

NEXT IAS

SUMMARY OF DOWN TO EARTH

[1-15 JULY, 2026]



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[1-15 July, 2026]

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SUBJECTIVE QUESTIONS

MCQS

RETHINKING ECONOMIC GROWTH: CAN POVERTY BE ERADICATED BEYOND GDP?

Context

- Recently, Elon Musk became the **world's first trillionaire**, symbolizing unprecedented wealth creation in the global economy. At the same time, billions continue to struggle with poverty, highlighting the growing challenge of **economic inequality** and raising questions about the effectiveness of the current growth-centric development model.

Global Wealth and Inequality: Key Facts

- Elon Musk's net worth crossed **US\$ 1 trillion**, making him wealthier than the combined wealth of nearly **46% of the world's population** (Oxfam).
- The number of global billionaires exceeded **3,000 in 2025**.
- According to **Oxfam**, the richest **1% increased their wealth by over US\$ 33.9 trillion (2015–2025)**.
- Around **3.4 billion people** live in countries spending more on **debt servicing than on health or education** (UNCTAD).
- Nearly **one in ten people** worldwide continues to live in **extreme poverty**.
 - These figures indicate that while wealth generation has accelerated, its distribution remains highly unequal.

Why Has Growth Failed to Eliminate Poverty?

- The traditional economic assumption has been that **higher GDP growth eventually benefits everyone** ('trickle-down economics'). However, recent global trends challenge this belief.

Major Concerns

- Decoupling of Growth and Shared Prosperity:** National incomes have increased. Wage growth has remained stagnant. Employment has become increasingly informal and precarious. Public investment in health, education and social protection has weakened.

- Rising Wealth Concentration:** Wealth is increasingly concentrated among a small section of society. Corporate dominance influences policy-making and weakens democratic accountability.
- Persistent Poverty:** Despite decades of economic expansion, extreme poverty remains widespread. Regional disparities and unequal access to opportunities continue to limit inclusive development.

Roadmap for Eradicating Poverty Beyond Growth

- Shift Beyond GDP:** GDP should not be the sole indicator of development. Greater emphasis should be placed on **human well-being, equity and sustainability**.
- Reduce Inequality:** Redistribute income, wealth and opportunities. Address inequalities in power, status and political representation.
- Strengthen State Intervention:** Governments should use progressive taxation, fiscal policy, monetary policy, competition policy, financial regulation, and social welfare programmes.
- Ensure Universal Basic Services:** Quality healthcare, education, nutrition, social security, and affordable housing.

Arguments Supporting the New Approach

- Promotes **inclusive development**.
- Reduces social and regional inequalities.
- Strengthens democratic institutions.
- Improves human development outcomes.
- Aligns with the **Sustainable Development Goals (SDGs)**, especially **SDG 1 (No Poverty)** and **SDG 10 (Reduced Inequalities)**.

Concerns and Criticisms

- Economic growth remains essential for employment generation, revenue mobilisation, infrastructure development, and technological innovation.
- Excessive redistribution may discourage private investment and entrepreneurship.
- Developing countries require sustained growth to achieve structural transformation.

- Thus, redistribution cannot completely substitute economic growth.

India's Perspective

- India follows the principle of **inclusive growth**, combining rapid economic expansion with social welfare.
- **Major Initiatives:**
 - PM Garib Kalyan Yojana
 - PM Jan Dhan Yojana
 - MGNREGA (now as VB-G RAM G Act)
 - Ayushman Bharat
 - National Food Security Act
 - Aspirational Districts Programme
 - Digital Public Infrastructure (JAM Trinity, UPI, DBT)
- These initiatives seek to ensure that the benefits of growth reach vulnerable sections of society.

Way Forward

- Pursue **high but inclusive economic growth**.
- Strengthen progressive taxation while ensuring a stable investment climate.
- Expand investments in health, education and skill development.
- Improve social protection and labour rights.
- Reduce wealth concentration through effective competition policy and transparent governance.
- Adopt multidimensional indicators such as the **Human Development Index (HDI)** and **Multidimensional Poverty Index (MPI)** alongside GDP.

COAL USE CONTINUES DESPITE BAN: COMPLIANCE GAPS AND AIR QUALITY CHALLENGES

Context

- Despite the **Commission for Air Quality Management (CAQM)** banning the use of coal in brick kilns across the National Capital Region (NCR), a significant majority of brick kilns continued using coal during **2025–26**.

Key Findings of the Survey

- **Continued Use of Coal:** In **2025**, around **77%** of the **128 surveyed brick kilns** used coal.
 - In **2026**, **72%** of the **152 surveyed kilns** continued using coal.
 - None of the kilns relied solely on coal; most used a combination of **coal and loose biomass**.

72% of kilns used coal in 2026 despite prohibition

78% kilns had no green cover in 2026

60 kiln owners did not receive formal order on coal ban

- **Adoption of Zig-Zag Technology:** All surveyed kilns had shifted from **Fixed Chimney Bull's Trench Kiln (FCBTK)** technology to **zig-zag kiln technology**, as mandated by CAQM.
 - However, nearly **70%** of the kilns suffered from cracked structures, broken walls, or poor-quality plaster, resulting in higher fuel consumption and reduced operational efficiency.
- **Poor Environmental Compliance:** Lack of green cover remained a major concern:
 - **2025:** 105 out of 128 kilns had no plantation.
 - **2026:** 118 out of 152 kilns lacked green cover.
 - Only **two kilns** had adequate plantation.
- **Inadequate Monitoring Infrastructure:** All kilns possessed the required monitoring facilities such as portholes, ladders, and platforms.
 - However, only about **36%** had safe monitoring platforms in 2025, and around **40%** had safe platforms in 2026.
- **Regulatory and Institutional Gaps:** No formal communication regarding the coal ban from **CAQM** or **State Pollution Control Boards (SPCBs)**.
 - No technical training or awareness programmes on cleaner fuel alternatives.

- No financial assistance or incentives for transitioning away from coal.
- **Significance for Air Quality:** Brick kilns are among the major contributors to **PM_{2.5}**, **PM₁₀**, **sulphur dioxide (SO₂)**, **nitrogen oxides (NO_x)**, and **black carbon emissions** in the NCR.
- Continued coal use undermines efforts to improve air quality and achieve compliance with the **NCAP** and **CAQM** directives.
- Structural deficiencies in zig-zag kilns reduce fuel efficiency and increase emissions despite technological upgrades.

Do You Know?

- **Commission for Air Quality Management (CAQM):** Statutory body established under the **Commission for Air Quality Management in National Capital Region and Adjoining Areas Act, 2021**.
- **Zig-Zag Kiln Technology:** Improves combustion efficiency, lowers coal consumption, and reduces particulate emissions compared to traditional **FCBTK** technology.
- **National Clean Air Programme (NCAP):** Launched in 2019 to reduce particulate pollution through city-specific action plans.

Way Forward

- Ensure effective enforcement of **CAQM** directions through regular inspections.
- Improve communication between regulators and brick kiln operators.
- Promote cleaner fuels such as **piped natural gas (PNG)**, **biomass pellets**, and **other approved alternatives**.
- Provide financial incentives and technical assistance for cleaner technologies.
- Strengthen third-party monitoring and emission audits.
- Develop mandatory green belts around kiln premises to reduce dust pollution.
- Build the capacity of kiln owners through awareness and training programmes.

RECOGNITION OF UNPAID CARE WORK: SUPREME COURT'S JUDGMENT ON HOMEMAKERS

Context

- Recently, the **Supreme Court of India** ruled that **₹30,000 per month** should be treated as the **minimum notional monthly income of a homemaker** while calculating compensation under the **Motor Vehicles Act, 1988**, in cases involving the death of a homemaker.

Background

- The case originated from a **motor accident compensation claim in Punjab** nearly 25 years ago.
- The deceased woman was a homemaker with no direct monetary income.
- The legal issue was how to assess the economic value of her unpaid domestic services.
- The Supreme Court settled the matter by fixing a benchmark income of **₹30,000 per month** for compensation purposes.

Key Observations of the Supreme Court

- Homemakers should not be treated as **financial dependents** merely because they do not earn wages.
- The functioning of a household depends significantly on unpaid domestic labour.
- The Court described homemakers as **nation builders**; providers of essential caregiving and household services; and contributors to the economy whose work remains undervalued.

Economic Value of Unpaid Care Work

- According to national and international estimates:
 - Around **16 billion hours** are spent globally every day on unpaid domestic and care work.
 - Women perform a disproportionately large share of this work.
 - Women's unpaid caregiving is estimated to contribute **15–17% of India's GDP**, despite remaining outside formal economic accounting.

Significance of the Judgment

- **Recognition of Invisible Labour:** Acknowledges the economic contribution of homemakers.
 - Challenges the perception that unpaid work has no monetary value.
- **Gender Justice:** Strengthens constitutional values of **equality (Article 14)** and **dignity (Article 21)**.
 - Promotes recognition of women's contribution to family and society.
- **Uniform Compensation Standard:** Establishes a benchmark for Motor Accident Claims Tribunals across India.
 - Reduces arbitrariness in compensation.
- **Policy Implications:** May influence debates on valuation of unpaid work, social security for homemakers, gender-sensitive economic policies, time-use surveys and national accounting.

Other Constitutional Provisions

- **Article 15(3):** Special provisions for women.
- **Article 39(a):** Adequate livelihood.
- **Article 39(d):** Equal pay for equal work.
- **Article 42:** Just and humane conditions of work.
- **Article 51A(e):** Duty to renounce practices derogatory to women's dignity.

Related Government Initiatives

- **Time Use Survey (National Statistical Office):** It measures time spent on paid and unpaid activities. It provides evidence for policymaking on unpaid care work.
- **Mission Shakti:** Umbrella scheme for women's empowerment and safety.
- **Beti Bachao Beti Padhao:** It promotes education and empowerment of women.
- **National Policy for Women (Draft):** It recognises unpaid domestic and care work in policy discussions.

Challenges in Recognising Unpaid Care Work

- Exclusion from GDP calculations.
- Lack of social security for homemakers.

- Gender stereotypes assigning domestic work solely to women.
- Absence of wages, pensions, or insurance for unpaid caregivers.
- Difficulty in assigning monetary value uniformly.

Way Forward

- Incorporate unpaid care work in economic planning through regular **Time Use Surveys**.
- Expand social security and insurance coverage for homemakers.
- Promote equal sharing of household responsibilities.
- Improve gender-sensitive budgeting.
- Increase awareness regarding the economic value of domestic work.
- Strengthen data collection on unpaid labour for evidence-based policymaking.

BOTS OVERTAKE HUMANS ON THE INTERNET: IMPLICATIONS OF THE AI-DRIVEN WEB

Context

- According to **Cloudflare Radar**, bots now account for **57.5% of global web requests**, while human-generated traffic constitutes **42.5%**.

What are Internet Bots?

- Bots are software programs that perform automated tasks over the internet.
- Modern AI has expanded their role in information retrieval, content analysis and online task execution, while traditionally used for indexing websites and monitoring networks.

Major Types of Bots

- **AI Crawlers:** Scan websites systematically. Used for search indexing and training Large Language Models (LLMs). Similar to traditional search-engine crawlers but with broader AI applications.
- **AI Fetchers:** Retrieve real-time information in response to user queries. Collect data such as prices, weather, news, stock values and product availability. Used by AI assistants like ChatGPT, Gemini, Claude and Perplexity.

- **AI Agents:** Perform multi-step tasks on behalf of users. Compare products, book services, summarize information and automate online actions. Represent the next generation of intelligent automation.

Why is Bot Traffic Increasing?

- **Rise of AI Assistants:** Modern AI systems increasingly access real-time internet data instead of relying only on pre-trained knowledge.
- **Shift from Search Engines to Answer Engines:** Earlier, users searched and visited multiple websites.
 - AI now gathers information from different sources and provides a consolidated answer.
 - It reduces the need for users to visit original websites.
- **Rapid Growth:** Fastly reported nearly **30% growth** in AI-related bot requests between January and May 2026.
 - Claude-related traffic increased by over **555%** during the same period.

How Bots Differ from Human Users?

- **Continuous Activity:** Humans follow daily and weekly usage patterns. Bots operate **24×7** without interruption.
- **Higher Infrastructure Demand:** Over **51%** of bot requests require direct access to origin servers.
 - Less than **9%** of human requests require such access.
 - Bots frequently seek fresh information such as breaking news, prices and inventory.
- **Emergence of the 'Zero-Click Internet':** AI platforms increasingly provide complete answers within their own interfaces. As a result:
 - Users spend less time on original websites.
 - Website traffic declines.
 - Publishers lose advertising revenue and user engagement.

Concerns for Publishers

- **Loss of Revenue:** Content is summarized by AI without users visiting the original source.

- **Copyright and Fair Compensation:** Questions arise regarding ownership of digital content, licensing for AI training, and revenue-sharing mechanisms.
- **Regulatory Developments:** The **UK Competition and Markets Authority (CMA)** has asked Google to provide publishers greater control over AI use of their content.
 - Google has begun testing publisher opt-out mechanisms for AI-generated search features while retaining traditional search visibility.

Implications

- **Positive:** Faster access to information; improved digital services; automation of repetitive online tasks; better productivity through AI agents; and enhanced user convenience.
- **Challenges:** Decline in publisher traffic and income; rising pressure on internet infrastructure; increased cybersecurity risks from malicious bots; copyright and intellectual property concerns; reduced transparency regarding information sources; and potential spread of misinformation through AI-generated summaries.

India's Perspective

- India's expanding digital ecosystem under **Digital India**, increasing AI adoption and growing digital public infrastructure make balanced governance of AI bots essential.
- Relevant initiatives include:
 - **IndiaAI Mission**
 - **Digital Personal Data Protection Act, 2023**
 - **National Cyber Security Strategy (proposed)**
 - **Bhashini** for AI-enabled language technologies
 - **Digital India Programme**
- A balanced framework should encourage AI innovation while protecting publishers, ensuring fair competition and promoting responsible use of digital content.

Way Forward

- Develop transparent AI content licensing frameworks.
- Strengthen copyright protection and revenue-sharing mechanisms.
- Promote responsible AI governance and accountability.
- Encourage publishers to adopt AI-friendly business models.
- Improve bot identification and traffic management.
- Foster international cooperation on AI regulation and internet governance.

FOREST DIVERSION IN INDIA

Context

- Resistance against forest diversion is increasing across India, with the **Hasdeo Arand forests (Chhattisgarh)** emerging as a major flashpoint.
- Official records reveal that **over 2.8 million trees** on forest land were approved for felling or recorded as felled between **July 2023 and May 2026** due to projects such as mining, hydropower and infrastructure.

Key Findings

- **Scale of Forest Diversion:** 288 forest diversion proposals were examined.
 - **242 proposals (over 80%)** received approval under the **Van (Sanrakshan Evam Samvardhan) Adhiniyam, 1980**.
 - Around **22,644 hectares** of forest land were



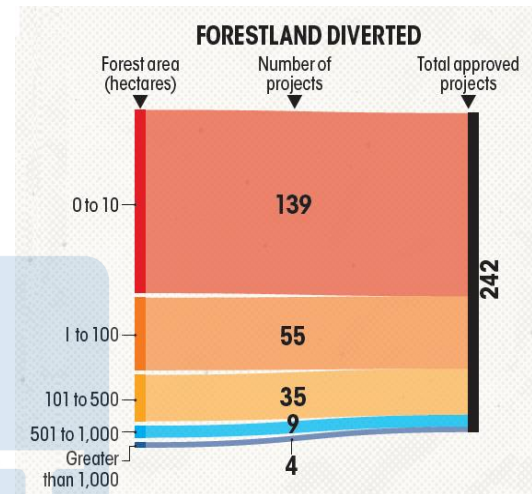
diverted for non-forestry purposes.

- Forest land was diverted across **27 sectors**.

Sector-wise Tree Felling:

- Mining: 1.35 million
- Hydropower: 0.93 million
- Rehabilitation: 0.23 million
- These three sectors together accounted for **nearly 90%** of the recorded tree felling.

State-wise Highlights:



- **Arunachal Pradesh:** Highest number of trees approved for felling (over **0.5 million**).
- **Odisha**
- **Chhattisgarh**
- **Largest Single Project:** **Kente Extension Opencast Coal Mine, Hasdeo Arand (Chhattisgarh)**
 - More than **0.4 million trees** approved for felling.
 - Spread across the **Surguja division**.
 - Associated with extensive public protests.

Hasdeo Arand Controversy

- Hasdeo Arand is one of India's largest contiguous forest landscapes and an important elephant corridor.
- **Major Issues:** Proposed diversion of over **1,700 hectares** of forest. Allegations of violation of **Forest Rights Act (FRA), 2006**; non-compliance with **PESA Act, 1996**; absence of mandatory **Gram Sabha consent**; and alleged forged signatures and fake consent letters.

- **Environmental Concerns:** Wildlife Institute of India (WII) warned about biodiversity loss, threat to the Hasdeo River, increased human-elephant conflict, and habitat fragmentation.

Legal Framework Governing Forest Diversion

- **Van (Sanrakshan Evam Samvardhan) Adhiniyam, 1980:** Formerly known as the **Forest (Conservation) Act, 1980**.
 - It aims to regulate diversion of forest land for non-forest purposes through prior approval of the Central Government.
- **Forest Rights Act (FRA), 2006:** It recognises individual forest rights, community forest resource rights, and rights of Scheduled Tribes and Other Traditional Forest Dwellers.
 - Gram Sabha consent is essential before diversion affecting recognised rights.
- **Panchayats (Extension to Scheduled Areas) Act (PESA), 1996:** It is applicable to Scheduled Areas. It provides:
 - Self-governance to tribal communities.
 - Mandatory consultation/consent of Gram Sabha in matters relating to land acquisition and development projects.

Constitutional Provisions

- **Article 48A:** Protection and improvement of the environment.
- **Article 51A(g):** Fundamental duty to protect forests and wildlife.
- **Fifth Schedule:** Protection of tribal interests in Scheduled Areas.

Environmental Implications

- **Ecological:** Loss of biodiversity; habitat fragmentation; decline in carbon sequestration; soil erosion; increased sedimentation of rivers; and disruption of elephant corridors.
- **Climate Change:** Reduced carbon sink capacity; increased greenhouse gas emissions; and greater vulnerability to extreme weather.
- **Hydrological Impact:** Reduced groundwater recharge, altered watershed functions, greater flood and drought risks.

Socio-economic Implications

- **Impact on Tribal Communities:** Displacement; loss of livelihood; cultural disintegration; food insecurity; and conflict over land rights.
- **Development Concerns:** Projects contribute to energy security, mineral extraction, infrastructure development, and employment generation.
 - Hence, balancing development with ecological sustainability remains a major governance challenge.

Issues in Forest Diversion Process

- High approval rate (**80%**) raises concerns about the rigor of environmental scrutiny.
- Tree enumeration absent in several projects.
- Inadequate cumulative impact assessments.
- Weak implementation of FRA and PESA.
- Limited transparency in public consultation.
- Questions over compensatory afforestation effectiveness.

Related Government Measures

- Compensatory Afforestation Fund (CAMPA)
- National Mission for a Green India
- National Afforestation Programme
- Forest Survey of India (FSI) monitoring
- PARIVESH Portal for online environmental clearances
- National Biodiversity Action Plan

Way Forward

- Ensure strict implementation of **FRA** and **PESA**.
- Make **Gram Sabha consent** transparent and verifiable.
- Conduct independent cumulative environmental impact assessments.
- Strengthen biodiversity valuation before forest diversion.
- Prioritise degraded land over dense forests for development projects.
- Improve quality and survival rate of compensatory afforestation.

- Enhance satellite-based monitoring and public disclosure of diversion data.
- Promote sustainable mining and renewable energy planning.
- Integrate ecological economics into project appraisal.

FOREVER CHEMICALS (PFAS) IN THE GANGA

Context

- Scientists warn that most **‘forever chemicals’** in the **Ganga** remain unidentified, raising concerns about the true scale of pollution in the river.
- It raises serious concerns over the scale of hidden pollution in a river that supports nearly **7% of the global population**.

What are Per- and Polyfluoroalkyl Substances (PFAS)?

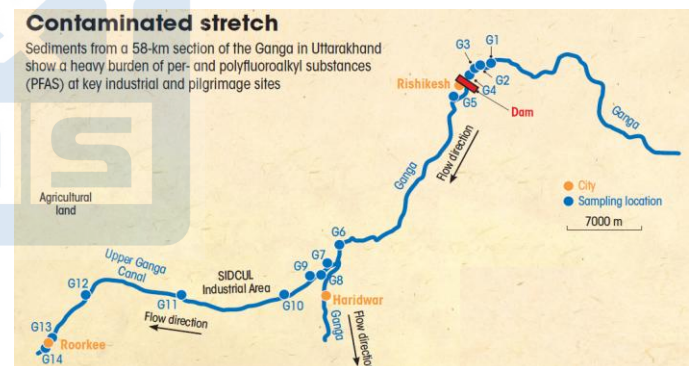
- They are a group of **synthetic fluorinated organic chemicals** widely used in industrial and consumer products due to their resistance to heat, water, oil, and stains.
- **Common Uses:**
 - Non-stick cookware (e.g., Teflon coatings)
 - Waterproof and stain-resistant textiles
 - Food packaging
 - Firefighting foams
 - Cosmetics
 - Pharmaceuticals
 - Industrial manufacturing

Why are they called ‘Forever Chemicals’?

- Possess an extremely strong **Carbon-Fluorine (C-F) bond**, one of the strongest in organic chemistry.
- Resist degradation in the environment.
- Persist in **water, soil, sediments, wildlife, and human blood** for decades.

Key Findings of the Study

- **Hidden PFAS Pollution:** Study conducted on **14 locations** across a **58-km stretch** of the Ganga between **Rishikesh and Roorkee (Uttarakhand)**.
 - Conventional analysis identified only **16 known PFAS compounds**.
 - Known PFAS concentration: **0.02–5.3 ng/g of sediment**
 - Total Extractable Organic Fluorine (EOF): **180–780 ng/g**
 - Indicates that **over 99% of fluorinated compounds remain unidentified**.
- **Industrial Hotspots:** Higher fluorine concentrations were recorded near Industrial Corridor, Pharmaceutical industries, cosmetic manufacturing units, and industrial manufacturing facilities.
 - Other contributors include untreated municipal sewage, urban wastewater discharge, and improper waste disposal.



What are PFAS Precursors?

- These are chemicals that are not highly persistent initially, but degrade over time into terminal PFAS, which remain permanently in the environment.
 - After oxidation, precursor-derived PFAS accounted for **up to 26%** of the fluorine burden.
 - **Concern:** River sediments act as **hidden reservoirs** of contamination. During Floods, monsoons, dredging, and sediment disturbance, PFAS can re-enter river water and spread to agricultural fields, fisheries, floodplains, and groundwater.

- **Dominance of Short-Chain PFAS:** The study found widespread occurrence of short-chain PFAS, and ultra-short-chain PFAS.

Significance

- **Stockholm Convention on Persistent Organic Pollutants (POPs):** Although they bioaccumulate less in humans, they move rapidly through water, spread over large distances, remain highly persistent and are difficult to remove from drinking water.

Health Impacts of PFAS

- Scientific studies associate PFAS exposure with various cancers, thyroid disorders, immune suppression, liver damage, reproductive disorders, developmental abnormalities, hormonal imbalance, and reduced vaccine effectiveness.
- **Environmental Impacts:** Long-term contamination of rivers and groundwater, bioaccumulation in aquatic organisms, entry into the food chain, threat to biodiversity, reduced soil quality, and increased drinking water treatment costs.

Why is PFAS Monitoring Difficult?

- **Conventional Techniques:** The study used targeted LC-MS/MS (Liquid Chromatography–Tandem Mass Spectrometry); non-targeted screening; extractable Organic Fluorine (EOF) analysis; and Direct Total Oxidisable Precursor Assay (DTOPA).
 - However, existing methods identify only a small fraction of PFAS, thousands of PFAS variants remain undetected, and sources of contamination become difficult to trace.
- **India's Regulatory Status:** At present, India has **no national PFAS standards** for drinking water, river sediments, soil, and food.
 - Lacks a dedicated national PFAS monitoring programme.
 - It creates challenges in risk assessment, pollution control, drinking water treatment, and public health protection.

Way Forward

- **Strengthen Monitoring:** Develop a nationwide PFAS surveillance programme. Include PFAS in routine river monitoring.

- **Establish Standards:** Formulate Indian standards for drinking water, sediments, soil, and food.
- **Source Identification:** Map industrial hotspots, and regulate high-risk industries.
- **Improve Wastewater Treatment:** Upgrade sewage treatment plants (STPs), and mandate industrial effluent treatment for PFAS removal.
- **Build Analytical Capacity:** Strengthen laboratories with advanced PFAS detection techniques, and promote research on emerging contaminants.
- **Adopt Precautionary Principle:** Reduce PFAS use wherever safer alternatives exist, and promote green chemistry and sustainable manufacturing.
- **Public Awareness:** Educate industries and citizens about PFAS risks, and encourage responsible disposal of PFAS-containing products.

LAC CULTIVATION IN INDIA & NEED FOR A 'LAC REVOLUTION'

Context

- Despite India being the world's largest producer and exporter of lac, domestic production has witnessed sharp fluctuations, raising concerns over sustainability and export competitiveness.

What is Lac?

- **Lac** is a natural resin secreted by the female **lac insect (*Kerria lacca*)**. It is the **only commercially exploited natural resin of animal origin**.
- India is the **largest producer and exporter** of lac globally.
- Major producing states are Jharkhand (~54% of production), Chhattisgarh, Madhya Pradesh, West Bengal, Maharashtra, and Odisha.

Types of Lac in India

- **Rangeeni Lac:** Deep red; From Palash, Indian jujube (Ber); and declining due to pests & climate stress
- **Kusmi Lac:** Light coloured; from Kusum; Increasing initially but now also under stress

Economic Importance of Lac

- **Industrial Uses:** Shellac for pharmaceuticals (tablet coating); cosmetics; food processing; furniture polish; perfumes; toys; electrical insulation; defence ammunition coating; and aircraft components.
- **Livelihood Importance:** Supports **3–4 million families**. Major source of supplementary income for tribal farmers. Generates significant export earnings.

Major Challenges

- **Climate Change:** Erratic rainfall, dense fog, excessive mist, heat waves, and hailstorms. These affect survival of insects, resin secretion, harvest quality, and productivity.
- **Pest and Disease Attacks:** Higher temperatures increase vulnerability to parasitoids, pathogens, and fungal infections.
 - Major pest is **Aprostocetus purpureus**.
- **Biological Impact:** Studies by ICAR indicate rising temperatures distort the **male-female ratio**. More males and fewer females reduce lac secretion because **only females produce resin**.
- **Declining Host Tree Health:** Heavy rainfall causes poor drying of branches, fungal infestation, and lower broodlac survival.
- **Labour Constraints:** Migration due to crop failures. Women and children often cannot climb tall host trees, reducing harvesting capacity.
- **Policy Gaps:** Lac is often treated as a **Minor Forest Produce (MFP)** rather than a mainstream agricultural commodity.
 - Lack of organized commercial cultivation.
 - Limited institutional procurement.
 - MSP remains outdated despite rising market prices.
- **Emerging Concern:** Due to declining domestic production:
 - India is importing lac from **Indonesia and Thailand**.
 - Global buyers may gradually shift to competing producers if supply shortages persist.

Climate Adaptation Measures

- ICAR has identified climate-resilient host plants:
 - **Flemingia semialata:** Drought tolerant, better broodlac retention, and suitable for Kusmi lac.
 - **Calliandra calothyrsus:** Fast growing, drought resistant, and supports both Rangeeni and Kusmi lac.
 - Farmers in Jharkhand have begun adopting these species following ICAR-NISA training.

Government and Institutional Support

- **ICAR–National Institute of Secondary Agriculture (ICAR-NISA):** Climate-resilient host plant research; farmer training; pest management; and improved broodlac technologies.
- **TRIFED:** Procures lac under MSP mechanism. Current MSP remains far below prevailing market prices, limiting its effectiveness.

Way Forward: Towards a ‘Lac Revolution’

- Grant **full agricultural commodity status** to lac.
- Revise MSP periodically based on market conditions.
- Expand climate-resilient host plantations.
- Strengthen pest surveillance and integrated pest management.
- Promote scientific broodlac production.
- Improve extension services and farmer training.
- Develop organized value chains and processing infrastructure.
- Enhance insurance and climate-risk support for lac farmers.
- Increase investment in R&D and climate adaptation.

ILLNESS-LINKED SUICIDES IN INDIA

Context

- According to the NCRB's **Accidental Deaths and Suicides in India (ADSI) 2024** report, **30,617 people died by suicide due to illness in 2024**, making illness the **second-largest cause of suicide** in India after family problems.

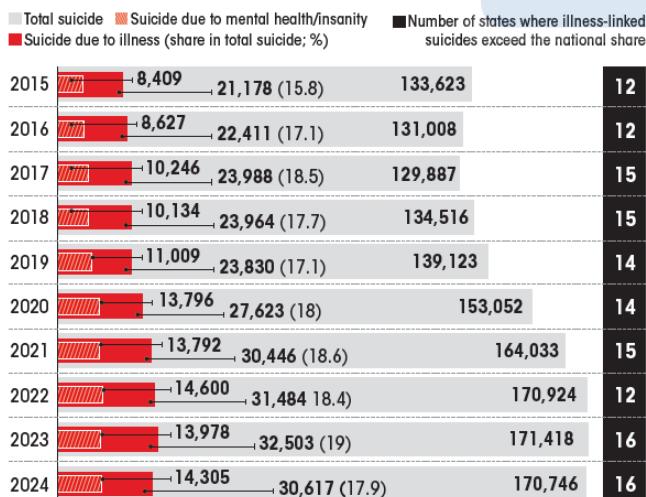
- Punjab has emerged as the state with the **highest proportion of illness-related suicides**, exposing a deep mental health crisis.

Key Highlights

- **National Scenario:**
 - Total suicides in India (2024): **1,70,746**
 - Suicides due to illness: **30,617 (18%)**
 - Suicides due to mental illness: **14,305**
 - Suicides due to prolonged diseases: **14,075**
 - Average **84 people died by suicide every day** due to illness.
 - Illness-related suicides increased by **about 45% between 2015 and 2024**.
- **Punjab: A Matter of Serious Concern:**
 - Total suicides (2024): **2,229**
 - Illness-related suicides: **1,123 (50.4%)**
 - Highest share among all States and Union Territories.
 - Since **2020**, Punjab has consistently recorded the highest proportion of illness-related suicides.

The burden of illness

Illness-related suicides have increased over the past decade, and now make up a fifth of all suicides in India



Source: "Accidental Deaths and Suicides in India 2024" report by the National Crime Records Bureau

Major Causes

- **Rising Mental Health Burden:** Depression, anxiety and other psychiatric disorders often remain **undiagnosed and untreated**.

- Mental illness accounted for nearly **95% of illness-related suicides in Punjab**.
- **Chronic Diseases:** Long-term illnesses such as diabetes, cancer and other chronic conditions create physical suffering, financial burden, emotional distress, and caregiver stress.
- **Financial Distress:** High medical expenditure pushes families into debt; and loss of livelihood and indebtedness increase psychological pressure.
- **Agrarian Stress:** Commercialisation of agriculture has increased farmer indebtedness, income uncertainty, market volatility, and psychological vulnerability.
- **Substance Abuse:** Drug addiction aggravates depression and other mental disorders, especially in Punjab.
- **Treatment Gap:** India faces an estimated **85% treatment gap** in mental healthcare.
 - Rural populations have limited access to psychiatrists and counselling services.

Challenges

- **Underreporting of Suicides:** It is argued that NCRB statistics are based on reported police cases and may underestimate the true burden, especially in rural and remote areas.
- **Poor Mental Health Infrastructure:** Shortage of psychiatrists and psychologists. Limited counselling facilities at Primary Health Centres. Long travel distances and wage loss discourage treatment.
- **Social Stigma:** Mental illness is often viewed as a social taboo. Families hesitate to seek timely professional help.
- **High Out-of-Pocket Healthcare Expenditure:** Medical treatment for chronic illnesses often leads to financial hardship, worsening mental stress.

Government Initiatives

- National Mental Health Programme (NMHP)
- District Mental Health Programme (DMHP)
- National Tele-Mental Health Programme (Tele-MANAS)
- Mental Healthcare Act, 2017

- Ayushman Bharat – Health and Wellness Centres, which integrate mental healthcare into primary healthcare.

Way Forward

- **Strengthen Mental Healthcare:** Increase the number of mental health professionals. Integrate mental health services into primary healthcare. Expand Tele-MANAS and digital counselling.
- **Improve Financial Protection:** Provide travel assistance and wage compensation for mental health patients. Strengthen financial support for families facing catastrophic health expenditure.
- **Community-Based Interventions:** Promote mental health awareness in schools, colleges and workplaces. Train ASHA workers and community health workers to identify early signs of psychological distress. Encourage community support groups and counselling services.
- **Address Socio-Economic Stress:** Strengthen farmer welfare measures. Improve access to affordable healthcare. Expand social security and livelihood support.
- **Improve Data Collection:** Strengthen suicide surveillance systems. Encourage accurate reporting to design evidence-based interventions.

MARINE LITTER: A GROWING THREAT

Context

- Recent incidents such as the **MSC Elsa-3 shipwreck (2025)** off the Kerala coast, increasing plastic accumulation along Indian beaches, and India's efforts to formulate a **National Marine Litter Policy** have brought **marine litter, particularly plastic pollution** into focus.

What is Marine Litter?

- According to **UNEP**, **Marine litter** refers to any persistent, manufactured or processed solid material discarded, disposed of or abandoned in the marine and coastal environment.
- **Major components** are plastics (largest share), fishing gear, glass, metal, rubber, and textiles.
 - Among these, **plastic accounts for nearly 80% of marine litter**.

Global Scenario

- According to **UNEP and World Ocean Assessment (2025)**:
 - Around **400 million tonnes** of plastic are produced annually.
 - Only about **10%** is recycled.
 - Around **52 million tonnes** enter the oceans every year.
 - Plastic threatens nearly **4,000 marine species**.
 - Every day, nearly **2,000 garbage trucks** worth of plastic enter oceans, rivers and lakes.
- There are **five major ocean garbage patches**, formed due to ocean gyres.

Sources of Marine Litter

- **Land-Based Sources (70–80%):** These include municipal solid waste, household waste, industrial waste, tourism, construction debris, stormwater drains, and rivers carrying urban waste.
 - **UNEP** estimates nearly 80% of marine litter originates from land.
- **Sea-Based Sources:** Fishing vessels, ghost fishing nets, cargo ships, offshore industries, aquaculture, and ship accidents.
 - **MSC Elsa-3 shipwreck** released large quantities of plastic nurdles along Kerala, Tamil Nadu and Sri Lankan coasts.

Pathway of Plastic to Oceans

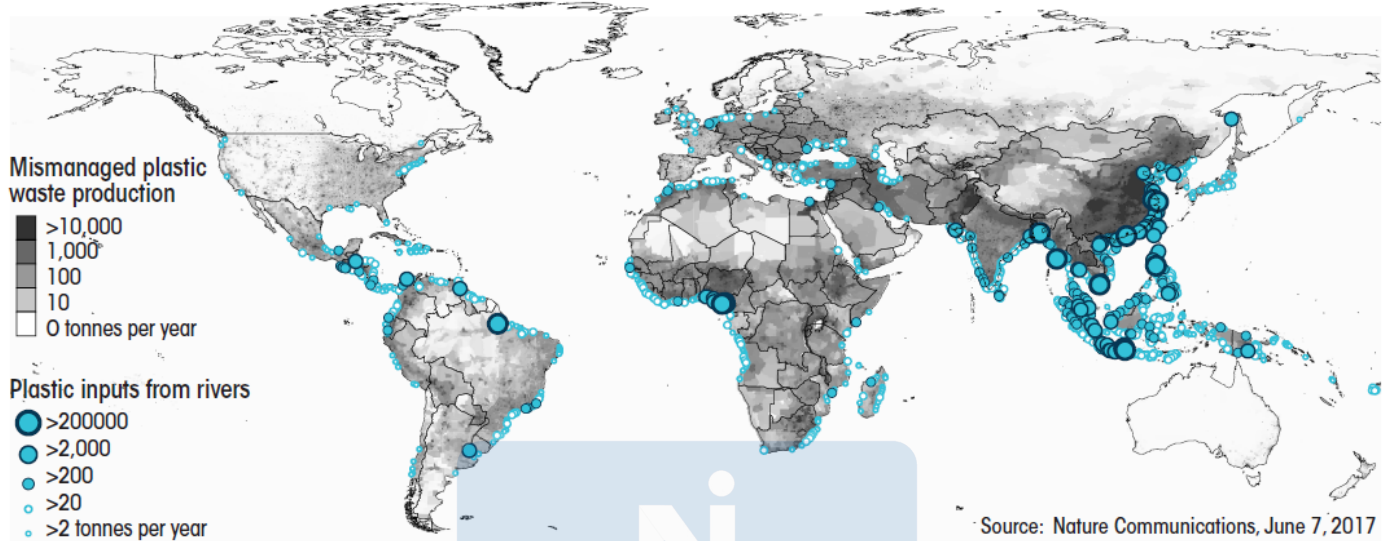
- Poor Waste Segregation → Roadside litter → Stormwater drains → Rivers → Estuaries → Sea → Ocean currents & Gyres → Remote islands and deep oceans

Rivers: Major Carriers of Plastic

- A **Nature Communications (2017)** study estimated that around **1.15–2.41 million tonnes** of plastic enter oceans annually through rivers.
 - **20 rivers account for 67%** of global riverine plastic pollution.
 - **103 of the top 122 plastic-carrying rivers are in Asia**.
 - **In India, Ganga basin** is the world's **second-largest contributor** of river-borne plastic entering oceans.

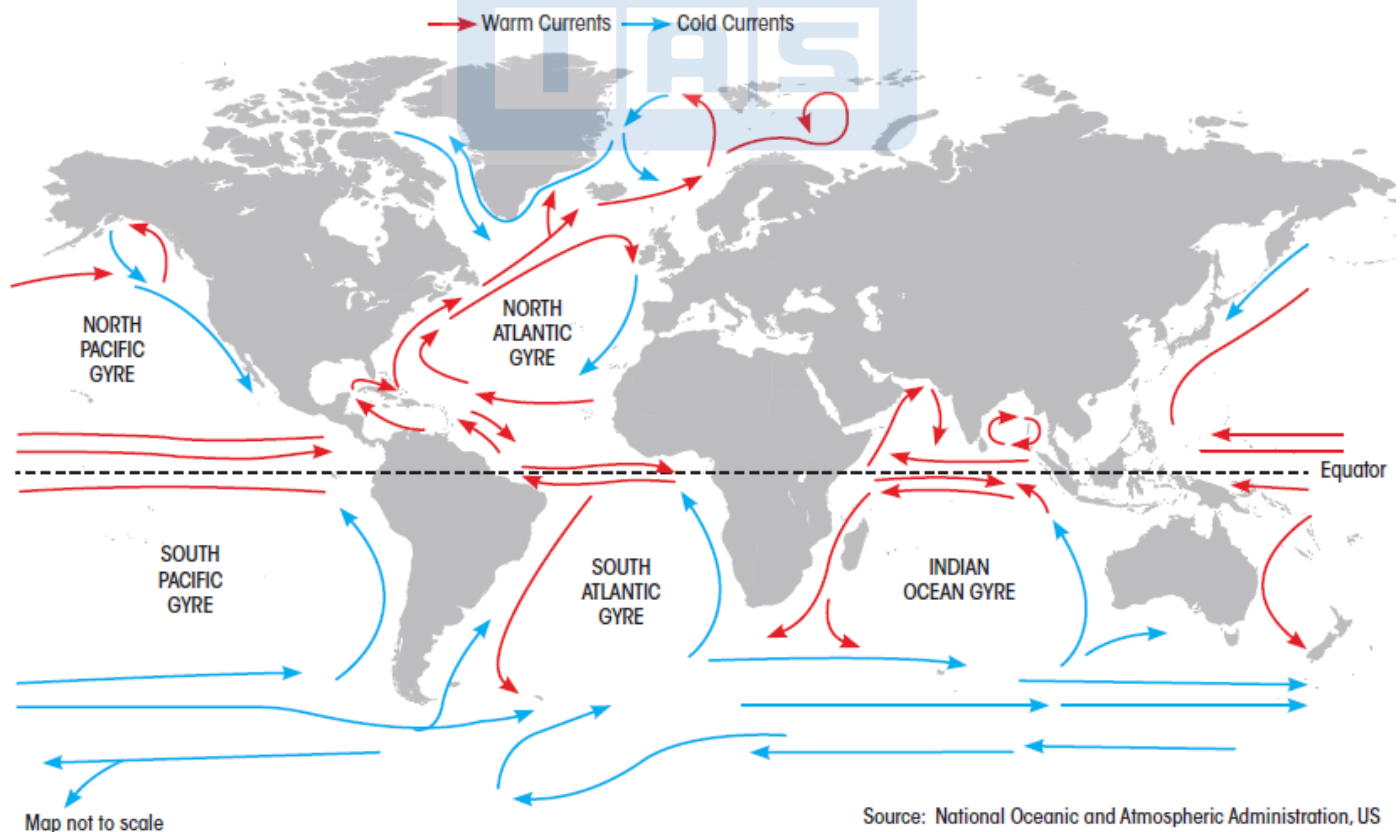
FROM RIVERS TO OCEANS

Between 1.15 and 2.41 million tonnes of plastic waste enters the ocean every year from rivers, with 74% of the waste entering in May-October. The top 20 polluting rivers, mostly in Asia, account for 67% of the global total.



DEEP SEA DUMPYARDS

The ocean churns up various types of currents. Together, these make up the systems of currents known as gyres. At the core of these gyres, there is a slow accumulation of litter which has now grown to enormous garbage patches.

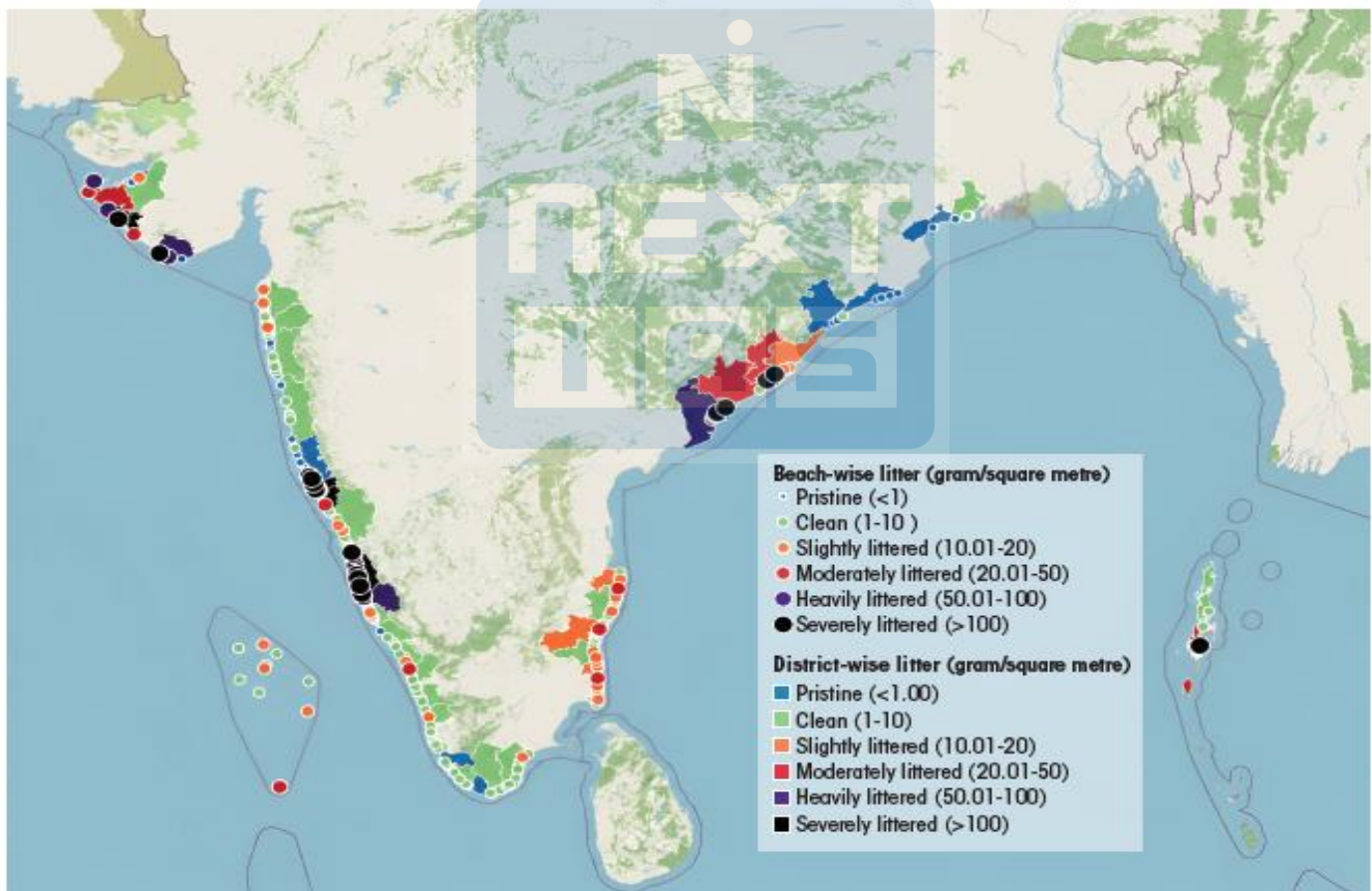


Indian Case Studies

- **Munambam Beach (Kerala):** Local fishermen increasingly catch plastic bottles, packaging waste, and fishing debris instead of fish.
 - Plastic inflow increases after heavy rainfall, floods, opening of dams, and river discharge from Periyar.
- **Mithi River (Mumbai):** Major reasons for pollution are unsegregated waste, informal settlements, industrial discharge, and inadequate waste collection.
 - The polluted river carries plastic directly into the Arabian Sea.
 - The **2005 Mumbai floods** highlighted how plastic-clogged drains aggravated urban flooding.
- **Lakshadweep Islands:** Even uninhabited islands now contain microplastics, hard plastics, and fishing gear.
 - Major polymers detected are Polyethylene (PE), Polypropylene (PP), PET, PVC, and Nylon.
 - It demonstrates the transboundary nature of marine litter.

COASTAL DEBRIS

Litter status at 261 beaches along the coast of Indian peninsular region



Source: Central Marine Fisheries Research Institute

Ecological Impacts

- **On Marine Biodiversity:**
 - **Entanglement:** Turtles, Dolphins, Whales and Seabirds become trapped in ghost nets.
 - **Ingestion:** Marine organisms mistake plastic for food. Impacts include starvation, internal injuries, reduced reproduction, and mortality.

- **Habitat Damage:** Plastic damages coral reefs, mangroves, seagrass beds, and benthic ecosystems
- **Toxic Chemicals:** Microplastics adsorb Persistent Organic Pollutants (POPs), heavy metals, and toxic chemicals. These enter the marine food chain.

Human Health Concerns

- Microplastics have been detected in blood, brain, heart, lungs, and placenta. However, long-term impacts remain uncertain.

Economic Impacts

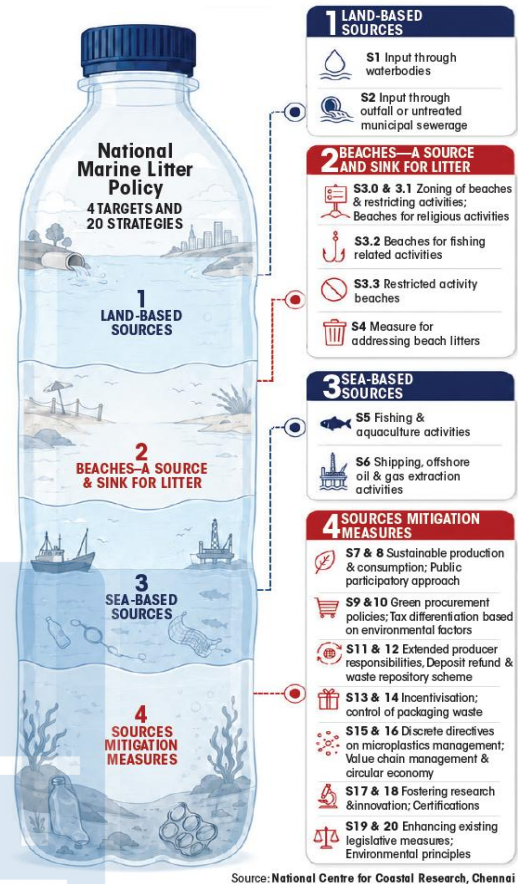
- **Fisheries:** Damaged fishing nets, reduced fish catch, and ghost fishing.
- **Tourism:** Dirty beaches reduce tourist arrivals.
- **Shipping:** Plastic damages propellers and engines.
- **Coastal Economy:** Higher expenditure on beach cleaning and waste management.

India's Initiatives

- **National Centre for Coastal Research (NCCR):** It is mapping marine litter, monitoring 75 beaches, and studying microplastics using satellites, drones, and numerical modelling.
- **National Marine Litter Policy (Draft):** Prepared by NCCR.
 - Focus areas are land-based sources, sea-based sources, reaches as source and sink, and source mitigation measures.
- **Plastic Waste Management Rules:** Extended Producer Responsibility (EPR)
 - Plastic Waste Management Rules, 2016 (amended)
 - Ban on identified Single Use Plastics (2022)
- **Swachh Bharat Mission:** It improves source segregation, door-to-door collection, and scientific waste disposal.
- **Blue Economy Vision:** Marine litter reduction supports sustainable fisheries, coastal tourism, and marine ecosystem conservation.

PLAN OF ACTION

Targets and strategies under India's proposed National Marine Litter Policy



Community-Based Best Practices

- **Residents of Kasturba Nagar Association (ROKA), Chennai**
 - **‘We Segregate’ initiative:** Three-bin system; community composting; door-to-door awareness; soft plastic collection
 - Outcome: Nearly **90 tonnes of dry waste diverted** from the environment.
- **Plastic Fischer:** Installed trash booms in Mumbai drains. Waste collected is recycled, and sent for co-processing in cement plants.
- **River Recycle:** Uses trash booms and extraction systems in the Mithi River to intercept waste before it reaches the sea.

Global Initiatives

- **UNEA Resolution 5/14:** Mandated negotiations for a **legally binding Global Plastics Treaty** covering the full life cycle of plastics.

- Negotiations continue under the **Intergovernmental Negotiating Committee (INC)**.
- **Sustainable Development Goals (SDGs):** Marine litter is linked with:
 - **SDG 6:** Clean Water and Sanitation
 - **SDG 12:** Responsible Consumption and Production
 - **SDG 13:** Climate Action
 - **SDG 14:** Life Below Water
 - **SDG 15:** Life on Land

Challenges

- Poor waste segregation at source
- Weak implementation of plastic bans
- Inadequate recycling infrastructure
- Large informal waste sector
- Lack of marine litter-specific legislation
- Transboundary movement of marine debris
- Insufficient scientific data on microplastics
- Weak monitoring and enforcement

Way Forward

- **Policy Measures:** Finalise and implement the National Marine Litter Policy. Strengthen Extended Producer Responsibility (EPR). Conclude a legally binding Global Plastics Treaty.
- **Waste Management:** Universal source segregation. Improve recycling infrastructure. Scientific management of plastic waste.
- **River Interception:** Install trash booms. River clean-up before litter reaches oceans.
- **Technology:** Satellite and drone-based monitoring. AI-enabled waste tracking. Real-time marine litter mapping.
- **Community Participation:** Beach clean-up drives. Behavioral change campaigns. Citizen-led segregation initiatives.
- **Research:** India-specific studies on microplastics, human health impacts, and marine ecosystem impacts.

CUSTOMISED CSR FRAMEWORK FOR THE COAL MINING SECTOR

Context

- The **Union Ministry of Coal** is drafting **India's first sector-specific Corporate Social Responsibility (CSR) Framework for the coal mining sector**.
- The framework aims to bring both **public and private coal mining companies** under a common CSR approach tailored to the unique social and environmental challenges associated with coal mining.

What is Corporate Social Responsibility (CSR)?

- Corporate Social Responsibility (CSR) refers to the **statutory obligation of eligible companies to contribute towards social, environmental, and economic development** through responsible business practices.

Legal Basis:

- **Companies Act, 2013 (Section 135)**
- **Companies (CSR Policy) Rules, 2014**
- **CSR Eligibility:** Companies meeting any one of the following criteria during the preceding financial year:
 - Net worth $\geq$ ₹500 crore
 - Turnover $\geq$ ₹1,000 crore
 - Net profit $\geq$ ₹5 crore
- **CSR Spending:** Eligible companies must spend **2% of the average net profits of the previous three financial years** on CSR activities.

Why is a Separate CSR Framework Needed for Coal Mining?

- The **existing CSR framework** is **generic** and does not address sector-specific issues. Coal mining presents unique challenges such as:
 - **Social Challenges:** Displacement and rehabilitation; livelihood loss; tribal welfare; health issues; skill development; and education in mining areas.

- **Environmental Challenges:** Land degradation, deforestation, air and water pollution, mine closure and ecological restoration, and climate change concerns.
- **Governance Challenges:** Growing participation of private mining companies; need for uniform CSR standards, better transparency and impact measurement.

Objectives of the Proposed Framework

- The framework seeks to:
 - Develop sector-specific CSR guidelines.
 - Align CSR with national development priorities.
 - Integrate Sustainable Development Goals (SDGs).
 - Improve transparency and accountability.
 - Promote measurable outcomes.
 - Encourage collaboration among mining companies.
 - Align CSR with sustainability reporting standards.

Institutional Framework

- **Ministry of Coal:** Nodal ministry; final approval of the framework.
- **Coal India Limited (CIL):** Entrusted with preparing the draft framework.
- **Indian Institute of Corporate Affairs (IICA):** Government think tank under the Ministry of Corporate Affairs; technical consultant for drafting the framework.

Evolution of the Proposal

- Discussions began within the Coal Ministry in **2024**.
- Received policy-level approval after **August 2025**.
- Industry consultation held in **October 2025**.
- Draft preparation assigned to CIL and IICA.
- Framework expected shortly after the initial March 2026 target.

12-Point Action Plan

- **Outcome-Based CSR:** Focus on measurable social outcomes rather than expenditure.
- **Community Need Assessment:** CSR projects based on local needs.
- **Convergence with Government Schemes:** Complement existing welfare programmes.
- Alignment with Coal Ministry Sustainability Initiatives
- **Public-Private Collaboration:** Joint CSR projects in mining regions.
- **Independent Impact Assessment:** Evaluation by credible external agencies.
- **Knowledge Sharing:** Workshops for improving CSR implementation.
- **Public Awareness:** Dissemination of successful CSR initiatives.
- **Annual CSR Awards:** Recognition of outstanding CSR efforts.
- **CSR Digital Portal:** Development of a KPI-based reporting portal by CIL.
- **Review of Existing CSR Projects:** Assessment of projects undertaken over the previous 2–3 years.
- **Integration with BRSR:** CSR aligned with Business Responsibility and Sustainability Reporting requirements.

Likely Components of the Final Framework

- According to CIL's Action Taken Report, the framework may include:
 - Mapping CSR projects with **UN Sustainable Development Goals (SDGs)**.
 - Output-Outcome based Key Performance Indicators (KPIs).
 - Global benchmarking of CSR practices.
 - Green Credit Framework.
 - Methodology for measuring CSR goodwill.
 - Standardised outreach and communication guidelines.
 - BRSR and Global Reporting Initiative (GRI) reporting readiness.
 - Comparative Impact Assessment Index.

- Pilot implementation involving one CIL subsidiary and one private mining company.

Significance

- **For Communities:** Better rehabilitation and resettlement; improved education and healthcare; enhanced livelihood opportunities; and inclusive development of mining-affected regions.
- **For Industry:** Uniform CSR standards; improved ESG performance; greater stakeholder trust; and better regulatory compliance.
- **For Government:** Stronger monitoring; evidence-based policymaking; and better alignment with national development goals.
- **For Sustainable Development:** Supports SDGs; encourages environmental restoration; and promotes responsible mining practices.

Challenges

- Diverse operational conditions across mining regions.
- Balancing profitability with social responsibility.
- Measuring long-term CSR outcomes.
- Avoiding duplication with government welfare schemes.
- Ensuring participation of private miners.
- Maintaining transparency and accountability.

Way Forward

- Finalise the framework through extensive stakeholder consultation.
- Strengthen independent social audits.
- Institutionalise periodic impact assessments.
- Promote technology-enabled CSR monitoring.
- Encourage local community participation in planning and evaluation.
- Integrate CSR with district development plans.
- Link CSR initiatives with India's climate and sustainability commitments.

Conclusion

- The proposed **sector-specific CSR framework for coal mining** marks an important shift from a

compliance-driven model to an **outcome-oriented, sustainability-focused approach**.

- By integrating **community welfare, environmental stewardship, SDGs, ESG principles, and transparent impact assessment**, the framework has the potential to make CSR more effective in mining-affected regions while fostering responsible and sustainable growth of the coal sector.

INDIA'S R&D DEFICIT: MISSING LINK IN BECOMING A GLOBAL INNOVATION POWER

Context

- India's private sector investment in R&D remains significantly below global standards, limiting innovation, technological competitiveness, and strategic autonomy, despite having one of the world's largest economies and a vast talent pool.

Why is India's Private Sector R&D Weak?

- **Historical Legacy of Protectionism:** Before the **1991 economic reforms**, Indian industries operated in a protected domestic market.
 - High tariff barriers reduced competitive pressure.
 - Firms preferred importing proven technologies instead of developing indigenous innovations.
- **Preference for Short-Term Profits:** Many firms prioritize quick returns over long-term research.
 - R&D involves high capital investment, long gestation periods, and uncertain outcomes.
- **Weak Innovation Culture:** Unlike Japan, South Korea and Taiwan, Indian industry has generally lacked long-term technological vision, risk-taking capacity, and sustained innovation culture.
- **Limited Competitive Pressure:** Continued tariff protection and import restrictions reduce incentives for firms to innovate.
 - Protection often encourages dependence rather than technological advancement.

India's R&D Performance: Key Facts

- **R&D Expenditure:** Increased from **US\$20.8 billion (2000)** to **US\$75.7 billion (2024)**.
 - India is among the **top 15 R&D spenders** globally.
- **R&D Intensity:** R&D expenditure is only **0.64% of GDP**.
 - India ranks around **55th globally** in R&D intensity.
 - Far below innovation-driven economies.
- **Private Sector Contribution:** Business finances only **36% of India's R&D**.
 - In leading economies, business contributes **over 70%**.

Global Comparison

- Israel (~93%); Vietnam (~90.5%); Leading OECD Economies (>70%); India (~36%)
- **Learning from Vietnam:** Export-oriented economy; high competition; minimal tariff protection; and strong industry-led innovation.
- **Learning from Rwanda:** Investing heavily in science and technology; and building innovation despite limited resources.

Challenges Facing Indian Industry

- Low risk appetite.
- Dependence on imported technology.
- Insufficient industry-academia collaboration.
- High cost of capital.
- Weak commercialization of research.
- Limited patent generation.
- Inadequate investment in frontier technologies such as AI, semiconductors and advanced manufacturing.

Government Initiatives

- **National Research Foundation (NRF):** It promotes industry-academia collaboration. It supports research in strategic sectors.
- **Atal Innovation Mission (AIM):** It encourages innovation and entrepreneurship.
- **Production Linked Incentive (PLI) Scheme:** It promotes domestic manufacturing in strategic sectors.

- **Anusandhan National Research Foundation (ANRF):** It strengthens India's research ecosystem, and encourages greater private participation.
- **Digital India & Startup India:** These support innovation-driven entrepreneurship, and foster technology-led economic growth.

Way Forward

- **Increase Private Sector Investment:** Introduce enhanced tax incentives for corporate R&D; and encourage venture capital in deep-tech sectors.
- **Promote Competition:** Reduce excessive tariff protection; and encourage globally competitive manufacturing.
- **Strengthen Industry-Academia Linkages:** Joint research centres; collaborative innovation clusters; and technology transfer mechanisms.
- **Support High-Risk Research:** Expand government funding for emerging technologies; and encourage patient capital for innovation.
- **Improve Ease of Doing Research:** Simplify regulatory approvals; strengthen intellectual property protection; and facilitate commercialization of innovations.
- **Focus on Strategic Technologies:** Semiconductors, Artificial Intelligence, biotechnology, defence technologies, green hydrogen, and quantum computing.

Importance for India

- Greater investment in R&D will improve global competitiveness, reduce dependence on imported technologies, enhance manufacturing productivity, generate high-quality employment, strengthen national security, promote technological self-reliance (Atmanirbhar Bharat), and increase India's strategic influence in the global order.

AVIAN MALARIA: A GROWING THREAT TO BIRD BIODIVERSITY

Context

- Recent studies published in *Nature Communications* (2025) and *BioRxiv* have highlighted the increasing spread of **avian malaria** among forest birds in

Hawaiian Islands (USA) and the Shola Sky Islands of the Western Ghats, India.

What is Avian Malaria?

- **Avian malaria** is a **vector-borne disease** affecting birds. It is caused primarily by the parasite **Plasmodium relictum**.
- The parasite is transmitted through the bite of infected mosquitoes, mainly **Culex quinquefasciatus** (Southern House Mosquito).
- It infects the bloodstream, destroys red blood cells, and may cause anaemia, organ failure, reduced reproductive success, and death in highly susceptible bird species.

Global Distribution

- Avian malaria has also been reported in Europe (parrots), Guatemala (wild birds), and Thailand (Humboldt penguins in zoos).
 - Thus, it is a **global wildlife conservation concern**.

Shola Sky Islands: India's Emerging Concern

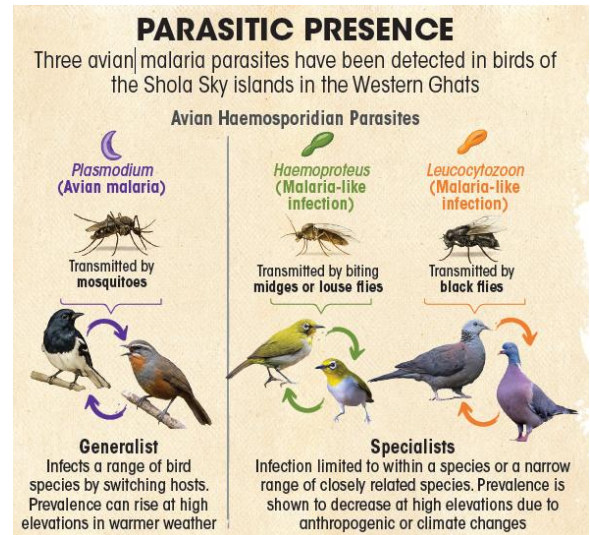
- **Shola Sky Islands** are high-elevation tropical evergreen forests, located in the **Western Ghats**.
- These forests are recognised as part of the **Western Ghats Biodiversity Hotspot**, known for high levels of endemism.

Parasites Found in Indian Birds

- Indian birds harbour three major groups of avian blood parasites:
 - **Plasmodium** (Mosquitoes); **Haemoproteus** (Biting midges); and **Leucocytozoon** (Black flies).
- **Plasmodium** is a **generalist parasite**, capable of infecting multiple bird species.
- **Haemoproteus** and **Leucocytozoon** are **specialist parasites**, infecting only specific host species.

Why is Climate Change a Major Concern?

- Climate change can accelerate disease spread by increasing mosquito abundance; expanding mosquito ranges to higher elevations; allowing parasites to survive in previously unsuitable habitats; and increasing transmission opportunities.



- Generalist parasites like **Plasmodium** are expected to expand faster than specialist parasites.

Impact of Human Activities

- Human-induced habitat changes are altering parasite communities. Studies suggest:
 - Decline in specialist parasites.
 - Increase in generalist parasites.
 - Greater risk of disease emergence.
- This process is called **Biotic Homogenisation**, where ecological communities become increasingly similar due to the dominance of widespread species.

WOH G64: A GIANT STAR ON THE BRINK?

Context

- Astronomers have reported that **WOH G64**, one of the largest known **Red Supergiant (RSG)** stars, is undergoing rapid changes and may have entered the **Yellow Hypergiant** phase, a rare transitional stage that could precede a **supernova explosion**.

What is WOH G64?

- It is among the **largest and brightest stars known** and has been studied continuously since the 1970s.
 - **Type:** Red Supergiant (RSG)
 - **Location:** Large Magellanic Cloud (Satellite galaxy of the Milky Way)

- **Distance from Earth:** About 163,000 light-years
- **Radius:** About 1,540 times the Sun
- **Mass:** About 30 Solar masses
- **Luminosity:** About 282,000 times the Sun
- **System:** Binary star system

What is a Red Supergiant (RSG)?

- A **Red Supergiant** is a massive star nearing the end of its life. It is comparatively cool (3,500–4,500 K), and extremely luminous and unstable.
- It is characterised by rapid mass loss through stellar winds.
- Examples include WOH G64, Betelgeuse, and Antares.

Life Cycle of a Massive Star

- **Protostar:** Forms through gravitational collapse of a gas cloud. Energy comes from gravitational contraction.
- **Main Sequence:** Hydrogen fusion into helium occurs. Stable phase lasting millions to billions of years.
- **Red Giant / Red Supergiant:** Core hydrogen is exhausted. Helium fusion begins. Outer layers expand enormously. The star becomes cooler but much brighter.
- **Yellow Hypergiant (Transition Phase):** Rare, short-lived stage. Temperature increases. Massive loss of outer layers. Indicates the star is approaching collapse.
- **Supernova:** Iron core collapses. A massive explosion ejects stellar material. Leaves behind Neutron Star and Black Hole.



What is a Yellow Hypergiant?

- A **Yellow Hypergiant** is one of the rarest stellar classes, extremely unstable, and very luminous.

- It is a transitional phase between Red Supergiant and Supernova.
- Its lifetime may last only **thousands to tens of thousands of years**, making it exceptionally rare to observe.

Why is WOH G64 Changing? (Three possible explanations)

- **Binary Star Interaction (Most Accepted):** WOH G64 belongs to a binary system. During the **common-envelope phase**:
 - The companion star became engulfed.
 - Interaction expelled the outer envelope.
 - The star appeared to transform from a Red Supergiant into a Yellow Hypergiant.
- **Recovery after a Massive Outburst:** WOH G64 may have experienced decades of heavy mass loss.
 - Dust obscured the system.
 - As the dust dispersed, astronomers observed its true nature.
- **Pre-Supernova Superwind:** The most exciting possibility is that:
 - The star has entered a **superwind phase**.
 - Huge amounts of matter are being expelled.
 - Such behaviour is expected shortly before a supernova.
 - However, this remains a hypothesis.

Why Can't Scientists Predict the Exact Time of Explosion?

- Despite modern telescopes, prediction remains difficult because:
 - Dense dust surrounds the star.
 - Binary interactions complicate observations.
 - Stellar evolution is inherently complex.
 - The transition phase is extremely short.
- Hence, claims that WOH G64 will definitely explode within our lifetime are neither confirmed nor ruled out.

Role of the Optical Gravitational Lensing Experiment (OGLE) Project

- **Purpose:** Long-term monitoring of stellar brightness; detection of exoplanets; gravitational lensing studies; and variable star observations.
- OGLE observations revealed:
 - 886-day pulsation cycles.
 - Sudden brightness declined around 2011.
 - Spectral transformation after 2014.

Large Magellanic Cloud (LMC)

- It is a dwarf satellite galaxy of the Milky Way. It is located about **163,000 light-years** away.
 - Rich in massive stars and active star-forming regions.
 - Visible mainly from the Southern Hemisphere.

What is a Supernova?

- A **Supernova** is the explosive death of a star. It occurs when:
 - Nuclear fusion stops.
 - Iron core collapses.
 - Gravity overwhelms internal pressure.
 - A powerful explosion ejects stellar material into space.
- The explosion can briefly outshine an entire galaxy.

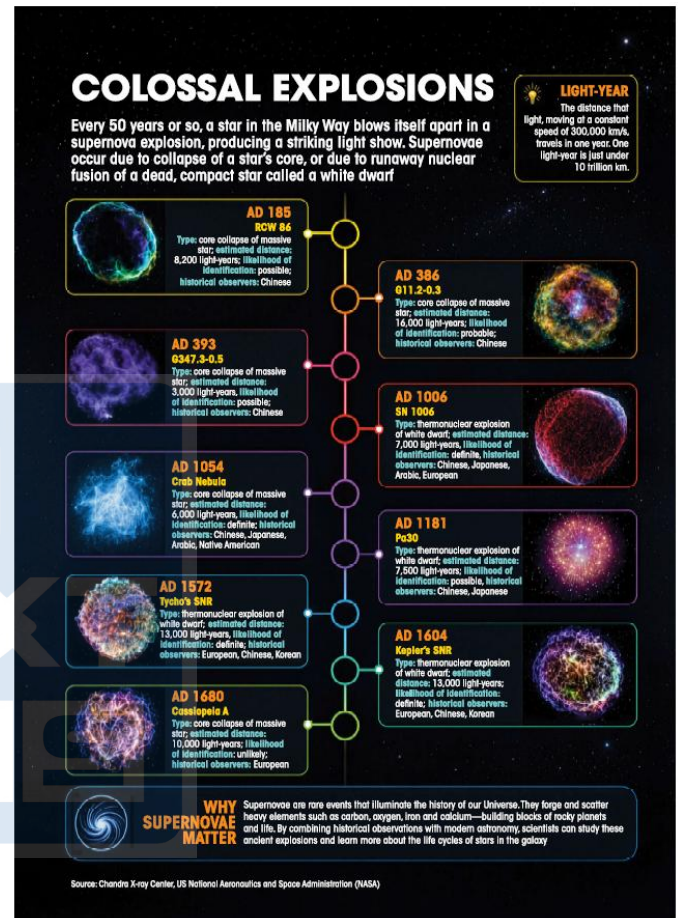
Importance of Supernovae

- **Formation of Heavy Elements:** Supernovae produce Iron, Gold, Uranium, Silver, Calcium, and Nickel.
 - These elements become part of future stars, planets and living organisms.
- **Birth of Compact Objects:** Depending on stellar mass, a supernova leaves behind Neutron Star, Pulsar, and Black Hole.

Other Potential Supernova Candidates

- **Betelgeuse:** Red Supergiant; Distance: ~640 light-years; located in Orion

- **Triggering New Star Formation:** Shock waves compress nearby gas clouds, initiating the birth of new stars.
- **Understanding Stellar Evolution:** Supernovae help astronomers understand nuclear fusion, stellar interiors, cosmic evolution, and origin of elements.



Historical Supernovae

- 185 AD: Chinese astronomers recorded the earliest known supernova (RCW 86)
- 1006: Brightest recorded supernova
- 1054: Formation of the Crab Nebula
- 1572: Tycho Brahe's 'New Star'
- 1604: Kepler's Supernova
- 1987: Supernova 1987A in the Large Magellanic Cloud
- **Spica (Alpha Virginis):** Blue-white giant star; Distance: ~240 light-years

Importance for India

- India contributes significantly to astronomy through:
- Inter-University Centre for Astronomy and Astrophysics (IUCAA), Pune
- ARIES, Nainital
- Indian Institute of Astrophysics (IIA)
- GMRT (Giant Metrewave Radio Telescope)
- AstroSat mission
- Participation in international astronomical collaborations

SDGs: ROAD TO 2030 AND THE POST-2030 DEVELOPMENT FRAMEWORK

Context

- A decade after the adoption of the **United Nations SDGs** in 2015, and with only five years remaining until the 2030 deadline, global progress remains inadequate. It has triggered discussions on the future of the global development agenda beyond 2030.

What are the Sustainable Development Goals (SDGs)?

- These were adopted by **193 UN Member States** at the **UN Sustainable Development Summit (2015)**.
- These consist of **17 Goals** and **169 Targets** under the **2030 Agenda for Sustainable Development**.
- They aim to balance **economic growth, social inclusion, and environmental sustainability**.
- SDGs are **universal**, applying to both developed and developing countries, unlike the **Millennium Development Goals (MDGs) (2000–2015)**.

MDGs Vs SDGs		
Aspect	MDGs (2000–2015)	SDGs (2015–2030)
Number of Goals	8	17
Coverage	Mainly developing countries	Universal (all countries)

Focus	Basic human development	Sustainable, inclusive and climate-resilient development
Nature	Sector-specific	Integrated and interconnected

Status of SDG Progress (UN SDG Report 2025)

- The latest **UN Sustainable Development Goals Report 2025** presents a concerning picture:
 - Only **18%** of the **169 SDG targets** are on track to be achieved by 2030.
 - Around **35% of targets** have either stalled or are moving backwards.
 - Another **18%** have regressed below the 2015 baseline.
- By 2030:
 - Nearly **8.9%** of the global population may continue to live in **extreme poverty**.
 - Approximately **8.9%** may still face **hunger**.

Major Areas of Concern

- Progress has stalled or deteriorated in more than half of the targets under:
 - **SDG 2: Zero Hunger**
 - **SDG 4: Quality Education**
 - **SDG 6: Clean Water and Sanitation**
 - **SDG 8: Decent Work and Economic Growth**
 - **SDG 10: Reduced Inequalities**

Challenges in Achieving SDGs

- **Financing Gap:** Achieving SDGs requires an estimated **US\$17 trillion** in investments.
 - Developing countries face severe fiscal constraints and debt burdens.
- **North-South Divide:** Developing countries argue that developed nations have not fulfilled commitments regarding climate finance, technology transfer, and capacity building.
 - It mirrors similar concerns during the MDG era.

- **Global Crises:** COVID-19 pandemic, climate change, geopolitical conflicts, inflation and food insecurity. These have diverted resources and slowed development.
- **Weak Implementation:** Uneven institutional capacity; data gaps and monitoring challenges; and poor policy coordination across sectors.

Achievements of the SDGs

- Despite slow progress, SDGs have generated several positive outcomes:
 - Mainstreamed sustainable development into national policies.
 - Encouraged evidence-based planning and monitoring.
 - Mobilised international cooperation and financing.
 - Strengthened partnerships among governments, civil society, and the private sector.
 - Promoted localisation of SDGs through local governments.

India's Experience

- India has integrated SDGs into:
 - **NITI Aayog's SDG India Index**
 - State and district-level monitoring
 - Panchayat-level planning under the **Local Indicators Framework**
 - Aspirational Districts Programme
- It demonstrates the localisation of global goals.

Post-2030 Debate

- Negotiations on the post-2030 global development framework are expected to begin around **2027**.
- Key questions include:
 - Should the world adopt a new set of global development goals?
 - Should existing SDGs continue with revised timelines?
 - Should greater emphasis be placed on implementation rather than introducing new targets?

- Many experts argue that the existing framework should largely continue, with stronger focus on financing, technology transfer, institutional capacity, accountability, and partnerships.

Way Forward

- **Focus on Means of Implementation:** Increase development finance; fulfil Official Development Assistance (ODA) commitments; and expand climate finance and technology sharing.
- **Strengthen Localisation:** Empower Panchayats and Urban Local Bodies; and improve local data collection and monitoring.
- **Promote Inclusive Growth:** Address multidimensional poverty; reduce regional and gender inequalities; and create quality employment.
- **Enhance Global Cooperation:** Reform multilateral institutions; strengthen South-South cooperation; and build resilient global supply chains.
- **Improve Governance:** Better monitoring mechanisms; greater transparency and accountability; and evidence-based policymaking.

DIAMANTINA ZONE: WHALE FALL ECOSYSTEM

Context

- Researchers from the Chinese Academy of Sciences discovered an ancient and vast **whale-fall ecosystem in the Diamantina Zone** in the southeastern Indian Ocean, which they have described as a '**whale necropolis**'.

What is a Whale Fall?

- A **whale fall** refers to the process in which the **carcass of a dead whale sinks** to the ocean floor, where it becomes a long-lasting source of nutrients for deep-sea organisms.
- It creates a unique ecosystem capable of sustaining marine life for years or even decades in the otherwise nutrient-poor deep ocean.

Diamantina Zone

- Formed during the separation of the **Australian and Antarctic continents** around **50–60 million years ago**.

- It is characterized by deep ocean trenches, complex underwater ridges, and extremely high biodiversity in deep-sea habitats.

Ecological Significance of Whale Falls

- Whale carcasses provide a rich source of organic matter in the deep sea, where food is scarce.
- They support diverse organisms such as bacteria, worms, crustaceans, molluscs, and deep-sea fishes.
- It is believed that several species have **evolved specifically to depend on whale fall ecosystems**.
- Whale falls contribute to nutrient recycling, carbon sequestration in the deep ocean, and maintenance of deep-sea biodiversity.

Why is Discovery Important?

- Expands scientific understanding of **deep-sea ecosystems**.
- Provides evidence that whale fall communities have existed for **millions of years**.
- Helps researchers study the evolution of specialized marine organisms.
- Highlights the ecological importance of conserving deep-sea environments.

TAPANULI ORANGUTAN

Context

- A study reported that **Cyclone Senyar** triggered massive landslides in the **Batang Toru Ecosystem** of **North Sumatra, Indonesia**, leading to the suspected death of **58 Tapanuli Orangutans**.

About the Tapanuli Orangutan

- **Scientific Name:** Pongo Tapanuliensis
- **IUCN Status:** Critically Endangered
- **Distribution:** Restricted to the **Batang Toru ecosystem** in North Sumatra, Indonesia.
- Recognized as a distinct species in **2017**.
- Considered the **world's rarest great ape**, with fewer than **1,000 individuals** remaining.

Major Threats

- Habitat fragmentation due to roads, mining and infrastructure.
- Deforestation and forest degradation.
- Climate change-induced extreme weather events.
- Small and isolated population, increasing extinction risk.

SUBJECTIVE QUESTIONS

1. In the light of the recent Supreme Court judgment on homemakers, discuss the need for recognising unpaid care work and suggest measures for its inclusion in India's development framework.
2. Balancing economic development with forest conservation has emerged as one of India's foremost governance challenges. Discuss in the context of recent forest diversion approvals and the protection of tribal rights.
3. Discuss the sources, impacts, regulatory gaps, and measures required to address Per- and Polyfluoroalkyl Substances (PFAS) pollution in Indian rivers, with special reference to the Ganga.
4. Corporate Social Responsibility in extractive industries requires a sector-specific approach rather than a uniform legal framework. Discuss in the context of the proposed CSR framework for India's coal mining sector.
5. Climate change and anthropogenic disturbances are increasing the risk of emerging wildlife diseases. Discuss with reference to avian malaria in Shola Sky Islands of the Western Ghats.

MCQS

1. Consider the following statements:
 1. The Van (Sanrakshan Evam Samvardhan) Adhiniyam, 1980 regulates diversion of forest land for non-forest purposes.
 2. Gram Sabha consent is an important safeguard under the Forest Rights Act, 2006 before diversion affecting recognised forest rights.

3. Hasdeo Arand is located in Odisha.

Which of the statements given above are correct?

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

2. With reference to the recent Supreme Court judgment on the valuation of homemakers' unpaid work under the Motor Vehicles Act, consider the following statements:

- 1. The Supreme Court held that ₹30,000 per month should be treated as the minimum notional monthly income of a homemaker for calculating compensation in motor accident claims.
- 2. The Court observed that homemakers are "nation builders" and that earning members are substantially dependent on the services provided by homemakers.
- 3. Women's unpaid caregiving work is estimated to contribute about 15–17% of India's GDP, despite remaining outside formal economic accounting.

Which of the statements given above is/are correct?

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

3. Which of the following best describes the concept of the 'Zero-Click Internet'?

- (a) Users increasingly browse the internet through offline applications.
- (b) AI systems provide answers directly without requiring users to visit original websites.
- (c) Search engines have stopped indexing websites.

(d) Internet traffic has reduced due to automation.

4. With reference to the 'Whale Fall' ecosystem, consider the following statements:

- 1. A whale fall refers to the carcass of a dead whale that sinks to the seafloor and supports a nutrient-rich deep-sea ecosystem.
- 2. The recently discovered ancient whale fall ecosystem in the Diamantina Zone is estimated to be about 5 million years old.
- 3. The Diamantina Zone was formed due to the separation of the Australian and Antarctic continents around 50–60 million years ago.
- 4. Whale fall ecosystems are found only in the Pacific Ocean.

Which of the statements given above are correct?

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

5. With reference to *Per- and Polyfluoroalkyl Substances (PFAS)*, consider the following statements:

- 1. PFAS are synthetic chemicals characterized by strong carbon-fluorine bonds.
- 2. They readily degrade in soil and water within a few months.
- 3. They are widely used in non-stick cookware, firefighting foams, and food packaging.

Which of the statements given above is/are correct?

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

-----Answer Key-----

1. (a) 2. (d) 3. (b) 4. (b) 5. (a)

