlike a regular petrol vehicle, it can *run on more than one type of fuel*, or a mixture of these fuels.
- The most common versions use a blend of *petrol and ethanol or methanol*.
- FFVs are also known as *dual-fuel vehicles*.
- They are capable of running on *100% petrol or 100% bio-ethanol or a combination of both*.
- **E20 fuel-** The original equipment manufacturers (OEMs) in India have already introduced vehicles that are compatible with E20 fuel (petrol blended with 20% ethanol).
  - The Government aims to achieve a complete *20% blending of ethanol by 2025*
- **Flex Fuel Strong Hybrid Electric Vehicles (FFSHEV)-** When FFV is integrated along with strong hybrid electric technology, it is referred as FFV-SHEVs.
- It essentially houses an *electric motor* which powers the vehicle alongside the traditional petrol engine.
- **Electrified Flex Fuel Vehicle-** It is a *100% ethanol-fuelled* variant.
- It is being seen as a broader push by the government for using alternative fuels like hydrogen, flex-fuel, biofuel etc.
- **Need for flex fuel-** To reduce carbon footprint and decrease the country's dependency on traditional fuel sources.
- This car will be the world's first BS-VI (Stage-II), which would also generate 40% electricity bringing the effective price of ethanol much

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lower.

- **Hybrid vehicles**

- **Strong hybrid** – It is another term for full hybrid vehicle capability to run solely on either electric or petrol modes

- **Mild hybrid** – They cannot run purely on one of these modes and mode merely as a supplement to the main mode of propulsion.

- **What is Hycross Prototype?**

- **Engine** - Toyota's Innova Hycross flex-fuel prototype comes with the 2-litre Atkinson Cycle petrol engine coupled with an electric motor.

- The Company claims the prototype can run on petrol with *more than 20% ethanol blending* that is currently mandated in India.

- **Performance**- It would be at par with the standard Hycross hybrid, even with ethanol-blended petrol.

- **Low carbon emission**- This will be achieved “on a comprehensive well-to-wheel basis”.

- **Energy storage**- It would run 60% of the time in the electric vehicle mode using energy stored in the battery pack, same as standard strong hybrid variant.

- **Ethanol blending**- Flex-fuel vehicles such as the prototype Hycross can run on blends of ethanol that are far higher than the current standard 20% mix (E20).

- **Fuel ratio**- This is made possible by equipping the engine with a fuel mix sensor and an engine control module (ECM) programming that senses and automatically adjusts for any ratio of designated fuels.

- ***Air fuel ratio is defined as the ratio of air and fuel of a mixture prepared for combustion.***

- **How do flex fuel cars work?**

- **Components**- Most components are the same as those in petrol-only cars.

- **Ethanol compatibility** - Special *ethanol-compatible components* are required to adjust to the different chemical properties and energy content in ethanol/ methanol, such as modifications to the fuel pump and fuel injection system.

- **Accommodate oxygen**- It is also calibrated to accommodate the higher oxygen content of ethanol.

- **Corrosion resistant**- The hybrid engine of the type used in the Hycross would have separate spark plugs, piston ring tops, and valves to render

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them more corrosion-resistant.

- **Catalyst-** A modified catalyst in the exhaust system is used to lower hydrocarbon emissions.
- The vehicle's fuel filter and fuel lines have also been tweaked.
- **Advantages of flex fuel vehicle**
- **Cheaper** - Ethanol is actually cheaper than petrol and diesel, and a higher blend of ethanol in petrol can help the government keep fuel prices in check.
- **Reduce import bill-** The program is the part of the broader strategy to cut dependence on imported crude in the *medium-to-long run*.
- The expected implementation of E20 by April 2025 is estimated to result in annual savings of Rs 35,000 crore in India's oil import bill.
- **Reduce harmful emissions-** The use of ethanol blending lowers harmful pollutants such as carbon monoxide, sulphur, and carbon and nitrogen oxides.
- **Sustainability** - Ethanol is a natural byproduct of plant fermentation, which makes it much more sustainable as compared to petrol or diesel.
- **Improved performance-** Fuel economy is generally lower with increased levels of ethanol, many flex fuel vehicles have improved acceleration performance when operating on higher ethanol blends.
- **Easier to adopt** - Flex-fuel vehicles are easier to adopt as compared to a fully battery-powered electric vehicle.
- A host of vehicles in India, including mass-market two-wheelers and cars are already E20 fuel compliant.
- *The National Biofuel Policy 2018 envisages a 2025 target of 20% blending.*
- **BRAZIL MODEL**
- **Varying fuel mix-** Countries such as Brazil can be flexible on the degree of the mix depending on crude prices, varying it when energy prices rise like they did after the Ukraine war.
- **Fuel blend-** In Brazil, nearly all cars are required to be able to handle fuel blends with a minimum of 22% ethanol.
- **Subsidy-** Brazil provides government subsidy to narrow the price gap of higher ethanol blends, in order to make the proposition viable.
- **What are the issues with flex fuel vehicle?**
- **Fuel efficiency-** Fuel efficiency takes a hit when ethanol is used as motive power.
- **Water intensive-** The source crops required for ethanol blending such

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as sugarcane are usually water guzzling crops.

- According to a NITI Aayog report, in 2019-20, more than 90% of the ethanol produced in the country came from sugarcane, which is a politically important crop in states such as Maharashtra and Uttar Pradesh.
- **Manufacturing** - Higher blending of ethanol will mean higher manufacturing costs which translates to pricier vehicles.
- Certain auto parts, especially those that come in contact with higher ethanol content, will have to be replaced with a compatible product to avoid corrosion.
- **Tax benefits** - As of now, flex-fuel vehicles carry a 28% GST, as against the 5% GST rate applicable on EVs. Tax benefits would result in the faster adoption of flex-fuel vehicles.

### **2. BS-VI Norms**

- Bharat stage (BS) emission standards are laid down by the government to regulate the output of air pollutants from internal combustion engine and spark-ignition engine equipment, including motor vehicles.
- India has adopted BS Emission Standards since 2000, modelled on European Union norms.
- The first emission norms with the name 'India 2000' were introduced in the year 2000. BS2 and BS3 were introduced in 2005 and 2010, while BS4 norms came into effect in 2017 with stricter emission standards or norms.
- The BS standards regulate tailpipe emissions of air pollutants, including particulate matter, SO<sub>x</sub>, and NO<sub>x</sub>, as well as carbon monoxide, hydrocarbons, and methane.
- Who sets them? The standards and timeline for implementation are set by the Central Pollution Control Board under the Ministry of Environment, Forests and Climate Change.
- In April 2020, India leapfrogged from BS-IV to the implementation of BS-VI. The central government has mandated that vehicle makers must manufacture, sell, and register only BS-VI (BS6) vehicles from April 1, 2020.
- It is applicable for cars, trucks, buses, three-wheelers, and two-wheelers (motorcycles, scooters, and mopeds).
- This emission norm does not apply to off-highway equipment and vehicles such as tractors, back-hoe loaders, excavators, etc.
- Difference between BS-IV and BS-VI

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- Both BS-IV and BS-VI are unit emission norms that set the maximum permissible levels for pollutants that an automotive or a two-wheeler exhaust can emit.
- Compared to BS4, BS6 emission standards are stricter.
- The main difference is in the amount of sulphur in the fuel, which is reduced from 50 ppm in BS IV fuel to 10 ppm in BS VI fuel for both gasoline and diesel. Hence, BSVI engines produce less harmful emissions and pollutants.

### **3. BIO FUEL POLICY**

- Biofuel is a type of fuel that is generated naturally or artificially from the biomass of **plant or algae material, and animal wastes**. It is considered a renewable energy source because the feedstock material can be replenished easily. They can be in solid, liquid, and gaseous forms but the liquid biofuels have the most potential to replace conventional transportation fuels.
- With rising crude oil prices, biofuels are seen as a sustainable alternative to be used mainly as a blending with petroleum-based fossil fuels. India also has set targets of 20% ethanol blending in petrol and 5% biodiesel blending in diesel by 2030 under the **National Policy on Biofuels 2018**.
- **Types of Biofuels**
- Many types of biofuels with different chemical compositions and physical properties are derived from biomass. They can replace traditional fossil fuels based on application suitability.
- **Biodiesel:** Biodiesel is a liquid fuel produced from vegetable oils and animal fats through transesterification.
  - It is used as a replacement or as a blending with petroleum-based diesel in various combinations such as B5, B20, B100, etc.
  - **B20** (commonly used due to cost-effectiveness, low emissions and compatibility with conventional engines) is a blend containing 20% biodiesel and 80% petroleum diesel.
  - **B100** (less commonly used) is a pure biodiesel.
- **Bioethanol:** Bioethanol is ethyl alcohol (Ethanol) generated through microbial fermentation of plant materials like corn, sugarcane or agricultural residues using ***Saccharomyces cerevisiae***.
  - It is mainly used as a blending agent with petrol to increase **octane** and cut down carbon monoxide and other harmful emissions.
  - E10 (10% ethanol mix) is the most commonly used blend, but other variations such as E-20 (blending target in India) are also used.
  - **E100** is pure ethanol and many countries including India are working on projects to use it as a replacement for petrol.
  - Flexible fuel vehicles can run on up to 85% ethanol blends (E85).
- **Biogas:** Biogas is a renewable fuel produced by **anaerobic digestion** of organic matter, such as **food or animal waste**, in an oxygen-free environment, either naturally occurring or intentionally created for industrial use.
  - It mainly consists of **methane**, with trace amounts of CO<sub>2</sub> and H<sub>2</sub>S, etc.
  - It is used for heating, power generation and vehicle fuel purposes



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- providing an alternative to natural gas.
- Upgraded biogas can also displace transportation and pipeline-quality natural gas.
- **Bio CNG:** Bio CNG is a **purified form of biogas**, processed to produce 95% pure methane gas, similar to commercially available natural gas.
  - The process residue is a high-quality concentrated liquid fertilizer, and CO<sub>2</sub> is measured and packed for food-grade CO<sub>2</sub>.
  - Bio-CNG is profitable due to multiple revenue streams for organic liquid and solid fertilizers.
  - It has a similar calorific value to Compressed Natural Gas (CNG) and involves commercial refining to increase methane content. The raw material is segregated biodegradable waste.
- **Biobutanol:** Biobutanol refers to butanol produced from the **fermentation of biomass** feedstocks such as starch.
  - It is unmixable in water and has a higher energy content, It can be added to diesel to reduce emissions.
  - The energy content in butanol is the highest among the other gasoline alternatives.
- **Biojet fuel:** Bio-jet fuel is aviation biofuel derived from biomass through various conversion processes such as **Fischer-Tropsch synthesis** or **synthesized paraffinic kerosene (SPK)** hydrotreating to yield a similar composition as conventional jet fuel.
  - Benefits include reduced particulate emissions, carbon footprint and contrail formation with drop-in capability for existing aircraft fleets.
  - However, availability constraints have restricted adoption to minor demonstration flights as of now.
- **Renewable Diesel:** Previously known as **green diesel**, chemically resembles petroleum diesel but is made from biomass feedstocks.
  - It is produced by hydrotreating vegetable oils and waste oils in the presence of catalysts and hydrogen under high temperatures and pressure (similar to grease oil).
  - This improves combustion efficiency compared to biodiesel while avoiding NO<sub>x</sub> emissions.
  - It has superior storage stability and cold temperature operability than biodiesel and can directly replace diesel without engine modifications.
- **Biochar:** It is the spectrum of black carbon, produced by the controlled process - **pyrolysis** of organic materials from forests and agricultural wastes.
  - It resembles normal wood **charcoal**.
  - The main objective for the production of biochar is its use in **carbon sequestration**.
  - It is speculated to have been used as a soil supplement in the Amazon basin thousands of years ago, where the regions of fertile soil known as "**Terra Preta**" (dark earth), were created by the indigenous people.
- **Bio-methanol:** Bio-methanol or renewable methanol is chemically identical to conventional methanol but produced from **syngas** obtained from the gasification of renewable feedstocks like crop residues or wood waste. Still in the demonstration phase globally.
- Other conceptual biofuel variants like bio-dimethyl ether, bio-synthetic natural gas, and biohydrogen may gain prominence in future.

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## **Generations of Biofuels**

Biofuels have evolved through different technological generations based on the type of organic feedstock used in the production:

### **Generations**

### **Key Characteristics**

- | <b>Generations</b>    | <b>Key Characteristics</b>  |
|-----------------------|---|
| <b>1st Generation</b> | <ul style="list-style-type: none"><li>- First-generation biofuels are mainly derived from consumable food items such as <b>starch, sugar, or vegetable oil.</b></li><li>- They are also known as conventional biofuels, such as ethanol prepared by the fermentation of sugarcane or sugar beets.</li></ul> <p>The most commonly known first-generation biofuels are <b>biogas, biodiesel, and bioalcohols.</b></p> |
| <b>2nd Generation</b> | <ul style="list-style-type: none"><li>- Second-generation biofuels are also called "<b>olive green</b>" or "<b>cellulosic-ethanol</b>" fuel.</li><li>- They are mainly derived from sustainable or non-food feedstocks, such as waste vegetable oil, forest residue, industry residue, and sustainable biomass.</li></ul>   |
| <b>3rd Generation</b> | <ul style="list-style-type: none"><li>- Third-generation biofuels are also known as "<b>algae fuel</b>" or "<b>oilage</b>," as they are produced from algae.</li><li>- Algae can lead to the production of all types of biofuels, such as:-<br/><b>Biodiesel, butanol, propanol, and ethanol</b>, with a high yield, of approximately ten times higher than second-generation biofuels.</li></ul>                   |
| <b>4th Generation</b> | <ul style="list-style-type: none"><li>- These latest biofuels are generated by using genetic engineering of both organisms and feedstocks for higher yields.</li><li>- Genetically modified <b>algae</b> and <b>cyanobacteria</b> are the main organisms to be used in the production of these biofuels.</li></ul>  |

### **Advantages and Applications of Biofuels**

- Biofuels provide several technical, economic and environmental benefits that make them promising substitutes for conventional fossil fuels.
- **Energy security:** Encouraging domestic production of biofuels can help reduce dependence on imported fossil fuels, thereby enhancing energy independence and supply resilience.
- In India, the current **E10 and E20** ethanol blending targets will help reduce the country's oil import burden by \$4 billion per year while also supporting the sugar industry economically.
- **Rural economy:** Additionally, farmers can earn additional revenue by selling raw materials like grain, sugar, or oilseeds to biofuel manufacturers, and
- They can also generate extra income by cultivating agricultural residues and dedicated energy crops.
- **Environmental gains:** Biofuels recycle carbon during their lifetime, unlike fossil fuels that have been buried for a long time, and therefore utilising biofuels does not increase atmospheric CO<sub>2</sub> if replantation sustains feedstock supplies.
- Furthermore, biofuels have lower particulate emissions.
- Biofuels burn cleaner with less sulfur and carbon monoxide emissions.
- Some biofuels such as biochar are being used for **carbon sequestration** in the soil.
- They will help India's environmental programmes such as the **Swachh Bharat Mission and Waste to Wealth Creation**.
- **Compatibility factor:** To make **bioethanol and biodiesel** suitable for engines and distribution infrastructure, they can be combined with current petrol and diesel supplies.
- Biofuels are mainly used in transportation as a fuel substitute, but they can also be used in smaller applications such as captive power generation, off-grid electricity supply, and power backup.
- The aviation sector is investigating blends of biofuel to lessen their carbon footprint.
- **Disadvantages of Biofuels**

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- There are numerous challenges to the development and harnessing of biofuels including the debate of food vs fuel, skewed cropping patterns, water stress market constraints etc.
- **Food vs Fuel Debate:** In the case of 1st and 2nd Generation Biofuels, using food crops like sugarcane and edible oilseeds for energy production may impact their availability for food consumption.
- India aims to achieve 20% ethanol blending with petrol by 2025-26, largely achieved through 1G ethanol from sugar cane and food grains.
- However, this large-scale cultivation may disrupt land use patterns, displacement of food crops, and increase water scarcity in water-stressed regions.
- **Suboptimal crop residue management:** Unsustainable removal of agricultural residues from the field can harm soil quality, water retention, and long-term productivity.
- **Cost competitiveness:** Biofuels like ethanol and biodiesel are not yet fully cost-competitive with petrol and diesel when considering production, distribution costs, and taxes/duties.
- **Technological barriers:**
  - Second-generation biofuels still face challenges like high costs, low yields, feedstock logistics, etc., requiring further research and development improvements.
  - In the case of **3rd** and **4th generation, Algal feedstock** growth requires overcoming challenges in maintaining optimal environments.
  - 4th generation biofuel techniques are still being developed and face uncertainty around commercial **scalability**.
- **Global Initiatives for Biofuels**
  - Globally, the use of biofuels is gaining importance due to growing concerns about energy security and the environment. Many countries are leading in the production and usage of biofuels such as Brazil (largest producer of bioethanol), EU (largest producer of biodiesel), USA, etc.
  - **Global Biofuel Alliance:** Led by India, it was launched at the G20 summit and aims to develop an alliance of governments, international organisations, and industry to facilitate the adoption of biofuels.
  - The alliance will focus on strengthening markets, facilitating global biofuels trade, developing concrete policy lesson-sharing, and providing technical support for national biofuels programs worldwide.
  - **Report on ‘Bioresources within a Net-Zero Emissions Economy’ (Energy Transitions Commission):** It recommends prioritising the use

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of biomass in sectors where there are limited low-carbon alternatives.

- **Roundtable on Sustainable Biomaterials (RSB):** It is an international initiative that brings together stakeholders such as farmers, businesses, and governments who are interested in the sustainability of biofuel production and distribution.
- It prescribes the "**RSB Certification System**" as a set of comprehensive sustainability standards.
- **Sustainable Biofuels Consensus:** It is an international initiative that aims to build collaboration among various stakeholders, including governments and the private sector, to ensure the sustainable production, trade, and use of biofuels.
- It facilitates **global biofuels trade, transport, and biofuels markets.**
- **Initiatives in India**
- The Indian Government has acknowledged the strategic role of biofuels in the Indian energy basket and prepared a road map to facilitate the early adoption of biofuels.

### **Amendments to the National Policy on Biofuels**

Ethanol, or ethyl alcohol, is a hydrocarbon that when burnt can generate heat and power engines. Since two decades, India has been moving towards putting in place an ecosystem to have more ethanol blended into petrol for use in vehicles, particularly 2- and 4-wheelers. Government records suggest about 75% of India's 220 million vehicles are 2-wheelers and 12% are 4-wheelers. Another proactive step in this regard has been taken by the government by amending the National Policy on Biofuels, 2018. The amendment has advanced the date by which fuel companies have to increase the percentage of ethanol in petrol to 20%, from 2030 to 2025. The policy of introducing 20% ethanol is expected to take effect from April 1, 2023.

#### **History of ethanol blending in India**

Since 2001, India has tested the feasibility of ethanol-blended petrol whereby 5% ethanol blended petrol or E5 (95% petrol-5% ethanol) was supplied to retail outlets. In 2002, India **launched the Ethanol Blended Petrol (EBP) Programme** and began selling 5% ethanol blended petrol in nine States and four Union Territories. It was extended to twenty States and four UTs in 2006. In 2015, the Ministry of Road Transport and Highways notified that E5 petrol and the rubber and plastic components used in gasoline vehicles produced since 2008 be compatible with the **E10 fuel**. Since 2020, India has been

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announcing its intent to achieve 10% blending by the end of 2022 and 20% blending by 2030. The Centre has also targeted 5% blending of biodiesel with diesel by 2030.

### **Current status of Ethanol Blending**

According to the Ministry of Petroleum and Natural Gas, the all India average blending stands at 9.90 (as of May 2022). Letters of Intent for supply of 468.56 crore litres of ethanol were issued at the start of this Ethanol Supply Year, out of which 415.88 crore litres has been contracted and 186.21 crore litres supplied so far.

Ethanol derived from **sugarcane juice/sugar syrup** and from **C heavy molasses** forms the bulk of this supply, with that from **surplus rice and damaged food grains** being a distant second. Around 16 lakh tonnes of sugar was subsumed to produce this ethanol.

India's current ethanol production capacity consists of 426 crore litres from molasses-based distilleries, and 258 crore litres from grain-based distilleries.

### **International experience**

Flex Fuel Engine technology (FFE), or vehicles that run entirely on ethanol, are popular in Brazil and comprise nearly 80% of the total number of new vehicles sold in 2019. The global production of fuel ethanol touched 110 billion litres in 2019, or about an average growth of 4% year per year during the last decade.

The U.S. and Brazil make up 92 billion litres, or 84% of the global share, followed by the European Union (EU), China, India, Canada and Thailand.

### **Salient features of National Biofuel Policy 2018**

**Introduced in 2018**, the National Biofuel Policy is aimed at reducing dependence on imports by encouraging fuel blending.

The Policy categorizes biofuels as – **(a) “Basic Biofuels”** viz. First Generation (1G) bioethanol & biodiesel and **(b) “Advanced Biofuels”** – Second Generation (2G) ethanol, Municipal Solid Waste (MSW) to drop-in fuels, Third Generation (3G) biofuels, bio-CNG etc..

The Policy expands the scope of raw material for ethanol production by allowing use of – **(a)** Sugarcane Juice, Sugar containing materials like Sugar Beet, Sweet Sorghum; **(b)** Starch containing materials like Corn, Cassava; **(c)** Damaged food grains like wheat, broken rice, Rotten Potatoes, unfit for human consumption for ethanol production.

With a thrust on Advanced Biofuels, the National Policy on Biofuels indicates a viability gap funding scheme for 2G ethanol Bio refineries of INR 5,000 crore in 6 years. The Policy encourages setting up of supply chain mechanisms for biodiesel production from non-edible oilseeds, used cooking oil, and short

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gestation crops. The **National Biofuel Coordination Committee (NBCC)**, with the Union Minister for Petroleum and Natural Gas as its head, is the agency to coordinate this blending programme.

### **2022 amendments to the National Policy on Biofuels**

The most important amendment has been **advancing the 20% blending date by five years** from Ethanol Supply Year (ESY) 2030 to 2025-26.

There has been an **introduction of more feedstock for production of biofuels**. Further, production of biofuels under the 'Make in India' programme in Special Economic Zones (SEZs), Export Oriented Units (EOUs); and permission to allow export of biofuels in specific cases are some other changes. Apart from addition of new members to the NBCC, the Committee has now been given the permission to change the policy which it earlier lacked.

### **Significance of adopting Ethanol Blending of Fuel**

**Reduce Import Bill:** As per a NITI Aayog Committee report of June 2021, India's net import of petroleum was 185 million tons at a cost of US\$ 55 billion in 2020-21. Most of the petroleum is used by vehicles. A successful 20% ethanol blending programme could save the country US\$4 billion per annum, or about INR 30,000 crore.

**Environment Benefits:** Ethanol burns more completely than petrol, it avoids emissions such as carbon monoxide. One crore liters of E-10 saves around 20,000 ton of CO<sub>2</sub> emissions.

**Health benefits:** Prolonged reuse of Cooking Oil for preparing food, particularly in deep-frying is a potential health hazard and can lead to many diseases. Used Cooking Oil is a potential feedstock for biodiesel and its use for making biodiesel will prevent diversion of used cooking oil in the food industry.

**MSW Management:** It is estimated that, annually 62 MMT of Municipal Solid Waste gets generated in India. There are technologies available which can convert waste/plastic, MSW to drop-in fuels. One ton of such waste has the potential to provide around 20% of drop-in fuels. (Drop-in fuels are the fuels that can be used without major change in infrastructure. Ethanol blended petrol is a drop-in fuel).

- **Challenges associated with Ethanol blending**
- **Efficiency:** It takes much more ethanol to power a vehicle's engine than petrol, therefore blending leads to a loss of efficiency. For instance, when using E20, there is an estimated loss of 6-7% fuel efficiency for 4-wheelers which are originally designed for E0 and calibrated for E10, 3-4% for 2-wheelers designed for E0 and calibrated

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for E10.

- **Harmful Residual Products:** It also leaves residual by-products that can corrode and damage the vehicle.
- **Environmental concerns:** On average, a ton of sugarcane can produce 100 kg of sugar and 70 litres of ethanol but that would mean 1,600 to 2,000 litres of water to produce 1 kg of sugar. This implies that a litre of ethanol from sugar requires about 2,860 litres of water.
- Further, tests conducted in India have shown that there is no reduction in nitrous oxides, one of the major environmental pollutants.
- **Is the new target achievable?**
- *Arguments in Favor:*
- **First**, the committee report estimates that adoption of electric vehicles should partially offset demand for ethanol leading to a lesser requirement of 722-921 crore litres in 2025.
- **Second**, the test vehicles using E20 fuel worked well in trials as per the committee report. There was not much reduction in performance and capability which should encourage its adoption.
- *Arguments against:*
- **Poor Implementation:** The 5% blending was started in 2002 and considerably expanded to various states and UTs in 2006. However, the proportion has remained low. e.g., the proportion of blending was 1.5% in 2013-14.
- **High Prices:** The prices of ethanol produced in India are higher compared to the U.S. and Brazil, because of the minimum support prices that the government provides. The cost of flex fuel vehicles (4-wheelers) could cost about ₹17,000 to ₹25,000 more than the current generation of vehicles. The 2-wheeled flex fuel vehicles would be costlier by ₹5,000 to ₹12,000 compared to regular petrol vehicles.
- **Lack of Supply:** Various experts have said that in order to achieve 20% blending, India would require a consistent supply of 1,500 crores litres of ethanol annually. This is way beyond the current production capacity.
- **Fund Crunch:** Many cooperative sugar mills have complained about a fund crunch as banks are reluctant to finance them given their weak balance-sheets.
- **Road ahead**



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- **First**, vehicles that run on ethanol need to be tuned accordingly so that they don't compromise on efficiency and usability.
- **Second**, to compensate the consumers for a drop in efficiency from ethanol blended fuels, tax incentives on E10 and E20 fuel may be considered.
- **Third**, a report by the Institute for Energy Economics and Financial Analysis (IEEFA) says that for India to meet its target, it will need to bring in additional 30,000 sq. km of land **under maize cultivation**. Further, half of this land can be used to produce **clean electricity from solar energy**.
- **Fourth**, in order to tackle the fund crunch, mills have asked for tripartite agreements between Oil Marketing Companies (OMCs), banks and cane suppliers to clear payments within 21 days.

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