

SUMMARY OF DOWN TO EARTH

[1-15 APRIL, 2026]



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SUBJECTIVE QUESTIONS

MCQS

FOOD IN THE AGE OF CLIMATE CHANGE

Context

- Food systems today are at the intersection of **climate change, livelihoods, nutrition, and ecology**.
- As modern agriculture contributes significantly to greenhouse gas emissions, the emerging paradigm is **climate-smart agriculture**, which integrates **livelihood security, nutritional outcomes, and ecological sustainability**.

About Food System & Climate Change

- Food systems today are both **victims and drivers of climate change**. Agriculture contributes significantly to greenhouse gas emissions, while climate change threatens crop productivity, water availability, and farmer livelihoods.
- Thus, the challenge is to redesign agriculture to ensure **livelihood security, nutritional adequacy, and ecological sustainability** simultaneously.

Low-Input and Climate-Resilient Agriculture

- Reduce dependence on costly external inputs (fertilisers, pesticides). Key rationale are:
 - High-input agriculture increases **costs and farmer vulnerability**.
 - Smallholders lack economies of scale.
 - **Low-input systems can maintain productivity** via soil and water management.

Water and Soil as Core Inputs

- Shift focus from chemical inputs to **natural resource management**. Key measures include:
 - Rainwater harvesting (traditional Indian practices)
 - Improving irrigation efficiency

- Enhancing soil organic matter

Risk Minimisation through Diversification

- The key idea is to **adopt multi-cropping and mixed farming systems**. It benefits:
 - Reduces climate risk (pests, droughts)
 - Ensures **multiple income streams**
 - Enhances biodiversity

Climate-Smart Crop Choices (Millets Focus)

- Promote crops suited to local ecology and nutrition needs.
- **Why Millets?**
 - Drought-resistant, climate-resilient
 - High nutritional value (iron, fibre)
 - Suitable for marginal soils

Food, Nutrition, and Gut Health

- **Key Idea:** Food choices influence **human health via gut microbiome**.
 - **Soil Health → Crop Diversity → Dietary Diversity → Gut Health**
 - Gut hosts trillions of microbes that are critical for immunity and metabolism
 - Diverse, fibre-rich diets support **healthy microbiota**

Conclusion: Towards Sustainable Food Systems

- Food must be reimagined as a system that **supports farmers' livelihoods, ensures nutritional security, and protects ecological balance**.
- The future lies in **climate-resilient, low-input, biodiversity-based agriculture**, supported by **policy reforms and conscious consumption**.
- As research shows, crops like millets can act as a bridge between **climate adaptation, nutrition, and sustainability**, making them central to India's agricultural transformation.

SANITARY WASTE MANAGEMENT IN INDIA

Context

- Women in rural areas of Himalayan states adopt reusable menstrual hygiene products, reducing sanitary waste.

About Sanitary Waste

- It comprises used menstrual pads and diapers that remains an under-recognized component of India’s solid waste management system.
- Its **environmental, financial, and social impacts are disproportionately high**, making it a critical governance and public health issue, despite forming a small fraction of total waste.

Case Study: Dehradun

- **Key Issues:** Mixed with dry waste or concealed in packaging.
 - Disposal methods: Open dumping, burial, and flushing in toilets.
 - **Handled manually by sanitation workers**, exposing them to health risks (infection, odour), social stigma and indignity.
- **Economic Burden:**
 - **Incineration cost: ₹1.75 lakh/month for 10 tonnes**
 - **Estimated cost for Dehradun city: ₹1.86 crore/month**

Environmental and Public Health Concerns

- **Non-biodegradability:** Over 90% of sanitary pads contain plastic.
- **Pollution:** Improper disposal contaminates soil and water.
- **Health risks:** Pathogen exposure for waste workers.
- **Infrastructure gaps:** Lack of disposal systems in India.

- Poor menstrual waste management is now recognized as a **global environmental and public health challenge**.

Emerging Solution: Reusable Menstrual Products

- **Waste Warriors Initiative:** Active since 2022 in Uttarakhand & Himachal Pradesh.
- Strategy includes awareness workshops, demonstrations of reusable pads & menstrual cups; community engagement via SHGs, schools, Anganwadis.
- **Adoption Trends:**
 - **Cloth pads:** Higher acceptance (cultural familiarity)
 - **Menstrual cups:** Adopted more by younger women
- **Long-term benefits:**
 - Cost-effective (cup lasts ~5 years)
 - Eliminates disposal challenges

Why Reusables Matter

- Reusable products significantly reduce waste burden.
- Cloth pads are **less polluting and sustainable**.
- Promote **circular economy in waste management**.
- Reduce pressure on municipal systems.

Challenges in Sanitary Waste Management

- **Behavioural Issues:** Social stigma around menstruation; and concealment of waste.
- **Policy Gaps:** Limited implementation of Solid Waste Management Rules, 2016; and lack of segregation at source.
- **Technological Constraints:** Incineration is costly and polluting; and limited eco-friendly alternatives.
- **Equity Concerns:** Burden falls on informal sanitation workers.

Way Forward

- **Promote Sustainable Alternatives:** Scale up reusable pads and menstrual cups; and encourage biodegradable sanitary products.
- **Strengthen Waste Segregation:** Mandatory **separate collection of sanitary waste**; and provide labeled disposal bags/bins.
- **Behavioural Change:** Awareness campaigns under **Swachh Bharat Mission**; and menstrual hygiene education in schools.
- **Protect Sanitation Workers:** Mechanization of waste sorting, and provide PPE and dignified working conditions.
- **Policy Integration:** Include sanitary waste in **Extended Producer Responsibility (EPR)**; and incentivize eco-friendly product innovation.

E20 ETHANOL BLENDING IN INDIA

Context

- From April 2026, India has mandated **20% ethanol blending (E20)** in petrol to reduce **crude oil imports**, enhance **energy security**, and lower **carbon emissions**.
- However, emerging evidence suggests that E20 is a **transitional solution with mixed outcomes**, raising concerns about its long-term sustainability.

About Ethanol Blending

- It is the process of **mixing ethanol (a biofuel made from crops like sugarcane or corn) with petrol** to be used as fuel in vehicles.
- Example:
 - **E10:** 10% ethanol & 90% petrol
 - **E20:** 20% ethanol & 80% petrol
- It is mainly done to reduce **dependence on crude oil**, lower **pollution and**

emissions, and promote **renewable energy sources**.

Rationale Behind Ethanol Blending

- India imports ~85% of its crude oil. Ethanol blending helps save **foreign exchange**, support **farm incomes**, and reduce **GHG emissions (partially)**.

Impact on Vehicles and Fuel Economy

- **Lower Energy Efficiency:** Ethanol has **lower calorific value**, leading to **higher fuel consumption**, and reduced mileage.
- **Compatibility Issues:** Older vehicles (pre-2023) are not designed for E20, that face corrosion risks, and material degradation.
- **Fuel System Concerns:** Ethanol is **hygroscopic** (absorbs water), and **corrosive in nature**, that can damage fuel lines, and rubber seals.

Environmental Implications

- **Positive Effects:** Better combustion due to oxygen content, that reduces **carbon monoxide (CO)**, **hydrocarbons (HC)**, and **particulate emissions**.
- **Negative Effects:**
 - **Increase in NOx Emissions:** E20 can increase **nitrogen oxides (NOx)**
 - **Toxic Aldehyde Emissions:** Higher emissions of **acetaldehyde**, and **formaldehyde**.
 - **Higher Evaporative Emissions:** Ethanol increases fuel volatility leads to **VOC emissions**, and contributes to **ground-level ozone**.
- **Regulatory Gap:** India lacks adequate monitoring of **aldehydes**, and strong **evaporative emission norms**, compared to **US, EU, Brazil**.

Economic and Agricultural Concerns

- **Food vs Fuel Debate:** Rising ethanol demand increases demand for **corn and sugarcane**. It leads to food inflation, and stress on the livestock sector.

- **Import Paradox:** India is importing **industrial ethanol, and corn** that undermines the goal of **self-reliance**.
- **Water Stress:** Sugarcane-based ethanol highly **water-intensive** impacting **groundwater levels**.

Policy Paradox: Transitional vs Long-Term Solution

- E20 is a **transitional fuel**, not a clean end-state. It risks diverting focus from **Electric Vehicles (EVs), and hydrogen-based mobility**.
- Global trend:
 - **EU:** Focus on electrification (90% CO₂ reduction target)
 - **US:** Limits blending to ~10–15%

Need for Strategic Reorientation

- **Promote 2G Ethanol:** From crop residues, and municipal waste. It reduces food-fuel conflict.
- **Shift Towards Industrial Use:** Ethanol as chemical feedstock, green solvent, bio-plastic input.
 - Global examples: USA, Germany, EU
- **Strengthen Regulations:** Introduce **aldehyde emission norms, and evaporative emission standards**.
- **Accelerate Clean Mobility:** Focus on **electric mobility, and renewable energy integration**.

A WARMER, SHORTER WINTER IN INDIA

Context

- India's winter of 2026 stands out as an anomaly, marked by a **near absence of cold extremes** and a **premature transition to summer-like conditions**.
- Analysis of IMD data reveals it as part of a **broader climatological shift**, characterised by **declining cold waves, rising temperatures, and increasing variability** in seasonal patterns.

IMD Classification

- **Cold Day:** Maximum temperature 4.5°C–6.4°C below normal
- **Severe Cold Day:** >6.4°C below normal
- **Cold Wave:** Minimum temperature 4.5°C–6.4°C below normal
- **Severe Cold Wave:** >6.4°C below normal

Decline of Cold Waves: Key Trends

- **February 2026: No cold day or cold wave recorded;** first such February in **five years**.
 - Comparison: 6 cold-wave days in 2022; 1 in 2023; 7 in 2024 and 5 in 2025.
 - It indicates a **sharp weakening of winter intensity**.
- **Seasonal Trend (Jan–Feb Combined)**
 - **24 events** in 2026 (second lowest in 5 years); 21 in 2023 (lowest); 38 in 2024 (peak).
 - It suggests **high inter-annual variability**, but overall declining severity.

Changing Geography of Cold Waves

- **Core Pattern:** Concentrated in **North, Northwest, Central India**
- **Emerging Shifts:** **Limited southern penetration**
 - 2023: Telangana & Karnataka affected
 - 2025: Only Telangana (1 day)
 - 2026: Only Karnataka
- **Spatial Variability:**
 - 2023: Widest spread (17 states)
 - 2025: Narrowest (9 states)
 - 2026: Expanded again (15 states)
- It reflects **unstable spatial behaviour of cold extremes**.

Warming Trend Across Cities

- **Major Observations:** 34 cities analysed:
 - 23 cities: Above-normal **maximum temperatures**

- 30 cities: Above-normal **minimum temperatures**
- **Key Pattern: “Normal” temperatures becoming rare**
 - Pan-India trend: From **Himalayas (Shimla, Srinagar) to coastal regions (Panjim)**
- **Himalayan Anomalies:** Warmer nights than days (relative to normal)
 - Extreme spikes:
 - Shimla: Up to **10°C above normal**
 - Itanagar: Night temp **~8°C above normal**
 - It suggests **elevation-dependent warming**, a critical climate signal

Scientific Evidence: Long-Term Climate Trends

- The observed 2026 anomalies align with broader research findings:
 - Declining cold waves and increasing heatwaves across India
 - Rising **minimum temperatures (warmer nights)**
 - Increasing **temperature anomalies and variability**

Conclusion

- India’s winter of 2026 reflects a **clear climatic transition** i.e. **weaker winters, earlier summers, and erratic spatial spread of cold events.**
- These trends align with long-term scientific evidence pointing to **climate change-driven restructuring of seasonal cycles**, rather than isolated anomalies.

ENERGY WARFARE IN THE STRAIT OF HORMUZ: IMPLICATIONS FOR INDIA AND THE WORLD

Context

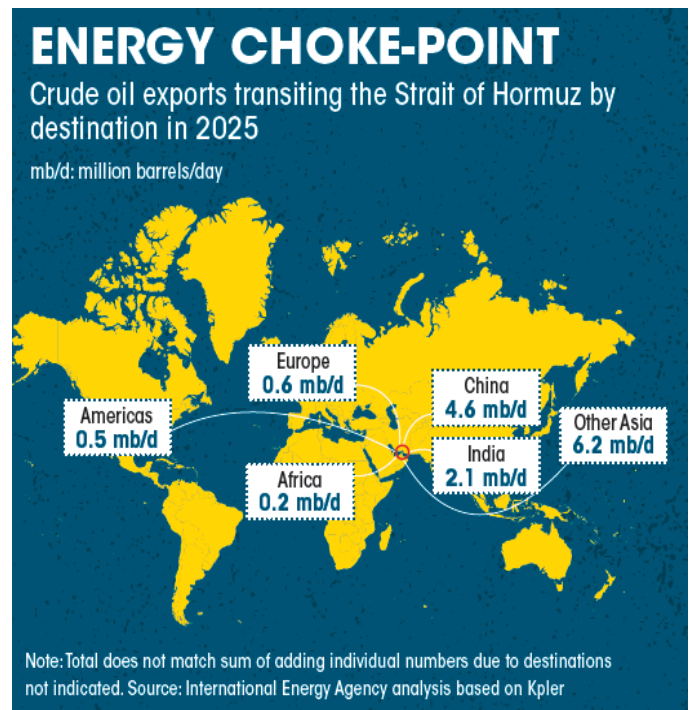
- The recent naval escort of Indian LPG tankers through the **Strait of Hormuz**

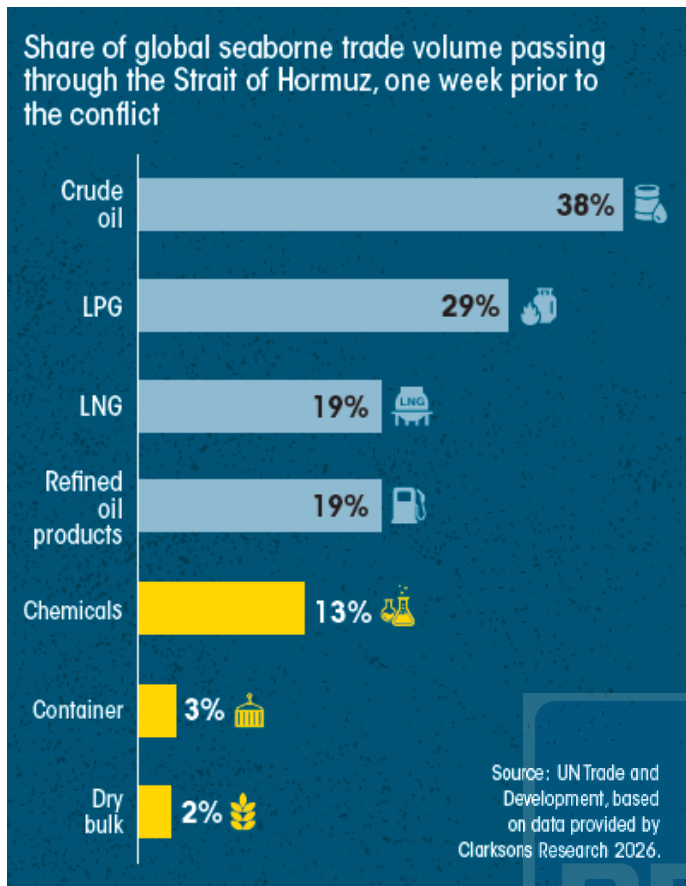
signals a structural shift in global energy trade.

- What was once largely commercial is now deeply geopolitical, resembling a **zero-sum strategic contest.**
- Control over energy flows has become a tool of coercion, reflecting the growing **weaponisation of trade and supply chains.**

Strategic Importance of the Strait of Hormuz

- A **critical maritime chokepoint**, only ~33 km wide.
- It handles a **significant share of global energy flows:**
 - ~35% of seaborne crude oil
 - ~29% of LPG
 - ~19% of LNG and refined products
- Nearly **20% of global oil trade passes through it.**
- Around **100 ships transit daily under normal conditions.**
- Maritime chokepoints like Hormuz are ‘systemic vulnerabilities’ where disruptions can trigger **global economic shocks and energy insecurity.**





- IEA released **400 million barrels** (record reserve release)
- Energy shocks from chokepoint disruptions resemble **1970s oil crises**, with cascading effects across sectors.

Impact on Asia: Maximum Vulnerability

- Asia consumes **~80% of Hormuz oil flows**; Major dependents are China, India, Japan, South Korea.
- **Severe impacts on developing nations:**
 - Nepal: LPG rationing
 - Sri Lanka: Weekly shutdowns
 - Pakistan: LNG crisis leads to school closures.
- It highlights **energy inequality and vulnerability of import-dependent economies.**

India's Energy Vulnerability

- **High Import Dependence:**
 - Crude oil: **88–90% imported**, in which ~50% via Hormuz.
 - LPG: **60% imported** (90% via Hormuz)
 - LNG: **68% from Gulf.**

India's Response

- Invoked **Essential Commodities Act, 1955**
- **4-tier rationing system:**
 - Priority: households, CNG
 - Cuts: industry (50%), fertilisers (70%)
- Increased domestic LPG production by **38%**
- Diversified imports: US, Russia, Norway, Algeria
- Push for **PNG (piped natural gas)** expansion

Broader Geopolitical Lessons

- **Energy Security & National Security:** Naval escorts and diplomacy show **militarisation of trade routes**

From Conflict to Energy War (2026 Crisis)

- Conflict triggered by **US–Israel strikes on Iran**, and Iran's retaliation led to **closure of the Strait**, causing **97% drop in shipping traffic**, and ~3,000 ships stranded.
- Escalation: Israeli strike on **South Pars gas field**; and Iranian strike on **Qatar's Ras Laffan LNG hub**.
- It resulted in a **full-fledged energy war**, targeting production and transit infrastructure.

Global Economic Impact

- Oil prices surged:
 - Touched **\$120/barrel**, stabilizing above \$100
 - Possible rise to **\$150 if disruption continues**
- LNG, LPG, fertilisers, helium prices increased

- **Checkpoint Vulnerability:** Hormuz exemplifies how **geography shapes geopolitics**
- **Weaponisation of Energy:** States increasingly using **energy supply as leverage.**
 - Control over chokepoints gives states **outsized geopolitical power**, making global trade fragile.

Way Forward for India

- **Diversification of energy sources** (Africa, Americas)
- **Strategic petroleum reserves expansion**
- **Accelerate renewables & green hydrogen**
- **Strengthen naval presence in IOR**
- **Promote regional energy cooperation**

OIL SHOCKS

- **1973 Crisis (First Oil Shock):** It was triggered by the **Yom Kippur War (1973)** between **Israel and a coalition of Arab states.**
 - **OPEC**, particularly Arab members, imposed an oil embargo on countries supporting Israel (primarily the US, Western Europe and Japan).
 - Oil prices quadrupled from US \$3 per barrel to \$12.
 - Global economic recession and inflation followed ('stagflation').
- **1979 Crisis:** Triggered by **Iranian Revolution** that toppled the Shah of Iran.
 - Production in Iran collapsed and exports fell sharply.
 - Oil prices doubled from \$15 per barrel to \$39, renewed global inflation and economic slowdown.
- **1990 Oil Price Spike:** Caused by **Iraq invasion of Kuwait or Gulf War** in 1990.
 - Oil prices jumped from \$20 per barrel to over \$40 temporarily and

- stabilised after coalition forces liberated Kuwait in early 1991.
- **2008 Oil Price Spike:** Caused by strong global demand, especially from China and emerging economies.
 - Geopolitical tensions (West Asia) and limited spare capacity resulted in tight supply.
 - Oil prices hit a record high of \$147 per barrel in July 2008.
 - **2020 Oil Price Collapse:** Triggered by global demand collapse due to COVID-19 lockdowns and **price war between Russia and Saudi Arabia** in early 2020 exacerbated oversupply.
 - West Texas Intermediate (WTI) crude futures briefly went negative in 2020.
 - **2026 Oil Price Spike:** The **US–Iran tensions** have driven Brent crude prices up from \$80 per barrel to \$120 within a week.

INDIA'S FERTILISER DEPENDENCE

Context

- Recent conflicts in West Asia and past disruptions (Russia–Ukraine war, China's export restrictions) highlight how **fertilizer security is directly linked to food security, fiscal stability, and geopolitical strategy.**

Scale of India's Fertiliser Dependence

- **High Import Dependence:** India is the **2nd largest fertiliser importer globally** (FAO data).
- **Demand vs Production (2024–25):**
 - **Demand:** ~64.9 million tonnes
 - **Production:** ~46.5 million tonnes
 - **Imports:** ~16 million tonnes
- **Import Concentration Risks:**
 - **Urea imports:** ~70% from Gulf (Oman, Qatar, Saudi Arabia, UAE)

- **DAP imports:** More than 40% from Saudi Arabia
- Heavy reliance on **Strait of Hormuz** (critical chokepoint)
- **Hidden Dependence (Raw Materials):**
 - 85% natural gas (urea feedstock) imported
 - 90–95% rock phosphate imported
 - ~50% phosphoric acid imported
- **Effective dependence rises to ~68–70%**, making India structurally vulnerable.

Link Between Fertiliser and Food Security

- Fertilisers are essential for **high crop yields and Green Revolution sustainability**.
- Supply disruptions leading to **lower yields, inflation, food insecurity**.

Recent Geopolitical Shocks

- **West Asia Conflict (2025–26):** Disruption in Gulf supply routes;
 - Gas supply restrictions → fertiliser plants running below capacity;
 - Likely **price rise and subsidy burden increase**;
- **Past Examples:**
 - **Russia–Ukraine War (2022):** Fertiliser prices doubled
 - **China export restrictions (2025):** Forced costly imports
- **Every disruption leads to reactive scrambling rather than strategic planning.**

Key Challenges

- **Supply Chain Concentration:** Overdependence on a few regions (Gulf, China, Russia)
- **Fiscal Burden:**
 - Fertiliser subsidy: ₹1.77 lakh crore (2024–25)
 - Urea heavily subsidised leading to **market distortion**.

- **Imbalanced Usage:** Excessive urea use leading to soil degradation & environmental damage.
- **Domestic Constraints:** Limited reserves of potash and phosphate; and high dependence on imported feedstock.

Strategies to Reduce Dependence

- **Diversification of Imports:** Shift sourcing to Southeast Asia (Indonesia, Malaysia, Vietnam); Africa, Central Asia, Latin America
 - Reduce geopolitical concentration risks
- **Overseas Investments:** Expand models like **Oman India Fertiliser Company (OMIFCO)**
 - Invest in rock phosphate (Morocco – 70% reserves); and potash mines abroad
- **Boost Domestic Production:** Improve plant efficiency; use low-grade domestic resources; and integrate with the **energy sector (green ammonia)**.
- **Strategic Fertiliser Reserve:** Maintain buffer stocks for crisis situations

Reforming Fertiliser Subsidy

- **Current Issues:** Urea price fixed since 2018 leading to overuse; and government bears **85–90% of cost**.
- **Suggested Reforms:**
 - Direct income transfers to farmers (per acre basis)
 - Rationalise urea pricing
 - Promote balanced nutrient use (NPK mix)

Way Forward

- Treat fertiliser as a **strategic sector like energy security**; and build **resilient and diversified supply chains**.
- **Biofertilisers & Organic Inputs:** Compost from agricultural waste; and microbial nitrogen fixation

- **Government Initiatives:** PM-PRANAM scheme

ECOCIDE: ENVIRONMENTAL HARM IN WARFARE

Context

- Recent geopolitical conflicts in West Asia highlight a growing but under-recognised dimension of warfare i.e. **environmental destruction**.
- Incidents involving incendiary weapons, toxic chemicals, and attacks on energy infrastructure demonstrate that ecological damage is no longer incidental but increasingly **systemic and strategic**.

Recent Evidence of Environmental Damage in Conflict

- **Use of Hazardous Substances:** Reports indicate use of **white phosphorus** over civilian areas in southern Lebanon, and alleged aerial spraying of **glyphosate**.
 - **White phosphorus** is highly incendiary; causes **severe burns**, fires, and long-term soil contamination.
 - **Glyphosate** is a herbicide that can contaminate **soil, crops, and water systems** at high concentrations.
- According to environmental monitoring groups, over **120 incidents of ecological harm** have been recorded in the ongoing conflict.

Destruction of Energy Infrastructure

- Airstrikes on **oil depots and refineries** triggered massive fires releasing **soot, hydrocarbons, sulphur and nitrogen compounds**.
- Reports of '**black rain**' (**acid precipitation**) affecting human health and agriculture.

Climate Impact of War

- Initial weeks of bombardment were estimated to emit **~5 million tonnes CO₂ equivalent**, exceeding annual emissions of some countries (e.g., Iceland).
- Emissions drivers: Burning oil facilities, military mobilization, and weapon production and deployment

When Does Environmental Harm Become a War Crime?

- Traditionally, environmental damage in war is treated as **collateral**, not primary harm. However, current conflicts challenge this assumption.
- **Historical Precedent:**
 - **Agent Orange (Vietnam War):** Long-term ecological and human health damage, and triggered global debate on environmental protection in warfare.

Existing Legal Frameworks

- **Additional Protocol I (1977):** Prohibits warfare causing '**widespread, long-term, and severe**' environmental damage.
- **Rio Declaration (1992):** Warfare is inherently destructive to **sustainable development** (Principle 24).
- **Rome Statute, 1998 (ICC):** Environmental damage is a war crime if it is **intentional**, causes **widespread, long-term, severe harm**, and is **disproportionate to military advantage**.

Concept of Ecocide

- It was proposed in 2021 as 'Unlawful or wanton acts committed with knowledge of causing **severe and widespread or long-term environmental damage**'.
- **Recent Developments:** 2024 proposal by **Vanuatu, Fiji, Samoa** to include ecocide as the **5th international crime** under the Rome Statute.

Ecology as a Tool of Conflict

- **Slow Environmental Transformation:** Afforestation policies replacing native ecosystems:
 - Example: Replacement of Mediterranean vegetation with **European pines**
 - Impacts: Biodiversity loss; Soil degradation; Altered fire regimes
- **War–Environment Nexus:** Environmental damage is now a **by-product** of conflict.
 - A **strategic instrument** (e.g., targeting infrastructure, altering landscapes)

Way Forward

- **Codify Ecocide** as an international crime with clearer thresholds
- Strengthen **monitoring mechanisms** (e.g., satellite-based environmental tracking)
- Integrate **environmental norms into military doctrines**
- Promote **universal participation in ICC frameworks**
- Enhance role of **non-state actors and civil society** in documentation and advocacy

WEST ASIA WAR: IMPACT ON INDIA'S PHARMACEUTICALS SECTOR

Context

- Recent geopolitical conflicts have exposed the fragility of global pharmaceutical supply chains.
- Disruptions in the supply of critical raw materials and rising input costs pose a serious threat to global public health, especially for developing nations dependent on affordable medicines from India.

About Geopolitics and the Changing Nature of 'Collateral Damage'

- Modern conflicts increasingly extend beyond battlefields to disrupt essential

civilian infrastructure, including healthcare systems.

- Geopolitical tensions and wars significantly affect pharmaceutical supply chains by interrupting logistics, increasing trade barriers, and creating uncertainty in global markets.
- Such disruptions disproportionately affect vulnerable populations, especially children, by limiting access to essential medicines and vaccines.

India as the 'Pharmacy of the World'

- India plays a central role in global health:
 - Supplies **generic medicines to ~200 countries**
 - Major provider of **vaccines (DPT, BCG, measles)** to UNICEF and WHO
 - Accounts for a significant share of **low-cost drugs globally**
- India's pharmaceutical sector is deeply integrated into global health systems, particularly in developing regions.

Structural Weakness: Dependence on Imported Raw Materials

- **Heavy Import Dependence: 70–75% of APIs and intermediates sourced from China.**
 - Dependence spans Key Starting Materials (KSMs), drug intermediates, and Active Pharmaceutical Ingredients (APIs).
 - India's dominance in generics is underpinned by reliance on Chinese raw materials, making it vulnerable to external shocks.

Impact of War on Pharma Supply Chains

- **Supply Chain Disruptions:** Damage to **air transit hubs and shipping routes**, delays in **temperature-sensitive drugs (e.g., cancer medicines)** and increased **logistics costs and rerouting**.

- Pharmaceutical supply chains are highly sensitive to geopolitical disruptions due to their complexity and just-in-time nature.
- **Rising Input Costs:** Increased cost of APIs and intermediates; currency volatility and insurance costs; and impact on **drug prices across the distribution chain.**
 - Rising trade pressures and tariffs significantly increase pharmaceutical costs, especially for generic manufacturers.
- **Medicines at Risk:** Shortages and price increases are expected in **Paracetamol (fever management), antibiotics (routine infections), diabetes medicines, and cancer drugs (temperature-sensitive).**
 - These medicines form the backbone of primary healthcare, amplifying the crisis.

Global Implications

- **Impact on Developing Countries:** Africa and low-income countries rely heavily on Indian generics.
 - Disruptions may cripple **public health programs**
- **Vaccine Supply Risks:** India supplies bulk vaccines globally;
 - ~70% of vaccine raw materials are imported → potential bottlenecks
- **Threat to Global Health Security:** Disruptions in pharmaceutical supply chains can undermine global health systems and pandemic preparedness.

Policy Responses and Gaps

- **Government Measures:** Production Linked Incentive (PLI) scheme to boost domestic API production; and increase in API exports.
- **Limitations:**
 - Continued **high import dependence;**
 - Rising share of imports from China;

- Insufficient domestic capacity in **KSMs and intermediates;**
- **Onshoring and diversification** are necessary but require long-term investment and policy coherence.

Way Forward

- **Short-Term Measures:** Strategic stockpiling of critical drugs and APIs; diversification of import sources; and strengthening logistics and cold-chain infrastructure.
- **Long-Term Measures:** Promote **domestic API and KSM manufacturing;** invest in **R&D and innovation;** build **resilient supply chains** (multi-country sourcing); and enhance **global cooperation in health security.**

MC MEHTA CASE & DELHI'S AIR POLLUTION GOVERNANCE

Context

- The case of **M C Mehta v Union of India** stands as proof that a proactive judiciary can accelerate action even when the executive drags its feet.

About the MC Mehta Case (1985–2024)

- It represents one of the most significant examples of **judicial activism in India**, where the **Supreme Court intervened to address Delhi's worsening air pollution** amid executive inaction.
- Over four decades, it transformed environmental governance, established new legal principles, and forced systemic policy changes.

Genesis: From Industrial Disaster to Environmental Jurisprudence

- Originated from the **1985 Oleum Gas Leak (Shriram Fertilizer case).**
- Led to the landmark doctrine of **Absolute Liability** for hazardous industries.

- Expanded from a single factory issue to **Delhi-wide air pollution governance**.
 - Courts recognized that pollution is systemic, not isolated, requiring structural reforms.

Judicial Innovations in Environmental Law

- **Right to Clean Environment (Article 21):** Supreme Court interpreted **Right to Life** to include clean air, and healthy environment.
 - It established environmental protection as a **constitutional mandate**.
- **Precautionary Principle:** Lack of scientific certainty ≠ excuse for inaction; and shifted burden of proof to **polluters**.
- **Polluter Pays Principle:** Polluters must bear cost of damage, and cost of mitigation
 - It led to **Environment Compensation Charges (ECC)**; and Pollution taxes on diesel vehicles.

Institutional Innovation: Role of EPCA

- The Supreme Court created the **Environment Pollution (Prevention and Control) Authority (EPCA)** to provide scientific data, policy recommendations, monitoring and compliance.
 - Bridged the gap between **law and science**.

Major Policy Interventions (Multi-Sectoral Approach)

- **Industrial Sector:** Relocation of polluting industries; and ban on dirty fuels like coal, pet coke, and furnace oil; and shift to **PNG/Clean fuels**.
- **Energy Sector:** Closure of **coal-based power plants in Delhi**
- **Transport Sector:** Conversion to **CNG-based public transport** (first of its kind globally)

- Leapfrogging emission standards: Euro norms to **BS-IV and further BS-VI**
- Ban on 10-year-old diesel vehicles and 15-year-old petrol vehicles.

- **Urban Measures:** Remote sensing for emissions monitoring; parking management strategies; and phasing out **leaded petrol**.
- **Emergency & Long-Term Planning:** **Graded Response Action Plan (GRAP)** for severe pollution episodes; and source-wise pollution control strategy.

National Impact (Spillover Effects)

- Extended to **NCR (multi-state coordination)**
- Applied to **13 other polluted cities (2004)**
- Influenced nationwide emission standards (SO_x, NO_x); and clean fuel transitions

Impact Assessment

- **Positive Outcomes:**
 - **~46% reduction in PM2.5** (since 2012 in monitored areas)
 - Diesel share reduced significantly
 - Decline in diesel vehicle market share
 - Universal shift of industries to cleaner fuels
- **Limitations:**
 - Pollution levels still above safe standards
 - Need for strong executive implementation, regional coordination, and long-term structural reforms.

FUELWOOD RESURGENCE AMID LPG CRISIS: ENERGY SECURITY LESSONS FOR INDIA

Context

- Amid West Asia conflict, **fuelwood has re-emerged as a critical fallback energy source**, as it disrupted global energy

supply chains, exposing India's dependence on imported liquefied petroleum gas (LPG).

Return to Fuelwood

- Across India, reports indicate a sharp surge in fuelwood demand:
 - **Chhattisgarh, Jharkhand, Odisha, Kerala:** Households reverting to fuelwood despite earlier LPG adoption
 - **Urban spillover:** Even city dwellers are sourcing fuelwood from outskirts
- **Informal markets booming**
 - Fuelwood bundles being sold near Raipur
 - Ranchi witnessing increased roadside trade
 - Balangir (Odisha) seeing LPG users shift to wood
- It reflects a '**distress-driven reverse transition**' in cooking energy use.

Historical Perspective: Echoes of the 1970s Oil Crisis

- The **1974 oil crisis** triggered LPG shortages in India
- That decade marked the beginning of the **transition from fuelwood to LPG**
- However, the transition remains incomplete even after five decades
 - Fuelwood continues to function as a **parallel energy system**.

Current Energy Mix

- **NSO (2021):** ~33% households use fuelwood; and ~50% rural households depend on it
- **NFHS-5:** ~41% population uses biomass fuels (fuelwood, dung cakes)
- **Urban India:** 89% households use LPG
- **Regional disparity:** 11 states have more than 50% households using solid fuels
 - These indicate **energy inequality and rural-urban divide**.

Fuelwood Economy

- Fuelwood is not merely a traditional fuel—it is an **organized informal economy**:
 - **Global market size:** \$37.04 billion (2024) and further projected ~\$46 billion by 2030 (Grand View Research)
 - **Livelihood dependence:** Millions of rural households engaged in collection and trade.
 - **Commercial circulation:** ~18% of fuelwood collected is sold in towns and cities.
- These demonstrate that fuelwood is a **market-driven energy commodity**, not just subsistence use.

Why Fuelwood Persists

- **Structural Reasons**
 - **Affordability:** Minimal or zero monetary cost
 - **Accessibility:** Locally available
 - **Supply reliability:** Not dependent on imports or logistics
 - **Cultural familiarity:** Traditional cooking practices
- The current LPG shortage reinforces these advantages.

Concerns and Challenges

- **Health Impacts:** Indoor air pollution leads to respiratory diseases; and disproportionate burden on women and children.
- **Environmental Costs:** Deforestation and forest degradation, and carbon emissions (though sometimes considered carbon-neutral locally).
- **Energy Poverty:** Indicates **lack of sustained access to clean energy**; and reflects gaps in schemes like **PM Ujjwala Yojana**.

Policy Implications

- **Strengthen Clean Energy Access:** Ensure **continuous LPG supply chains**; and improve refill affordability (subsidies, DBT efficiency).
- **Diversified Energy Basket:** Promote alternatives like biogas, electric cooking, and solar-based solutions.
- **Sustainable Fuelwood Management:** Agroforestry and community forestry, and efficient cookstoves to reduce emissions.
- **Focus on Energy Justice:** Address rural-urban disparities, and target vulnerable populations.

DECLINING CAMEL POPULATION IN RAJASTHAN

Context

- Recently, the **Rajasthan High Court** observed a **sharp decline in camel population** despite a protection law.

Trend in Camel Population

- India's Camel population has **declined by more than 75% since the 1970s**, a decline driven by economic transitions, shrinking rangelands, legal constraints, and declining institutional support
 - ~7.5 lakh in 2004, ~3.2 lakh (year of enactment of protection law) in **2015** and ~1.5 lakh in **2021**.
- It indicates a **continuous and steep decline**, even after legal protection.

Legal Framework

- **Rajasthan Camel Act, 2015:** Rajasthan Camel (Prohibition of Slaughter and Regulation of Temporary Migration or Export) Act, 2015.
- **Key Provisions:**
 - Ban on **slaughter of camels**
 - Restriction on **transport/export outside the state**
 - Regulation of **migration of camels**

- Camel declared as the **State Animal of Rajasthan**.

About Camels

- They are exceptionally suited to dryland ecosystems, and deeply embedded in the **cultural lives of pastoral communities** such as the **Raika, Rabari, and Fakirani Jat**.

Key Camel Breeds in India

- **Dromedary Camels (Rajasthan and Gujarat):**
 - **Bikaneri (Rajasthan):** Commonly used for cart pulling and heavy draught work.
 - **Jaisalmeri (Rajasthan):** Primarily used for **riding, camel safaris, and long-distance travel**, especially in the **Thar Desert**.
 - **Mewari (Southern Rajasthan):** This is a **dual-purpose breed**, utilized for both milk production and draught.
 - **Kachchhi (Gujarat):** It is commonly used for ploughing and carting in the **Rann of Kachchh** and surrounding regions.
 - **Kharai (Gujarat):** Adapted to **coastal and mangrove ecosystems**. It is an excellent swimmer, capable of crossing creeks and feeding on mangroves.
- **Bactrian (Camelus bactrianus), Ladakh:** The **double-humped camel**, or Bactrian camel, is found exclusively in the **high-altitude cold desert of Ladakh**.
 - **Critically Endangered** on the IUCN Red List of Threatened Species.
 - **Gobi and Gashun Gobi deserts** of northwest China and Mongolia.

ENERGY CONSERVATION RULES AMENDMENT (2021-22)

Context

- Recently, the Union Ministry of Power amended the **Energy Conservation Rules, 2012**, fixing the value of **one metric tonne of oil equivalent** at **₹22,774** for 2021–22.

Key Provisions of the Amendment

- Standardization of Energy Value:** Fixes **₹22,774** per metric tonne of oil equivalent for 2021–22.
- Applicability:** Applies to **Designated Consumers (DCs)** under the Energy Conservation Act.
 - These include **energy-intensive industries** like steel, cement, power, etc.
- Regulatory Mechanism:** Provides a **uniform benchmark** for energy consumption, energy savings, and efficiency improvements.

Link with PAT Scheme & ESCerts

- Perform, Achieve and Trade (PAT) Scheme:** A **market-based mechanism** launched in 2012.
 - It targets energy efficiency in industries
 - Industries achieving excess savings get **Energy Saving Certificates (ESCerts)**

Significance of the Amendment

- Economic Signal for Energy Efficiency:** Assigns **monetary value to energy savings**, and encourages industries to adopt **efficient technologies**.
- Boost to Market-Based Mechanisms:** Strengthens **trading of ESCerts**, and aligns with global practices like **carbon markets**.
- Policy Certainty:** Standard valuation reduces ambiguity, and helps industries plan **long-term investments**.

- Climate Commitments:** Supports India's **NDC targets**, and aids transition toward a **low-carbon economy**.

FIREFLY DIVERSITY IN INDIA

Context

- A recent study published in *Zootaxa* has compiled the **first comprehensive checklist of fireflies in India**, documenting **92 species**.

Key Findings of the Study

- Historical Compilation:** Based on **scientific literature from 1881 to October 2025**
 - It represents over **two centuries of cumulative research**, and consolidates scattered and fragmented data into a **single reference framework**.
- Endemism:** **>60% species are found only in India**, indicating **high biodiversity and uniqueness** of Indian ecosystems.
- Distribution Insights:**
 - Fireflies (Family: **Lampyridae**) show wide distribution across **forests, wetlands, and grasslands**.
 - Sensitivity to **habitat changes and light pollution**
 - It helps map **biogeographical patterns in India**.

Importance for Conservation

- Baseline for Policy & Research:** First **authoritative checklist** for India. It helps in species monitoring, red List assessments, and conservation prioritisation.
- Indicator Species:** Fireflies act as **bioindicators** of ecosystem health, and pollution levels.
 - Decline signals **environmental degradation**.
- Threats Identified:**
 - Habitat loss** (urbanisation, deforestation)

- **Light pollution** (disrupts mating signals)
- **Pesticide use**
- Climate change impacts.

CATTLE DISEASE EMERGENCY IN RUSSIA

Context

- Russia has reported an outbreak of an animal disease identified officially as **pasteurellosis or rabies**, affecting multiple regions.

What is the Disease?

- **Pasteurellosis:** It is a **bacterial infection** caused by *Pasteurella multocida* that affects livestock such as cattle, sheep, and poultry.
 - It can spread rapidly in poor sanitary conditions, and is **treatable with antibiotics** if detected early.
- **Rabies:** It is a **viral zoonotic disease** affecting mammals, transmitted through bites/saliva.
 - **Almost always fatal once symptoms appear.**
 - Requires **culling only after confirmation.**

Risk of International Spread

- Outbreak regions are **close to China**, raising cross-border concerns. However:
 - **Pasteurellosis is not mandatorily reportable** to WHO.
 - Limited global surveillance reduces transparency.
- Global zoonotic disease monitoring systems highlight **inconsistent reporting standards** as a major challenge.

SUBJECTIVE QUESTIONS

1. Discuss how climate change is transforming food production, distribution, and consumption patterns. Suggest sustainable strategies to ensure food security in the 21st century.
2. Examine the economic, environmental, and technological implications of achieving the E20 target. Discuss the key challenges associated with its implementation and suggest measures to ensure sustainable outcomes.
3. Discuss the extent to which existing international humanitarian law addresses environmental harm in warfare. Should ecocide be recognized as an independent international crime?

MCQS

1. With reference to E20 fuel in India, consider the following statements:
 1. E20 fuel contains 20% ethanol and 80% petrol.
 2. Ethanol used in blending is primarily produced from petroleum refining.
 3. The Ethanol Blending Programme aims to reduce greenhouse gas emissions.

Which of the statements given above is/are correct?

 - (a) 1 and 3 only
 - (b) 2 only
 - (c) 1, 2 and 3
 - (d) 1 only
2. With reference to the term 'Ecocide', consider the following statements:
 1. It refers to extensive destruction of ecosystems causing severe environmental damage.

2. It is recognized as a core crime under the Rome Statute of the International Criminal Court.
3. It may include acts committed during both peacetime and wartime.
- Which of the statements given above is/are correct?
- (a) 1 only
(b) 1 and 3 only
(c) 2 and 3 only
(d) 1, 2 and 3
3. Which of the following principles was evolved in the Oleum Gas Leak Case (MC Mehta v. Union of India)?
- (a) Absolute Liability
(b) Polluter Pays Principle
(c) Precautionary Principle
(d) Sustainable Development
4. Which doctrine ensures that the State holds natural resources in trust for public use?
- (a) Absolute Liability
(b) Public Trust Doctrine
(c) Polluter Pays Principle
(d) Precautionary Principle

