

IAS MAINS 2024 CONTEMPORARY ISSUES ENVIRONMENT

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Topic wise segregated **Previous Year** Questions

& ECOLOG

Practice Ouestions for High Retention

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MEDHA ANAND AIR-13 (CSE-2023)

66 I was a part of with Mains Test Series interview guidance at GS Score and Sir helped me in enhancing both my answer writing skills in GS and Essay. I am truely grateful to sir for the personal guidance and mentorship he offered me. 99

NITESH KUMAR MISHRA AIR-158 (CSE-2023)

66 GS SCORE has been really helpful in my preparation. I had used the Mains Test Series and the Feedback and guidance was really awesome. GS SCORE was the only mock which I gave and the feedback motivated and helped me alot. 99

AMBIKA RAINA AIR-164 (CSE-2022)



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and many more...

AISHWARYAM AIR-10 (CSE-2023)

66 GS SCORE helped me during the preparation I practised lot of mock test on the GS Score platform to understand the structure of answer writing. I am gratefull to this platform for providing such guidance to me and many more aspirants. **99**

SAURABH SHARMA AIR-23 (CSE-2023)

66 Mains Tests at GS SCORE in the simulated environment helped me thoroughly complete my preparation with discipline. I would like to thank GSSCORE. 99

SWATI SHARMA AIR-15 (CSE-2022)

66 UPSC Style mock papers coupled with evaluation by faculty members of GS SCORE themselves enhanced my confidence to write answers as per the demand. I am thankful. 99





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ECOSYSTEM AND ECOLOGY

1. IUCN REPORT ON MANGROVE ECOSYSTEMS -CLIMATE RESILIENCE AND HABITAT LOSS.

CONTEXT: The International Union for Conservation of Nature (IUCN) recently published a comprehensive report detailing the dual role of mangroves in enhancing climate resilience and the alarming rate of habitat loss they are experiencing.

IUCN Report on Sundarban Mangroves:

 According to the IUCN, nearly 35% of the world's mangroves have been lost in the past 50 years, and the current rate of loss is estimated at 0.16% per year. This trend is particularly concerning given the critical ecosystem services mangroves provide.

Several factors contribute to the rapid loss of mangrove habitats:

- Agricultural Expansion and Aquaculture: According to the Food and Agriculture Organization (FAO), shrimp aquaculture accounts for approximately 38% of global mangrove deforestation.
- Urban Development: Coastal urbanization leads to habitat destruction. For example, in Thailand, urban expansion in coastal areas has led to significant mangrove loss.
- Climate Change: The IUCN report highlights that climate change-induced sea-level rise could submerge many low-lying mangrove forests, especially those that cannot migrate inland due to topographical constraints.

• Addressing mangrove loss requires a multi-faceted approach:

• Conservation and Restoration Initiatives: The Mangroves for the Future (MFF) initiative has been instrumental in promoting sustainable development in coastal regions of Asia and the Indian Ocean.

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- Sustainable Aquaculture Practices: Implementing integrated mangrove-shrimp farming systems, which involve replanting mangroves around shrimp ponds, has shown promise in balancing economic and ecological interests.
- ► **Policy and Legislation:** The implementation of marine protected areas (MPAs) and enforcing strict land-use regulations can significantly mitigate mangrove loss.

Ecosystem connectivity and impacts on ecosystem services from human activities



Case Studies

Indonesia: Indonesia has one of the largest mangrove areas globally and has implemented ambitious restoration projects. The national program, launched in 2021, aims to restore 600,000 hectares of mangroves by 2024. Early results indicate a positive impact on biodiversity and local livelihoods.

The IUCN report highlights the critical role of mangroves in climate resilience and the urgent need to halt their loss. By implementing comprehensive conservation strategies, promoting sustainable practices, and enforcing robust policies, it is possible to safeguard these invaluable ecosystems.

PRACTICE QUESTION

Q. Discuss the causes and consequences of coral bleaching on the coastal environment.

2. CORAL BLEACHING IN GREAT BARRIER REEF - PERSISTENT CLIMATE STRESSORS AND RECOVERY EFFORTS

CONTEXT: According to the Australian Institute of Marine Science (AIMS), over 60% of the reef has experienced some degree of bleaching in recent years. This has severe implications for marine biodiversity, tourism, and the fishing industry, which are all heavily reliant on a healthy reef ecosystem.

• Several factors contribute to the persistent coral bleaching in the GBR:

- ► **Rising Sea Temperatures:** The **Intergovernmental Panel on Climate Change (IPCC) reports** that global temperatures have risen by 1.1°C since pre-industrial times, with the GBR's waters warming by approximately 0.4°C per decade over the past 40 years.
- Ocean Acidification: According to NOAA, the ocean's surface pH has decreased by 0.1 units since the industrial revolution, representing a 30% increase in acidity.
- Pollution and Runoff: The Great Barrier Reef Marine Park Authority (GBRMPA) identifies pollution as a significant contributor to the reef's decline.



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- Addressing the challenges faced by the GBR requires a multifaceted approach:
 - Climate Action: International agreements like the Paris Accord aim to limit global warming to well below 2°C. Nationally, Australia is working towards a target of net-zero emissions by 2050, which includes transitioning to renewable energy sources and enhancing carbon sequestration.
 - ► Coral Restoration Projects: The Reef Restoration and Adaptation Program (RRAP) in Australia is spearheading such efforts, aiming to restore millions of corals by 2030.
 - Improving Water Quality: Measures to reduce agricultural runoff and improve water quality are vital. Programs like the Reef 2050 Water Quality Improvement Plan focus on reducing sediment, nutrient, and pesticide loads entering the GBR.

Case Studies

Lady Elliot Island: This island, located at the southern tip of the GBR, has been the site of extensive restoration efforts. The Lady Elliot Island Eco Resort, in collaboration with research institutions, has successfully increased coral cover through reef monitoring and restoration projects, showcasing a model for sustainable tourism and conservation.

The Great Barrier Reef's ongoing battle with coral bleaching underscores the urgent need for concerted global and local efforts to mitigate climate change and promote reef resilience.

PRACTICE QUESTION

Q. What are the reasons for the coral bleaching over the World. Discuss the consequences of coral bleaching on environment.

3. MARINE HEATWAVES IN ARCTIC OCEAN -ACCELERATED SEA ICE LOSS AND SPECIES MIGRATION

CONTEXT: The National Snow and Ice Data Center (NSIDC) reported that the Arctic sea ice extent in September 2023 was among the lowest ever recorded, a direct consequence of prolonged marine heatwaves. The loss of sea ice not only accelerates global warming by reducing the Earth's albedo effect but also affects the habitat of numerous species.

n Reasons for Marine Heatwaves

- Climate Change: The Arctic is warming at more than twice the global average rate, a phenomenon known as Arctic amplification. According to the IPCC, the region has warmed by 3°C since the pre-industrial era, leading to increased frequency and intensity of heatwaves.
- ➤ Ocean Currents: Changes in ocean circulation patterns, such as the weakening of the Atlantic Meridional Overturning Circulation (AMOC), contribute to the persistence of warm water in the Arctic. This disrupts the normal cooling processes and exacerbates heatwave conditions.
- ➤ Atmospheric Patterns: Shifts in atmospheric pressure systems, like the Arctic Oscillation, influence the distribution of heat in the region. Positive phases of the Arctic Oscillation bring warmer air masses into the Arctic, intensifying marine heatwaves.

• Way Forward

• Mitigating Climate Change: Reducing greenhouse gas emissions is paramount. Global efforts under agreements like the Paris Accord aim to limit temperature rise.



- Enhancing Monitoring and Research: Investing in satellite and in-situ monitoring systems will improve the understanding and prediction of marine heatwaves.
- ► Adaptive Conservation Strategies: Developing adaptive management plans for Arctic marine ecosystems can help mitigate the impacts of heatwaves.



Case Studies

• **Barents Sea:** The Barents Sea has experienced severe marine heatwaves in recent years, leading to significant sea ice loss. Studies by the Norwegian Polar Institute indicate that the region has seen a 50% reduction in winter sea ice cover since the 1980s. This has resulted in northward migration of species like Atlantic cod, disrupting the local food web and impacting traditional fishing communities.

Marine heatwaves in the Arctic Ocean pose a significant threat to global climate stability and biodiversity. Accelerated sea ice loss and species migration are direct consequences of these heatwaves, driven primarily by climate change.

PRACTICE QUESTION

Q. Discuss the impact of marine heatwaves in the Arctic Ocean on sea ice loss and species migration. Examine the underlying causes and suggest measures to mitigate these effects.

4. COASTAL EROSION IMPACTING ECOSYSTEM - INFRASTRUCTURE VULNERABILITY AND ADAPTATION STRATEGIES

CONTEXT: According to the United Nations, approximately 40% of the world's population lives within 100 kilometers of the coast, making coastal erosion a pressing global concern.

Reasons for Coastal Erosion

Climate Change: Rising sea levels, attributed to global warming, accelerate coastal erosion. The Intergovernmental Panel on Climate Change (IPCC) reports that global sea levels have risen by MAINS SAMPOORNA **ENVIRONMENT & ECOLOGY**



about 20 cm since 1900, with projections of an additional rise of 26-77 cm by 2100, depending on emission scenarios.

- Human Activities: Coastal development, including the construction of buildings, roads, and ports, often disrupts natural sediment transport.
- ➤ Natural Forces: Waves, tides, and storms continuously shape coastlines. Extreme weather events, like hurricanes and typhoons, can cause sudden and severe erosion. For instance, Hurricane Sandy in 2012 caused extensive coastal erosion along the eastern seaboard of the United States.

b Way Forward

- Sustainable Coastal Management: Implementing integrated coastal zone management (ICZM) strategies can help balance development and conservation. This involves coordinated efforts to manage coastal resources sustainably, considering both environmental and socio-economic factors.
- Nature-Based Solutions: Promoting the use of natural defenses, such as restoring mangroves, coral reefs, and wetlands, can help protect coastlines. These ecosystems act as buffers against wave action and storm surges, reducing the impact of erosion.
- Policy and Legislation: Enforcing regulations to prevent unsustainable coastal development and sand mining is crucial. Policies that promote the relocation of vulnerable infrastructure and communities can also reduce the risk of erosion-related damage.

Case Studies

India: In the state of Odisha, the government has undertaken extensive mangrove restoration projects to combat coastal erosion. The **Mahanadi Delta region**, once heavily affected by erosion, has seen significant improvements in coastal stability and biodiversity due to these efforts. The restoration of mangroves has also provided additional benefits, such as enhancing fishery resources and carbon sequestration.

Coastal erosion presents a multifaceted challenge that impacts ecosystems, infrastructure, and communities. Addressing this issue requires a combination of sustainable management practices, nature-based solutions, and robust engineering measures.

PREVIOUS YEAR QUESTION

Q. Explain the causes and effects of coastal erosion in India. What are the available coastal management techniques for combating the hazard? (2022)

PRACTICE QUESTION

Q. Discuss the impact of coastal erosion on ecosystems and infrastructure. Examine the underlying causes and suggest adaptation strategies to mitigate these effects.

5. DEOXYGENATION IN RIVERINE ECOSYSTEMS -AGRICULTURAL RUNOFF AND BIODIVERSITY LOSS

CONTEXT: The Mississippi River Basin in the United States and the Yangtze River in China are notable examples where agricultural runoff has led to significant deoxygenation, adversely affecting aquatic life and local communities.

Reasons for Deoxygenation

► Agricultural Runoff: According to the Environmental Protection Agency (EPA), agricultural runoff contributes to over 50% of nutrient pollution in U.S. water bodies.



- ► **Industrial Discharges:** Factories and industrial plants often discharge pollutants, including nitrogen and phosphorus, into nearby water bodies.
- ► **Urban Runoff:** Urban areas contribute to deoxygenation through stormwater runoff that carries pollutants from streets, lawns, and wastewater into rivers and lakes.

b Way Forward

- ► **Sustainable Agricultural Practices:** Techniques such as precision farming, which optimizes the use of fertilizers, and the establishment of buffer zones (strips of vegetation) along waterways can significantly mitigate nutrient pollution.
- Regulation and Policy Enforcement: Governments need to enforce stricter regulations on agricultural practices and industrial discharges. Policies should incentivize farmers to adopt best management practices and penalize non-compliance.
- ► **Restoration Projects:** Restoring wetlands and riparian zones can enhance the natural filtration of nutrients before they reach water bodies.
- Public Awareness and Education: Educating farmers, industries, and the public about the impacts of nutrient pollution and the importance of water conservation can drive collective action towards reducing deoxygenation.

Case Studies

Chesapeake Bay, USA: The Chesapeake Bay has long suffered from nutrient pollution leading to hypoxia. The Chesapeake Bay Program, a regional partnership, has implemented comprehensive strategies to reduce nutrient inputs from agriculture, including cover crops, riparian buffers, and nutrient management plans. These efforts have shown positive trends in water quality and a decrease in the extent of hypoxic zones.

Deoxygenation in riverine ecosystems poses a severe threat to aquatic biodiversity and the health of water bodies. Addressing this issue requires a multi-faceted approach, combining sustainable agricultural practices, stringent regulatory frameworks, restoration projects, and public awareness initiatives.

PRACTICE QUESTION

Q. Discuss the impact of deoxygenation in riverine ecosystems on biodiversity. Examine the underlying causes and suggest measures to mitigate these effects.



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BIODIVERSITY

1. IMPACT OF EL NINO ON THE LAKES OF WORLD - HYDROLOGICAL CYCLES AND FRESHWATER ECOSYSTEMS

CONTEXT: El Niño event has been making headlines due to its profound impacts on global weather patterns, hydrological cycles, and freshwater ecosystems.

El Nino and its impact on Lakes

► El Niño events disrupt normal weather patterns, leading to extreme conditions such as droughts and floods. These changes have direct and indirect effects on lakes, altering water levels, temperature, and ecological balance. For example, during the 2015-16 El Niño, Lake Poopó in Bolivia completely dried up due to prolonged drought, while Lake Victoria in East Africa experienced severe flooding.

Reasons for the Impact

- Altered Precipitation Patterns: El Niño often causes significant shifts in rainfall distribution. Regions
 that typically receive abundant rainfall may experience drought, while arid regions may see increased
 precipitation.
- ► **Temperature Changes:** Elevated temperatures associated with El Niño events can increase evaporation rates, reducing lake levels in some regions.
- Extreme Weather Events: El Niño exacerbates the frequency and intensity of extreme weather events, such as storms and cyclones.

• Way Forward

• Monitoring and Early Warning Systems: Enhancing monitoring of climatic conditions and lake ecosystems can help predict and manage the impacts of El Niño.

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- ➤ Water Management Strategies: Developing adaptive water management practices, including the construction of reservoirs and the implementation of water-saving techniques, can mitigate the adverse effects of fluctuating water levels on lakes.
- **Ecosystem Conservation:** Protecting and restoring lake ecosystems can enhance their resilience to climatic changes.
- **Community Engagement:** Involving local communities in managing and conserving lake resources can ensure sustainable practices and improve adaptive capacity.

LA NIÑA CLIMATE IMPACTS

December-February

10

Case Studies

Lake Poopó, Bolivia: Lake Poopó, once Bolivia's second-largest lake, dried up completely during the 2015-16 El Niño due to prolonged drought and high evaporation rates. This had devastating effects on local communities and biodiversity. The lake's desiccation highlighted the need for sustainable water management practices and better preparation for climatic variability.

El Niño events have far-reaching impacts on the lakes of the world, significantly affecting hydrological cycles and freshwater ecosystems. The altered precipitation patterns, temperature changes, and extreme weather events associated with El Niño pose challenges for lake management and biodiversity conservation. However, through enhanced monitoring, adaptive water management, ecosystem conservation, and community engagement, it is possible to mitigate these impacts and build resilience.

PRACTICE QUESTION

Q. Discuss the impact of El Niño on the lakes of the world, focusing on changes in hydrological cycles and freshwater ecosystems. Examine the underlying causes and suggest measures to mitigate these effects.

2. TURTLE CONSERVATION - HABITAT DESTRUCTION AND POACHING THREATS

CONTEXT: According to the International Union for Conservation of Nature (IUCN), nearly half of all turtle species are threatened with extinction.

n Reasons for Turtle Decline

- ➤ Habitat Destruction: Coastal development disrupts nesting sites, while pollution and dam construction degrade freshwater ecosystems. The World Wildlife Fund (WWF) reports that over 90% of marine turtle nesting sites in the Caribbean have been lost due to coastal development.
- ► **Poaching and Illegal Trade:** Illegal trade, driven by demand for traditional medicine, pets, and luxury items, poses a significant threat. **TRAFFIC**, the wildlife trade monitoring network, has documented a sharp increase in the illegal trade of turtle shells and eggs in recent years.

b Way Forward

- ➤ Protected Areas: Establishing and effectively managing protected areas is crucial. Marine Protected Areas (MPAs) and freshwater reserves can safeguard critical habitats and nesting sites. Enforcement of anti-poaching laws within these areas is essential.
- Community Engagement: Involving local communities in conservation efforts can enhance protection measures.
- ► Legislation and Enforcement: Strengthening laws against illegal trade and ensuring their rigorous enforcement can deter poaching.
- Restoration Projects: Initiatives to restore degraded habitats can improve the survival rates of turtle populations.

Case Studies

• Olive Ridley Turtles in Odisha, India: The mass nesting of Olive Ridley turtles at Gahirmatha beach in Odisha is one of the world's largest. However, the population has faced threats from fishing activities and coastal development. The Odisha government, along with NGOs, has implemented measures such as regulated fishing zones, community patrolling, and awareness campaigns. These efforts have led to a significant increase in nesting numbers, showcasing the impact of coordinated conservation actions.

Turtle conservation faces significant challenges from habitat destruction and poaching. Addressing these threats requires a multi-faceted approach, including the establishment of protected areas, community engagement, strong legislation, and habitat restoration.

PRACTICE QUESTION

Q. Discuss the impact of habitat destruction and poaching on turtle conservation. Examine the underlying causes and suggest measures to mitigate these effects.

3. TIGER CONSERVATION - HUMAN-WILDLIFE CONFLICT AND HABITAT FRAGMENTATION

CONTEXT: Tiger Population: Tigers (Panthera tigris) are among the most endangered big cats, with fewer than 4,000 individuals left in the wild. They play a crucial role in maintaining ecosystem balance by regulating prey populations and shaping forest habitats.

n Reasons for the Tiger Population Decline

- Habitat Loss and Fragmentation: The World Wildlife Fund (WWF) estimates that tigers have lost over 93% of their historic range due to human activities.
- ► Human-Wildlife Conflict: As human populations expand into tiger habitats, conflicts arise over resources. Tigers may prey on livestock, leading to retaliatory killings by communities.

b Way Forward

- Habitat Conservation and Connectivity: Connecting fragmented habitats allows for gene flow and enables tigers to roam freely between populations. For example, the Terai Arc Landscape in Nepal and India connects tiger habitats across borders, enhancing genetic diversity and resilience.
- Community Engagement: Implementing sustainable livelihoods, such as eco-tourism and alternative income opportunities, can reduce dependency on natural resources and alleviate human-wildlife conflicts.
- ➤ Anti-Poaching Measures: Enhanced monitoring, intelligence-led operations, and cooperation between law enforcement agencies and local communities can curb illegal wildlife trade and poaching activities.
- ► Global Collaboration: Initiatives like the Global Tiger Recovery Program (GTRP) facilitate collaborative efforts to double wild tiger populations by 2022, focusing on habitat protection, law enforcement, and community engagement.

Case Studies

Corbett Tiger Reserve, India: Corbett Tiger Reserve in Uttarakhand, India, has successfully implemented community-based conservation initiatives. Projects like the **Village Eco-Development Committees (VEDCs)** involve local communities in conservation activities, providing economic incentives and reducing human-wildlife conflict. As a result, the tiger population in Corbett has shown steady growth, demonstrating the efficacy of community-centered conservation approaches.

Tiger conservation efforts must address the dual challenges of habitat fragmentation and human-wildlife conflict to secure the future of these magnificent animals. By prioritizing habitat conservation, promoting sustainable livelihoods, enhancing anti-poaching measures, and fostering global collaboration, we can ensure that tigers continue to roam the forests of Asia and contribute to ecological stability.

PRACTICE QUESTION

Q. Discuss the challenges of tiger conservation, focusing on habitat fragmentation and human-wildlife conflict. Examine the underlying causes and suggest measures to mitigate these effects.

4. ARTIFICIAL REEFS - MARINE BIODIVERSITY AND CLIMATE RESILIENCE

Context in News (2023-24):

For the first time in India, 210 artificial reefs to be installed in the Arabian Sea, near Worli Koliwada in Mumbai Maharashtra. With increasing threats to natural reefs from climate change, pollution, and overfishing, artificial reefs are gaining attention for their potential to enhance marine biodiversity and provide habitat resilience.

n Artificial Reef

➤ Artificial reefs are human-made structures deployed in marine environments to mimic natural reef habitats. These structures can be made from various materials, including concrete, steel, and recycled materials like old ships and cars. By providing surfaces for marine organisms to attach to and sheltering spaces for fish and invertebrates, artificial reefs serve as biodiversity hotspots and contribute to ecosystem productivity.

Need for Artificial Reef

- ► Enhancement of Marine Biodiversity: Artificial reefs create new habitats that support a diverse array of marine life. They attract fish species, coral polyps, and other organisms seeking shelter and breeding grounds.
- ► Climate Resilience: As natural reefs face threats from coral bleaching, ocean acidification, and sealevel rise due to climate change, artificial reefs offer resilient habitats.

b Way Forward

- ► Ecosystem Restoration: Deploying artificial reefs in degraded marine areas can aid in ecosystem restoration. Restoration projects often involve integrating artificial reefs with coral transplantation efforts to accelerate reef recovery.
- ► **Research and Monitoring:** Conducting scientific research and monitoring programs are essential to assess the effectiveness of artificial reefs. Monitoring helps evaluate biodiversity changes, habitat suitability, and the long-term ecological impacts of artificial reef deployments.

Case Studies

• **Great Barrier Reef, Australia:** In response to coral bleaching events and habitat degradation, Australia has initiated several artificial reef projects within the Great Barrier Reef Marine Park. These projects involve deploying reef structures designed to enhance coral settlement and provide habitats for fish species. Initial results indicate promising outcomes in terms of biodiversity enhancement and ecosystem resilience.

Artificial reefs represent a promising strategy for marine conservation and climate resilience in the face of ongoing environmental challenges. While they cannot fully replace natural reefs, they complement existing conservation efforts by providing habitats and promoting biodiversity.

PRACTICE QUESTION

Q. Discuss the role of artificial reefs in enhancing marine biodiversity and promoting climate resilience. Examine the challenges and opportunities associated with artificial reef deployment.

5. SUNDARBANS: BECOMING A FRAGILE ECOSYSTEM - RISING SEA LEVELS AND MANGROVE DEFORESTATION

CONTEXT: The Sundarbans, the largest mangrove forest in the world spread across India and Bangladesh, faces increasing threats to its fragile ecosystem in 2023-24. Rising sea levels and mangrove deforestation are exacerbating vulnerabilities in this UNESCO World Heritage site, raising concerns among environmentalists and local communities.

Reasons for Sundarbans becoming vulnerable to Climate Change

- ▶ **Rising Sea Levels:** According to the Intergovernmental Panel on Climate Change (IPCC), sea levels in the region have risen significantly over the past century, leading to increased salinity in freshwater habitats and erosion of mangrove islands.
- Mangrove Deforestation: The loss of mangrove cover reduces the natural buffer against tidal surges and exposes coastal communities to greater risks during cyclones and tsunamis.

• Way Forward

- Climate Resilience Strategies: Implementing climate-resilient measures such as mangrove restoration, afforestation of degraded areas, and constructing embankments can mitigate the impacts of rising sea levels.
- Sustainable Development Practices: Promoting sustainable livelihoods through eco-tourism initiatives and community-based resource management can reduce dependency on mangrove resources.
- ► **International Cooperation:** Joint initiatives on climate adaptation, transboundary conservation planning, and sharing of scientific knowledge can strengthen conservation outcomes.

Case Studies

Mangrove Restoration in Satkhira, Bangladesh: The Satkhira district in Bangladesh has implemented mangrove restoration projects with the support of local communities and international organizations. These projects involve replanting native mangrove species, establishing protected areas, and promoting sustainable aquaculture practices. The restored mangrove areas have improved coastal protection and enhanced biodiversity, demonstrating the effectiveness of community-driven conservation initiatives.

The Sundarbans, a UNESCO World Heritage site and vital ecological treasure, confronts significant challenges from rising sea levels and mangrove deforestation. Urgent actions, including climate-resilient strategies, sustainable development practices, and international cooperation, are crucial to safeguarding this fragile ecosystem.

PRACTICE QUESTION

Q. Discuss the challenges facing the Sundarbans due to rising sea levels and mangrove deforestation. Evaluate the effectiveness of current conservation strategies and suggest measures for sustainable management.

6. MARKET-BASED APPROACHES TO FOREST CONSERVATION - ECONOMIC INCENTIVES AND COMMUNITY INVOLVEMENT

CONTEXT: Forests play a critical role in maintaining ecological balance, supporting biodiversity, and providing essential ecosystem services. However, they face threats due to deforestation, urbanization, and climate change. In response, market-based mechanisms have emerged as effective tools to promote forest conservation.

Brief Overview of Market-based approaches

- Market-based approaches recognize the economic value of ecosystem services provided by forests. By assigning a "price" to these services, we can incentivize sustainable forest management. Here are some key points:
- ► Ecosystem Services Valuation:
 - Forests offer a suite of goods and services vital to human health and livelihood, including carbon sequestration, watershed management, biodiversity support, and scenic landscapes.
- > Types of Market-Based Mechanisms:
 - **Payments for Ecosystem Services (PES)**: These involve compensating landowners for maintaining or enhancing specific ecosystem services.
 - Eco-labeling: Certifying sustainably produced forest products.
 - Tax incentives, subsidies, and trading of rights or credits under regulatory caps.

Reasons for Market-Based Approaches

- Incentivizing Conservation: Economic incentives encourage landowners to protect forests rather than exploit them. Perrier Vittel S.A. pays upstream landowners in France for following sustainable management practices.
- **Community Involvement**: Engaging local communities ensures sustainable practices. Communitybased forest management in Nepal led to improved forest health and livelihoods.

• Way Forward

- Policy Frameworks and Guidelines: The INTERCEDE project in Europe aims to enhance forest value through market instruments.
- ► **Capacity Building**: Educate landowners, policymakers, and communities about market-based approaches. Training programs for sustainable forest practices.

Case Studies

Costa Rica's Payment for Ecosystem Services Program: Landowners receive payments for forest conservation, leading to increased forest cover and improved water quality. Positive impact on biodiversity and carbon sequestration.

Market-based approaches provide a pathway to conserve forests while benefiting both ecosystems and communities. By recognizing the true value of nature's capital, we can secure a sustainable future for our forests.

PRACTICE QUESTION

Q. Discuss the role of market-based mechanisms in promoting sustainable forest use, emphasizing economic incentives and community participation.

7. CONSTRUCTED WETLANDS: BENEFITS AND CHALLENGES - URBAN POLLUTION AND ECOLOGICAL RESTORATION

CONTEXT: Urbanization continues to reshape our cities, impacting natural ecosystems. Constructed wetlands, designed for ecological and water treatment purposes, play a crucial role in mitigating urban pollution. Let's explore their benefits and challenges.

D Brief Overview of Constructed Wetland

- ► Constructed wetlands are engineered systems that mimic natural wetlands. Here's why they matter:
- ➤ Water Quality Improvement: Wetlands act as natural filters, removing pollutants (nutrients, heavy metals, and organic matter) from urban runoff. The Tianjin Eco-City in China uses constructed wetlands to treat wastewater before discharge.
- Carbon Sequestration: Wetlands store carbon, mitigating climate change. The Zimovia Tract in Alaska sequesters carbon through its wetland vegetation.
- Wildlife Habitat: Wetlands provide refuge for diverse species. The London Wetland Centre hosts migratory birds and rare plants.
- Urban Heat Island Mitigation: Wetlands cool urban areas, reducing heat island effects. The Millennium Park in Chicago features wetland gardens.

Reasons for Focus

- ▶ Urban Pollution Challenges: Rapid urban expansion threatens wetlands. Wetland loss due to infrastructure development in Mumbai, India.
- Ecological Restoration Imperative: Restoring wetlands enhances urban resilience. The Everglades Restoration Project in Florida aims to revive degraded wetlands.

• Way Forward

- ▶ **Integrated Planning**: Incorporate wetlands into urban design. The Singapore Marina Barrage integrates a freshwater reservoir with a wetland park.
- ► **Policy and Regulation**: Strengthen wetland protection laws. The Ramsar Convention promotes wetland conservation globally.

Case Studies

- Bristol's Floating Harbour Wetlands:
 - ► Revitalized industrial docks into thriving wetlands.
 - Improved water quality and biodiversity.
- Chennai's Pallikaranai Marsh Restoration:
 - ► Reclaimed a degraded marsh for flood control.
 - ► Enhanced bird habitats.

Constructed wetlands offer a sustainable solution to urban challenges. Balancing ecological restoration with urban needs is essential for resilient cities.

PREVIOUS YEAR QUESTION

- Q. Comment on the National Wetland Conservation Programme initiated by the Government of India and name a few India's wetlands of international importance included in the Ramsar Sites. (2023)
- Q. What is wetland? Explain the Ramsar concept of 'wise use' in the context of wetland conservation. Cite two examples of Ramsar sites from India. (2018)

PRACTICE QUESTION

Q. Discuss the role of constructed wetlands in urban pollution control and ecological restoration.

8. VULTURES AT RISK IN INDIA - DRUG TOXICITY AND CONSERVATION EFFORTS

CONTEXT: Vultures, once abundant across the subcontinent, vulture populations have plummeted by over 99% in recent decades, primarily due to the widespread use of veterinary drugs like diclofenac.

Vultures at Risk in India

► Vultures play a vital ecological role by efficiently disposing of carcasses, thereby preventing the spread of diseases and maintaining ecosystem health. The decline has been attributed to the ingestion of diclofenac, a non-steroidal anti-inflammatory drug used in veterinary medicine.

n Reasons for the Vultures population decline

- ➤ Drug Toxicity from Diclofenac: Even a small amount of diclofenac in livestock carcasses can cause renal failure in vultures, leading to rapid population declines. Studies estimate that diclofenac poisoning caused a decline of over 99% in vulture populations in India.
- Indirect Effects on Ecosystem: The decline of vultures has led to increased carcass biomass, attracting feral dogs and rodents that feed on carcasses.

• Way Forward

- ➤ Ban on Diclofenac and Regulatory Measures: Implementing and enforcing a ban on veterinary diclofenac is crucial to protecting vultures. India has banned the manufacture and sale of diclofenac for veterinary use, but enforcement remains a challenge.
- Vulture Safe Zones and Conservation Breeding: Conservation breeding programs, such as those conducted by the Bombay Natural History Society (BNHS) and other organizations, aim to breed and release vultures into the wild, supplementing dwindling populations.

MAINS SAMPOORNA **ENVIRONMENT & ECOLOGY**

Community Engagement and Education: Involving local communities in vulture conservation efforts through education programs, birdwatching tourism, and participatory monitoring can foster stewardship and reduce human-vulture conflicts.

Case Studies

BNHS Vulture Conservation Breeding Program: The BNHS, in collaboration with government agencies and zoos, operates vulture conservation breeding centers in Pinjore (Haryana) and Rani (Assam). These centers breed vultures in captivity and release them into safe habitats. The program has successfully bred and released several vultures, contributing to the recovery of critically endangered species.

The decline of vultures in India due to drug toxicity poses significant ecological and public health challenges. Immediate actions, including banning diclofenac, promoting safe alternative drugs, establishing vulture safe zones, and engaging communities in conservation, are critical to reversing their decline.

PRACTICE QUESTION

Q. Discuss the factors contributing to the decline of vulture populations in India. Evaluate the effectiveness of current conservation strategies and propose measures for sustainable vulture management.

9. GREAT INDIAN BUSTARDS: CONSERVATION AND CHALLENGES - WIND ENERGY DEVELOPMENT AND HABITAT PROTECTION

CONTEXT: The conservation status of the Great Indian Bustard (GIB), India's critically endangered bird species, remains precarious amidst ongoing challenges posed by wind energy development and habitat fragmentation. With only around 150 individuals left (2011 Data) in the wild, urgent conservation efforts are needed to prevent the extinction of this iconic bird.

Reasons for the decline of Great Indian Bustard

- ► Habitat Loss and Fragmentation: The grasslands and scrublands essential for their survival have been converted for agriculture, reducing available foraging and breeding grounds.
- ► **Impact of Wind Energy Development:** Collisions with wind turbine blades and disruption of traditional flight paths have resulted in fatalities among GIB populations.

b Way Forward

- ➤ Mitigating Wind Energy Impacts: Conducting environmental impact assessments (EIAs) and adopting technology like radar monitoring for early warning systems can mitigate risks to GIB populations.
- ► Habitat Restoration and Protection: Restoration of degraded habitats through native vegetation planting and sustainable land management practices can enhance habitat quality and connectivity.
- Community Engagement and Awareness: Collaboration with stakeholders, including governments, NGOs, and private sectors, is essential for sustainable management of GIB habitats.

Case Studies

Jaisalmer Desert National Park, Rajasthan: The Jaisalmer Desert National Park is a critical habitat for GIBs in India. Efforts to designate and expand protected areas within the park have been instrumental in conserving GIB populations. Measures include habitat restoration, strict enforcement against poaching, and community-based conservation initiatives.

The conservation of the Great Indian Bustard faces multifaceted challenges, primarily from habitat loss, fragmentation, and the expanding footprint of wind energy projects. Balancing sustainable development with biodiversity conservation is essential to secure the future of this endangered species.

PRACTICE QUESTION

Q. Discuss the conservation challenges faced by the Great Indian Bustard, focusing on habitat loss and the impact of wind energy development.

10. THREAT OF INVASIVE ALIEN SPECIES - GLOBAL TRADE IMPACTS AND ECOSYSTEM DISRUPTION

CONTEXT: The threat posed by invasive alien species (IAS) continues to escalate in 2023-24, driven largely by global trade and climate change. These non-native organisms, introduced unintentionally or deliberately outside their native range, have significant ecological, economic, and health implications.

Invasive alien species

• Globalization and increased trade have accelerated the spread of IAS, posing a significant threat to biodiversity and ecosystem stability worldwide.

Impact of Invasive Alien Species on Environment

- **Impact on Biodiversity:** According to the IUCN, invasive species are a primary driver of species extinctions, second only to habitat destruction.
- ► Economic and Health Implications: The economic costs of IAS are substantial, affecting agriculture, fisheries, and infrastructure. For instance, the introduction of the zebra mussel (Dreissena polymorpha) in North America has caused billions of dollars in damage to water intake systems.

b Way Forward

- **Prevention and Early Detection:** Strengthening biosecurity measures at ports, airports, and borders is crucial to prevent the unintentional introduction of IAS.
- Control and Eradication: Implementing control measures, such as mechanical removal, chemical treatment, and biological control (using natural predators or pathogens), can manage established IAS populations.
- ▶ **Public Awareness and Education:** Raising awareness among stakeholders, including governments, industries, and the public, about the risks associated with IAS is essential.

Case Studies

Brown Tree Snake in Guam: The introduction of the brown tree snake (Boiga irregularis) to Guam, likely via military cargo shipments during World War II, devastated the island's native bird populations. The snake, lacking natural predators in Guam, proliferated rapidly and caused ecological imbalances.

Invasive alien species pose a significant threat to global biodiversity, economies, and public health, exacerbated by increasing globalization and climate change. Effective management strategies, including prevention, early detection, control measures, and public awareness, are essential to mitigate these impacts.

PRACTICE QUESTION

Q. Discuss the impacts of invasive alien species on biodiversity and ecosystems, emphasizing their global trade origins and management challenges.

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POLLUTION

1. RISING POLLUTION IN INDIAN RIVERS -URBANIZATION PRESSURES AND WATER QUALITY MANAGEMENT

CONTEXT: In 2023, the alarming rise in pollution levels in Indian rivers has emerged as a pressing environmental and public health concern.

Rising pollution in Indian Rivers

► Discharge of untreated industrial effluents, agricultural runoff containing pesticides and fertilizers, and domestic sewage are major contributors. Pollutants such as heavy metals, pathogens, and nutrients degrade water quality, threaten aquatic biodiversity, and pose risks to human health through contaminated drinking water sources.

n Reasons for Increased Pollution in Indian Rivers

- ▶ Industrial Discharges: According to the Central Pollution Control Board (CPCB), many industries fail to comply with effluent standards, exacerbating pollution levels in rivers like the Ganga and Yamuna.
- ► Urbanization and Domestic Sewage: Urban centers, lacking adequate sewage treatment infrastructure, discharge untreated sewage directly into rivers.

• Way Forward

- Strengthening Regulatory Frameworks: Enforcing stringent pollution control norms and monitoring mechanisms for industries and municipalities is critical.
- **Investment in Wastewater Treatment:** Upgrading and expanding sewage treatment plants (STPs) in urban areas to ensure comprehensive wastewater treatment before discharge into rivers.

➤ Community Participation and Awareness: Engaging local communities, NGOs, and stakeholders in river conservation through awareness campaigns, citizen science initiatives, and participatory monitoring builds stewardship and fosters sustainable river management practices.

Case Studies

Yamuna Action Plan, Delhi: The Yamuna River, severely polluted due to urbanization and industrial discharges, has been the focus of the Yamuna Action Plan (YAP). Initiatives under YAP include setting up sewage treatment plants, intercepting drains carrying untreated sewage, and promoting riverfront development with ecological restoration components.

Addressing rising pollution in Indian rivers demands integrated efforts across policy, governance, technology, and community participation. Sustainable water management practices, coupled with stringent enforcement of environmental regulations and public awareness, are essential to restore and maintain the health of river ecosystems.

PRACTICE QUESTION

Q. Discuss the factors contributing to rising pollution levels in Indian rivers, emphasizing urbanization pressures and industrial discharges.

2. PEST ATTACK AND ITS IMPACT ON CROP PRODUCTION - PESTICIDE RESISTANCE AND ECOLOGICAL BALANCE

CONTEXT: In 2023-24, the escalation of pest attacks on crops has become a critical issue affecting agricultural productivity globally.

Pest attack and its impact on crop production

 Farmers rely heavily on pesticides to control pests and protect crops, but overuse and misuse have led to the development of pesticide-resistant strains. This phenomenon not only reduces the effectiveness of pesticides but also disrupts ecological balances by affecting non-target organisms and ecosystem services critical for agriculture.

Reasons for Increased Pest Attack:

- ▶ **Pesticide Resistance:** According to the Food and Agriculture Organization (FAO), over 600 species of pests have developed resistance to one or more pesticides globally.
- ► Ecological Imbalance: The decline in beneficial species disrupts ecological balances and can exacerbate pest outbreaks, creating a cycle of dependency on more potent pesticides.

b Way Forward

- Integrated Pest Management (IPM): IPM emphasizes pest monitoring, crop rotation, use of resistant crop varieties, biological control agents like natural enemies of pests, and judicious use of pesticides as a last resort.
- ► **Promoting Sustainable Agriculture:** Encouraging sustainable farming practices such as organic farming, agroecology, and agroforestry reduces reliance on synthetic pesticides.

Case Studies

Bt Cotton in India: Bt cotton, genetically modified to produce Bacillus thuringiensis (Bt) toxin, effectively controls bollworm pests. Initially, Bt cotton reduced pesticide use and increased yields. However, prolonged cultivation has led to the development of resistance in bollworm populations, necessitating integrated pest management strategies to sustain its effectiveness.

Managing pest attacks and pesticide resistance in agriculture requires a balanced approach that considers ecological, economic, and social dimensions. Integrated pest management, sustainable agricultural practices, and continuous innovation in pest control technologies are essential for safeguarding crop production while preserving environmental quality and ecosystem services.

PREVIOUS YEAR QUESTION

Q. Sikkim is the first 'Organic State' in India. What are the ecological and economical benefits of Organic State? (2018)

PRACTICE QUESTION

Q. Discuss the impact of pesticide resistance on crop production and ecosystem health, emphasizing the need for integrated pest management strategies.

3. AIR POLLUTION CONTROL IN INDIA - URBAN HEALTH IMPACTS AND POLICY ENFORCEMENT.

CONTEXT: According to the World Health Organization (WHO), several Indian cities consistently rank among the most polluted globally, with PM2.5 levels far exceeding safe limits. Delhi, Mumbai, and Kolkata are among the worstaffected cities, witnessing alarming spikes in pollution during winter months due to factors like stubble burning and weather patterns.

Reasons for increased Air Pollution in India

- Health Impacts: Studies estimate that air pollution contributes to over 1.2 million premature deaths annually in India, highlighting its profound public health implications.
- Sources of Pollution: Major contributors to urban air pollution include vehicular emissions, industrial
 activities, construction dust, biomass burning, and domestic sources such as cooking with solid fuels.

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• Way Forward

- Strengthening Policy Frameworks: Enforcing stringent emission standards for industries, promoting cleaner fuels, and regulating vehicular emissions through stricter vehicle inspection norms (like Bharat Stage VI standards) are crucial steps.
- ▶ Promoting Sustainable Transport: Encouraging the adoption of electric vehicles (EVs), improving public transportation infrastructure, promoting non-motorized transport options like cycling and walking, and implementing congestion pricing measures can reduce vehicular emissions and improve urban air quality.
- Public Awareness and Participation: Engaging citizens through awareness campaigns, citizen science initiatives, and community-based monitoring programs fosters public participation in air pollution control efforts.

Case Studies

National Clean Air Program (NCAP): Launched by the Government of India, NCAP aims to reduce PM2.5 and PM10 levels by 20-30% in 122 non-attainment cities by 2024. The program emphasizes city-specific action plans, source apportionment studies, and capacity-building initiatives to strengthen air quality management at the local level.

Addressing air pollution in Indian cities demands concerted efforts across policy, technology, and public awareness domains. Effective enforcement of emission standards, promotion of sustainable transport, and community engagement are essential for achieving tangible improvements in urban air quality.

PREVIOUS YEAR QUESTION

- Q. What are the key features of the National Clean Air Programme (NCAP) initiated by the government of India? (2020)
- Q. The adoption of electric vehicles is rapidly growing worldwide. How do electric vehicles contribute to reducing carbon emissions and what are the key benefits they offer compared to traditional combustion engine vehicles. (2023)

PRACTICE QUESTION

Q. Discuss the impact of air pollution on urban health in India, emphasizing policy interventions and enforcement challenges.

4. GROUNDWATER CONTAMINATION IN INDIA -INDUSTRIAL EFFLUENTS AND SUSTAINABLE WATER USE

CONTEXT: According to the Central Ground Water Board (CGWB), over 60% of India's districts face groundwater contamination issues, primarily due to industrial discharge, agricultural runoff, and inadequate sanitation practices.

n Reasons for Groundwater Contamination in India

➤ Industrial Effluents: Industrial activities release pollutants like heavy metals (e.g., arsenic, lead, mercury) and organic chemicals into the soil, which percolate into groundwater aquifers. For instance, in regions like Gujarat's industrial belt and Uttar Pradesh's leather tanneries, untreated effluents have contaminated local groundwater, posing health risks to nearby communities.

► Unsustainable Agricultural Practices: States like Punjab and Haryana, known for intensive agriculture, face groundwater contamination issues due to high nitrate levels and pesticide residues.

b Way Forward

- **Regulatory Enforcement:** Strengthening environmental regulations and enforcing stringent norms for industries to treat and dispose of effluents responsibly.
- ▶ Promoting Sustainable Practices: Encouraging sustainable agricultural practices such as organic farming, integrated nutrient management, and precision irrigation techniques reduces chemical inputs and mitigates groundwater contamination risks.
- ► **Community Participation and Awareness:** Engaging local communities through awareness campaigns, capacity-building programs, and participatory groundwater monitoring fosters stewardship and ensures grassroots involvement in groundwater protection efforts.

Case Studies

Bhopal Gas Tragedy, Madhya Pradesh: The 1984 Bhopal gas leak disaster resulted in widespread contamination of groundwater with toxic chemicals like methyl isocyanate. Decades later, local communities continue to face health hazards due to groundwater pollution, highlighting the long-term impacts of industrial accidents and the challenges in remediation efforts.

Addressing groundwater contamination in India requires a multi-pronged approach integrating policy reforms, sustainable practices, and community engagement. Effective regulation of industrial effluents, promotion of sustainable agriculture, and empowering local communities are essential for ensuring the availability of safe and clean groundwater.

PRACTICE QUESTION

Q. Discuss the causes and consequences of groundwater contamination in India, focusing on industrial effluents and agricultural practices.

5. PLASTIC WASTE CRISIS IN THE INDIAN HIMALAYAN REGION - REMOTE WASTE MANAGEMENT AND ENVIRONMENTAL DEGRADATION

CONTEXT: In 2024, the issue of plastic waste has intensified in the Indian Himalayan Region (IHR), posing severe environmental and socio-economic challenges.

Plastic Waste Crisis in the Indian Himalayan Region

➤ Tourist influx, coupled with limited waste disposal facilities in remote areas, has exacerbated the accumulation of single-use plastics (SUPs) and microplastics in fragile ecosystems. Rivers like the Ganges, flowing from the Himalayas, carry plastic debris downstream, affecting downstream communities and ecosystems.

n Reasons for the Plastic Waste Crisis in the Indian Himalayan Region

- ► **Tourism and Plastic Consumption:** Tourist hubs like Manali, Rishikesh, and Leh witness significant plastic waste generation during peak seasons, straining local waste management capacities.
- Limited Waste Management Infrastructure: Inadequate recycling facilities and informal waste disposal practices contribute to plastic litter accumulation in natural habitats, threatening wildlife and water sources.

• Way Forward

- Policy Interventions: States like Sikkim and Himachal Pradesh have implemented bans on SUPs in protected areas to mitigate environmental degradation.
- Community Engagement: Engaging local communities, youth groups, and stakeholders in plastic waste management through awareness campaigns, clean-up drives, and capacity-building workshops fosters a culture of waste reduction and responsible tourism practices.
- Innovative Solutions: Adopting innovative technologies such as plastic waste-to-energy conversion, community-based recycling centers, and plastic collection drives incentivized by deposit schemes can promote circular economy principles and reduce plastic pollution in remote areas.

Case Studies

Dharamshala Waste Management Initiative, Himachal Pradesh: The town of Dharamshala has implemented decentralized waste management systems, including segregated waste collection and composting of organic waste. Initiatives like "Waste Warriors" engage local communities in plastic waste clean-up drives and recycling efforts, demonstrating effective grassroots solutions to plastic pollution.

Addressing the plastic waste crisis in the Indian Himalayan Region requires collaborative efforts encompassing policy reforms, community engagement, and technological innovations. Sustainable waste management practices and behavioral changes among tourists and residents are crucial for preserving the ecological integrity and scenic beauty of this ecologically sensitive region.

PRACTICE QUESTION

Q. Discuss the challenges posed by plastic waste in the Indian Himalayan Region, highlighting its environmental impacts and socio-economic implications.

6. INDIA'S BATTLE AGAINST SINGLE-USE PLASTICS - LEGISLATIVE REFORMS AND CONSUMER BEHAVIOR

CONTEXT: According to the Central Pollution Control Board (CPCB), India generates over 25,000 tons of plastic waste daily, with a significant portion ending up in landfills, water bodies, and natural habitats.

n Reasons for the Topic

- Environmental Impact: Plastic pollution has become a global concern, with estimates suggesting that over 8 million tons of plastic enter the oceans annually, affecting biodiversity and ecosystem services.
- Health Risks: Chemical additives in plastics, such as phthalates and bisphenols, can leach into food and water, posing health risks to consumers. Microplastics, ingested by marine organisms, bioaccumulate in the food chain, potentially impacting human health through seafood consumption.

• Way Forward

- ► Legislative Reforms: The Plastic Waste Management Rules, 2016, mandate plastic waste segregation, recycling, and phasing out of certain categories of SUPs.
- ► Consumer Awareness and Behavior Change: Educating consumers about the environmental and health impacts of SUPs, promoting reusable alternatives, and fostering sustainable consumption habits through awareness campaigns, school programs, and digital media platforms.
- ► Innovation and Research: Initiatives like the Atal Innovation Mission support startups developing sustainable solutions for plastic waste management.

Case Studies

Maharashtra Plastic Ban: Maharashtra implemented a comprehensive ban on certain SUPs in 2018, including bags, cutlery, and thermocol products. The ban aimed to reduce plastic consumption, promote alternatives like cloth bags and compostable materials, and enforce penalties for violators.

India's battle against single-use plastics necessitates coordinated efforts across governance, industry, and civil society to achieve sustainable development goals. Legislative reforms, coupled with consumer education and technological innovations, are pivotal in transitioning towards a plastic-free future.

PRACTICE QUESTION

Q. Discuss the challenges and strategies in India's campaign against single-use plastics, emphasizing legislative reforms and consumer behavior change.

7. NITROGEN POLLUTION: AGRICULTURAL PRACTICES AND WATERWAY CONTAMINATION

CONTEXT: According to the World Resources Institute (WRI), agriculture accounts for approximately 70% of global nitrogen pollution.

n Reasons for increased Nitrogen Pollution

- ▶ Impact on Water Quality: Nitrogen runoff from agricultural fields enriches water bodies with nutrients, promoting algal blooms. Decomposing algae consume oxygen, leading to hypoxic (low oxygen) conditions harmful to aquatic life.
- Agricultural Practices: In regions like the Indo-Gangetic plains in India and the Midwestern United States, high nitrogen inputs from fertilizers and animal manure have led to elevated nitrate levels in groundwater, impacting millions reliant on it for drinking.

b Way Forward

- ▶ **Precision Agriculture:** Countries like the Netherlands have implemented precision farming to minimize nitrogen losses while maintaining crop yields.
- ► **Buffer Zones and Wetlands:** The Chesapeake Bay Program in the United States employs riparian buffers and wetland restoration to mitigate nitrogen pollution from agricultural runoff.
- ► **Policy and Regulation:** The European Union's Nitrate Directive and similar policies mandate member states to monitor and reduce nitrogen pollution from agriculture.

Case Studies

• **Punjab's Green Revolution, India:** The introduction of high-yielding crop varieties and intensive fertilizer use during Punjab's Green Revolution increased agricultural productivity but also heightened nitrogen pollution. Initiatives promoting diversification from rice-wheat cropping to pulses and oilseeds, coupled with efficient irrigation and fertilizer management, aim to reduce nitrogen inputs and groundwater contamination.

Addressing nitrogen pollution requires a holistic approach integrating technological innovation, policy reform, and stakeholder engagement. Sustainable agricultural practices, precision farming technologies, and ecosystem-based solutions like buffer zones and wetlands play crucial roles in mitigating nitrogen runoff and safeguarding water quality.

PRACTICE QUESTION

Q. Discuss the causes and consequences of nitrogen pollution from agricultural practices, emphasizing its impact on water quality and ecosystem health.

8. RADIOACTIVE DISCHARGES FROM NUCLEAR PLANTS - ENVIRONMENTAL MONITORING AND PUBLIC HEALTH CONCERNS

CONTEXT: Nuclear power plants play a crucial role in meeting energy demands, but their operations involve the release of radioactive substances into the environment. As concerns grow about public health and ecological consequences, monitoring and regulation become paramount.

n Radioactive Discharges from Nuclear Plants

- Nuclear power plants emit minute quantities of radioactive gases and liquids during normal operations. These discharges can impact humans, animals, plants, and sea life. Here are key points:
- ▶ Monitoring and Control: The U.S. Nuclear Regulatory Commission (NRC) mandates rigorous monitoring of discharges to minimize environmental impacts.
- ► **Safety Standards**: The International Atomic Energy Agency (IAEA) sets strict safety standards for restricting radionuclide releases and protecting people and the environment.

n Reasons for Focus

- ► **Public Health Concerns**: Radioactive discharges pose health risks to nearby communities. Tritium releases from nuclear plants can contaminate groundwater.
- ► Ecological Impact: Radioactive substances affect ecosystems and biodiversity. Strontium-90 accumulation in aquatic organisms.

b Way Forward

- ► Advanced Monitoring Techniques: Develop real-time monitoring systems for rapid response. Continuous air and water sampling networks.
- ► Stringent Regulations: Enforce stricter limits on permissible releases. Regular audits of plant compliance.

Case Studies

- **Chernobyl Exclusion Zone**: Ongoing monitoring after the 1986 disaster. Lessons on long-term effects of radioactive contamination.
- **Fukushima Daiichi Recovery**: Japan's efforts to contain and monitor discharges. Balancing energy needs with environmental safety.

Balancing nuclear energy production with environmental protection requires robust monitoring, global cooperation, and transparent regulations. Our choices today shape the safety of generations to come.

PRACTICE QUESTION

Q. Discuss the challenges posed by radioactive discharges from nuclear plants and propose strategies for minimizing their impact on public health and the environment.

9. ACID RAIN: IMPACT ON ENVIRONMENT -INDUSTRIAL EMISSIONS AND ECOSYSTEM ACIDIFICATION

CONTEXT: Governments worldwide collaborate to minimize acid rain, as seen in initiatives such as the Acid Deposition Monitoring Network in East Asia (EANET).

Reasons for Acid Rain:

- ► **Industrial Emissions:** Coal-fired power plants and metal smelting facilities are major sources of sulfur dioxide emissions, contributing significantly to acid rain formation.
- Ecosystem Impacts: Acidic conditions in lakes and rivers affect fish populations and biodiversity, while acidic soils can inhibit plant growth and nutrient uptake, leading to forest decline and reduced crop yields.


b Way Forward

- Emission Reduction: The Clean Air Act in the United States and similar regulations in Europe have successfully reduced acid rain impacts through emission controls.
- **Buffering and Neutralization:** Applying lime or calcium carbonate to acidic soils and water bodies to neutralize acidity and restore pH balance.
- International Cooperation: Collaborating on transboundary air pollution agreements and initiatives, such as the Convention on Long-Range Transboundary Air Pollution (CLRTAP), to address acid rain impacts across national borders through shared responsibility and coordinated mitigation efforts.

Case Studies

Scandinavian Lakes and Forests: Implementation of emission controls and ecosystem restoration efforts under the Gothenburg Protocol of CLRTAP has led to significant improvements in water quality and forest health.

Addressing acid rain requires concerted efforts at local, national, and international levels to reduce industrial emissions, mitigate environmental impacts, and restore affected ecosystems. Sustainable development practices, regulatory frameworks, and technological innovations play crucial roles in minimizing acid deposition and safeguarding environmental health.

PRACTICE QUESTION

Q. Discuss the causes and consequences of acid rain, emphasizing its impact on ecosystems and human health. Propose measures for sustainable environmental management to address acid rain pollution.

10. INDIA'S COAL PLANTS: SO2 EMISSION CONTROL -CLEAN ENERGY TRANSITIONS AND AIR QUALITY IMPROVEMENTS

CONTEXT: According to the Centre for Research on Energy and Clean Air (CREA), less than eight per cent of India's coal-based power plants have installed the technology recommended by the Union Ministry of Environment, Forest and Climate Change (MoEF&CC) to keep sulphur dioxide (SO2) emissions in check.

• Impact of high Air Pollution from Indian Power Plants

- Air Quality Concerns: Coal-fired power plants are significant contributors to particulate matter and sulfur dioxide emissions, impacting public health and ecological balance.
- Climate Commitments: Addressing SO2 emissions from coal plants is essential for aligning with climate goals while ensuring energy security and economic growth.

• Way Forward

- Technological Upgradation: FGD technology removes sulfur dioxide from exhaust gases before they are released into the atmosphere, significantly lowering emission levels. For instance, NTPC's FGD installation at its power plants aims to achieve stringent emission norms.
- ► **Renewable Energy Expansion:** India's National Solar Mission and Wind Energy Program promote renewable energy investments and capacity additions, contributing to cleaner electricity generation.



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 Policy and Regulation: The Ministry of Environment, Forest, and Climate Change (MoEFCC) mandates compliance with emission norms under the Environment Protection Act, 1986, and promotes cleaner technologies through subsidies and incentives.

Case Studies

NTPC's Talcher Super Thermal Power Station, Odisha: NTPC adopted a phased approach to install FGD units at its Talcher plant, one of India's largest coal-fired facilities. The project aims to comply with emission standards set by the Central Pollution Control Board (CPCB) and reduce environmental impacts in the region.

India's efforts to control SO2 emissions from coal plants are crucial for achieving sustainable development goals, improving air quality, and fulfilling international climate commitments.

PRACTICE QUESTION

Q. Discuss India's initiatives to control SO2 emissions from coal-fired power plants, emphasizing technological advancements, policy interventions, and their impact on air quality improvement.

11. 8-POINT PLAN IN NCR AND NEARBY REGIONS UNDER GRAP STAGE-IV - SEASONAL POLLUTION MANAGEMENT AND PUBLIC HEALTH RESPONSES

CONTEXT: The air quality crisis in the National Capital Region (NCR) demands urgent action. The Commission for Air Quality Management in NCR and Adjoining Areas has invoked an eight-point action plan aligned with Stage-IV of the Graded Response Action Plan (GRAP).

• What is the Graded Response Action Plan (GRAP)?

➤ The GRAP is a set of emergency measures designed to prevent air quality deterioration after specific thresholds are reached in the Delhi-NCR region. Implemented by the Commission for Air Quality Management, it aims to mitigate pollution effectively.

• The Eight-Point Action Plan (Stage-IV GRAP):

- ► **Truck Traffic Restrictions**: Prohibit entry of truck traffic into Delhi, except for those transporting essential goods and services, along with LNG/CNG/electric trucks. Reduce vehicular emissions and congestion.
- LCV Entry Control: Restrict non-Delhi-registered Light Commercial Vehicles (LCVs) from entering Delhi, except EVs/CNG/BS-VI diesel vehicles carrying essential items.
- Diesel MGV and HGV Ban: Ban the operation of Delhi-registered diesel Medium Goods Vehicles (MGVs) and Heavy Goods Vehicles (HGVs), except for those transporting essential items. Targeting high-emission vehicles.
- Construction and Demolition (C&D) Halt: Prohibit C&D activities in linear public projects (highways, roads, flyovers, power transmission, and pipelines).
- Online Classes for Grades VI to IX, XI: Transition physical classes for these grades to online mode. Minimize outdoor exposure for students.
- ▶ Office Capacity Limits: Allow 50% capacity in public, municipal, and private offices, with the remainder working remotely.

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- Central Government Work-from-Home Protocols: Empower the Central Government to decide on work-from-home guidelines for employees in Central Government offices.
- Additional Emergency Measures: Encourage State Governments to consider closing educational institutions, restricting non-essential commercial activities, and implementing an odd-even vehicle registration scheme.

causes and Sources of Air Pollution in Delhi-NCR:

• **Stubble Burning**: Crop residue burning in neighboring states (Punjab, Haryana, Uttar Pradesh) remains a primary cause during October and November.

• Way Forward:

- ► Strict Enforcement and Monitoring: Ensure compliance with the action plan. Regular audits and penalties for violations.
- ► **Technology Adoption and Research**: Promote cleaner fuels, electric vehicles, and sustainable construction practices. Invest in research for innovative pollution control solutions.

The eight-point action plan underscores the urgency of addressing air pollution in Delhi-NCR. Collective efforts, stringent measures, and sustainable practices are essential for cleaner air and public health.

PRACTICE QUESTION

Q. Discuss the eight-point action plan implemented under GRAP Stage-IV for air quality management in Delhi-NCR and its significance in mitigating pollution.

12. METAL MINING POLLUTION - TAILINGS MANAGEMENT AND LAND RECLAMATION

CONTEXT: Discharge of mining waste into rivers affects 50 times more people than tailings dam disasters.

n Impact of Metal Mining Pollution

- ► Environmental Impact: The Mount Polley mine disaster in Canada resulted in a significant release of tailings containing copper and other pollutants into nearby water bodies, causing extensive environmental damage.
- ► **Community Health Concerns:** In regions like Minas Gerais, Brazil, the collapse of tailings dams at iron ore mines has resulted in tragic human and environmental consequences.

• Way Forward

- ► **Improved Tailings Management:** Implementing advanced technologies for tailings storage and treatment, such as thickened tailings disposal and dry stacking, to minimize water usage and reduce the risk of dam failures.
- ► Land Reclamation and Rehabilitation: Rehabilitating disturbed mining areas through revegetation, soil stabilization, and ecosystem restoration to mitigate habitat loss and promote biodiversity recovery.
- Regulatory Frameworks and Monitoring: The International Council on Mining and Metals (ICMM) advocates for responsible mining practices through its Performance Expectations framework.



Case Studies

Bingham Canyon Mine, USA: Located in Utah, the Bingham Canyon Mine employs advanced tailings management techniques such as engineered covers and monitoring systems to minimize environmental impacts. Reclamation efforts have successfully restored habitat and vegetation in the surrounding area, demonstrating sustainable mining practices in a sensitive ecosystem.

Metal mining pollution poses significant environmental and public health challenges globally, necessitating proactive measures for sustainable resource extraction and waste management. Effective tailings management, land reclamation, and regulatory frameworks are essential in minimizing environmental footprints and promoting ecosystem resilience.

PRACTICE QUESTION

Q. Discuss the environmental impacts of metal mining pollution, focusing on tailings management and land reclamation strategies.



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WASTE MANAGEMENT

1. MICROPLASTICS: IMPACT ON LAND AND WATER - MARINE FOOD WEB CONTAMINATION AND WASTE PREVENTION

CONTEXT: According to the 2024 Plastic Overshoot Day (POD) Report. India will release 391,879 tonnes of microplastics and will be the second leading polluter of the waterbodies after China (787,069 tonnes) in the world, the analysis by Swiss non-profit EA Earth Action showed.

Impact of Microplastics on Environment

- Environmental Impact: Research in the Arctic has documented microplastic contamination in remote marine environments, highlighting the widespread distribution and persistence of plastic pollution.
- ➤ Human Health Concerns: The presence of toxic additives and pollutants absorbed by microplastics raises concerns about their cumulative effects on human health, including endocrine disruption and carcinogenicity.

• Way Forward

- Source Reduction and Waste Prevention: Initiatives like the European Union's Single-Use Plastics Directive and bans on microbeads in cosmetics demonstrate regulatory efforts to curb plastic pollution at its source.
- ► **Technological Solutions:** Innovative solutions such as nanoparticle filters and biofiltration systems show promise in removing microplastics from water sources and minimizing environmental contamination.
- > **Public Awareness and Education:** Empowering consumers to make sustainable choices and participate in plastic waste reduction initiatives fosters collective action against plastic pollution.



Case Studies

The Great Pacific Garbage Patch: Cleanup efforts and research initiatives by organizations like The Ocean Cleanup aim to mitigate plastic pollution in marine environments and raise awareness about ocean conservation.

Microplastic pollution represents a global environmental challenge requiring concerted efforts to address its sources, impacts, and mitigation strategies. Sustainable waste management practices, technological innovations, and public engagement are pivotal in reducing plastic pollution and safeguarding ecosystems and human health from the adverse effects of microplastics.

PRACTICE QUESTION

Q. Discuss the sources and impacts of microplastic pollution on terrestrial and aquatic ecosystems, emphasizing its implications for marine food web contamination and human health.

2. ISSUE OF SOLID WASTE MANAGEMENT -URBAN INFRASTRUCTURE AND RECYCLING INNOVATIONS

CONTEXT: India generates over 150,000 metric tons of solid waste daily, with urban areas accounting for a significant portion.

Impact of Solid Wastes on Environment:

- Environmental Impact: Open dumping and burning of waste release harmful pollutants and greenhouse gases, contributing to air quality degradation and climate change.
- Public Health Concerns: The World Health Organization (WHO) highlights the link between poor waste management and public health hazards, underscoring the need for comprehensive sanitation solutions.

• Way Forward

- ► **Infrastructure Development:** Initiatives like the Swachh Bharat Mission Urban (SBM-U) aim to improve urban sanitation infrastructure and promote behavioral change towards cleaner cities.
- Promoting Recycling and Circular Economy: Innovations such as material recovery facilities (MRFs) and decentralized composting units facilitate resource recovery from waste streams and promote circular economy principles.
- Policy and Governance: State-level initiatives like Maharashtra's ban on single-use plastics and Delhi's construction and demolition waste management rules demonstrate legislative efforts to address specific waste streams.

Case Studies

Indore, Madhya Pradesh: Indore transformed its waste management practices through decentralized waste collection, segregation at source, and community participation. The city's Cleanest City Award under the Swachh Survekshan reflects successful waste management strategies and public engagement in sustainable urban development.

Addressing the issue of solid waste management in India requires integrated approaches, technological innovations, and community participation to achieve sustainable urban development goals.



PREVIOUS YEAR QUESTION

Q. What are the impediments disposing the huge quantities of discarded solid waste which are continuously being generated? How do we remove safely the toxic wastes that have been accumulated in our habitable environment? (2018)

PRACTICE QUESTION

Q. Discuss the challenges and opportunities in solid waste management in urban India, emphasizing infrastructure development, recycling innovations, and policy interventions.

3. SOLAR WASTE MANAGEMENT: NEW CHALLENGES - PHOTOVOLTAIC PANEL RECYCLING AND SUSTAINABILITY

CONTEXT: SolarPower Europe and PVCycle, supported by the European Union in India and the Union Ministry of New and Renewable Energy, could generate over 34,600 tonnes of cumulative solar waste in India by 2030, according to a report prepared by the National Solar Energy Federation of India.

D Current Scenario and Challenges with Solar Waste Management

- India's Global Position: India's ambitious targets for solar power installations have propelled it into a leading position globally.
- Policy Framework Gap: However, the country lacks a dedicated policy framework for managing the disposal and recycling of solar panels.
- ► Future Solar Waste Estimate: As per estimates, India could generate over 34,600 tonnes of cumulative solar waste by 2030, highlighting the urgency for action.
- ► Solar Panel Lifespan: Solar panels typically have a lifespan of 20-25 years, after which they need replacement.
- Recyclable Materials: These panels contain materials like silicon, tellurium, silver, and other metals, making them valuable for recycling.
- ➤ Low Recycling Rate: Despite this, the recycling rate remains low due to the absence of regulatory mandates and economic incentives.
- Cost of Recycling: The cost of recycling a solar panel is significantly higher than landfill disposal, discouraging proper disposal practices.

Impact of Lack of Policy Formulation:

- Regulatory Shortfall: The lack of specific regulations addressing solar waste is a primary reason for the current predicament.
- ➤ Comparison with EU: Unlike countries like the EU, which have stringent Waste Electrical and Electronic Equipment (WEEE) directives, India has not incorporated solar panels into its electronic waste management regulations.
- ► Environmental Risks: This regulatory gap allows discarded panels to end up in landfills, posing environmental risks due to the leaching of toxic materials.



Case Studies

European Union (EU): The EU's WEEE Directive mandates that PV module manufacturers manage the collection and recycling of solar panels. This approach ensures that producers take responsibility for the environmental impact of their products throughout their lifecycle.

As India advances towards its renewable energy goals, addressing the issue of solar waste management is imperative. Effective policies, infrastructure development, incentives, and regulatory frameworks are essential to mitigate environmental risks and harness the economic potential of recycled materials.

PRACTICE QUESTION

Q. Discuss the challenges and prospects of solar waste management in India. What lessons can India learn from global practices, and what steps should it take to ensure effective management of solar waste?

4. E-WASTE MANAGEMENT IN INDIA -TECHNOLOGICAL OBSOLESCENCE AND INFORMAL RECYCLING HAZARDS

CONTEXT: In the year 2021-2022 alone, India produced approximately 1.601 million tonnes of e-waste, with a collection and processing rate significantly lower than the generated amount.

- The challenges associated with e-waste management in India are multifaceted:
 - Informal Sector Dominance: Over 90% of e-waste in India is managed by the informal sector, which operates outside formal regulatory frameworks.
 - ► Health and Environmental Risks: Workers in the informal sector are exposed to hazardous substances such as lead, mercury, and cadmium during e-waste recycling activities.

b Way Forward

- To address the challenges posed by burgeoning e-waste in India, a concerted effort encompassing policy reforms, infrastructure development, and public awareness is essential:
- ➤ Policy Reforms: India's E-Waste (Management and Handling) Rules, 2022, represent a significant step forward with expanded coverage and stringent provisions for Extended Producer Responsibility (EPR).
- Infrastructure Development: Investment in recycling infrastructure is pivotal to improving collection rates and enhancing recycling efficiency.
- Public Awareness and Education: Increasing public awareness about the hazards of improper e-waste disposal is crucial.

Effective e-waste management is crucial for sustainable development and environmental preservation in India. By implementing stringent regulations, enhancing recycling infrastructure, and fostering public awareness, India can mitigate the adverse impacts of e-waste on health, environment, and economy.

PRACTICE QUESTION

Q. Discuss the challenges associated with e-waste management in India. What measures should be taken to ensure effective and sustainable management of electronic waste?

5. CONVERTING PLASTIC WASTE INTO FUEL -CIRCULAR ECONOMY INITIATIVES AND CARBON EMISSIONS REDUCTION

CONTEXT: In a groundbreaking development, researchers from the University of Cambridge have unveiled a novel system capable of converting plastic waste and greenhouse gases into sustainable fuels and valuable products using solar energy.

Current Scenario and Challenges

- The proliferation of plastic waste and escalating greenhouse gas emissions pose critical environmental threats worldwide.
- Plastic pollution, particularly from non-biodegradable plastics like polyethylene terephthalate (PET), persists in landfills and oceans, causing harm to ecosystems and marine life.
- Simultaneously, carbon dioxide (CO2) emissions contribute significantly to global warming and climate change, necessitating urgent mitigation measures.
- ► As of recent data, **global plastic production has exceeded 400 million metric tonnes** annually, with only a fraction being recycled effectively.
- ► Meanwhile, CO2 levels in the atmosphere continue to rise, surpassing 415 parts per million in recent measurements.
- ► Traditional methods of waste management, including recycling and incineration, fall short in addressing the magnitude of these challenges.

• Waste to Energy Technological Innovation:

- The development of a solar-powered reactor capable of simultaneously converting plastic waste and CO2 into valuable fuels and chemicals represents a paradigm shift in waste-to-energy technologies.
- ► This system harnesses the renewable energy of the sun to drive chemical reactions, minimizing energyintensive processes associated with conventional waste management and CO2 reduction.

• Way Forward

- ► To leverage the potential of solar-powered recycling technologies and advance towards a circular economy, several strategies can be adopted:
- ► Scaling Up Technology: Expand research and development efforts to optimize solar-powered reactors for commercial applications.
- Policy and Regulatory Frameworks: Implement supportive policies that incentivize the adoption of innovative waste-to-energy technologies.
- ► Public Awareness and Education: Educate the public on the benefits of circular economy initiatives and the role of technology in reducing plastic waste and CO2 emissions.

Case Studies

University of Cambridge's Solar-Powered Reactor: The integrated reactor developed by researchers demonstrates the feasibility of converting plastic waste and CO2 into valuable fuels efficiently and selectively. This case highlights the potential of academic-industry collaborations in advancing sustainable technologies.





The development of solar-powered technologies for converting plastic waste and CO2 into fuels represents a significant step towards achieving a sustainable, circular economy.

PRACTICE QUESTION

Q. Discuss the significance of solar-powered technologies in converting plastic waste and CO2 into fuels. What are the challenges and opportunities associated with integrating these technologies into a circular economy framework?





ENVIRONMENTAL CONSERVATION

1. ANTHROPOCENE - HUMAN IMPACT ON EARTH'S GEOLOGY AND ECOSYSTEMS

CONTEXT: The proposal to add an Anthropocene Epoch to the geological time scale was rejected for a variety of reasons, none of them related to the fact that human societies are changing this planet.

• Impact of Humans on Environment

- Geological and Environmental Impact: Carbon dioxide levels have risen from pre-industrial levels of about 280 ppm to over 420 ppm in 2023, contributing to global warming and climate change.
- ► Ecosystem Disruption: The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) reports that around 1 million species are at risk of extinction due to human activities.

• Way Forward

- Sustainable Development Goals (SDGs): Goals such as SDG 13 (Climate Action), SDG 14 (Life Below Water), and SDG 15 (Life on Land) focus on mitigating human impact and restoring ecosystems.
- ► **Technological Innovations:** Remote sensing, geographic information systems (GIS), and artificial intelligence (AI) can enhance our understanding of human impact and support data-driven conservation efforts.
- ► **Policy and Governance:** International agreements like the Paris Agreement aim to limit global warming and reduce GHG emissions, highlighting the importance of collaborative action.



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Case Studies

Amazon Rainforest, South America: The Amazon Rainforest, often referred to as the "lungs of the Earth," faces significant threats from deforestation, illegal logging, and agricultural expansion. Initiatives like the **Amazon Sustainable Landscapes Program** aim to protect biodiversity, promote sustainable land use, and restore degraded areas through reforestation and community engagement.

The Anthropocene epoch underscores the profound and lasting impact of human activities on Earth's geology and ecosystems. Addressing these challenges requires a multifaceted approach, including sustainable development, technological innovation, and robust policy frameworks.

PRACTICE QUESTION

Q. Discuss the concept of the Anthropocene and its implications for Earth's geology and ecosystems. Evaluate the evidence of human impact on the planet and the challenges it poses.

2. DECLINING GREEN COVER IN CAUVERY RIVER BASIN - DEFORESTATION AND WATERSHED MANAGEMENT

CONTEXT: The National Green Tribunal (NGT) has issued notices to the governments of Karnataka, Tamil Nadu, and Kerala following a report by the Indian Institute of Science (IISc) highlighting the drastic reduction in green cover in the Cauvery basin over the past five decades.

Current Scenario and Challenges

- ► The IISc report reveals that the Cauvery basin has lost 12,850 square kilometres (sq km) of green cover between 1965 and 2016.
- ► This reduction is primarily attributed to **extensive agricultural and horticultural activities**, which now cover 73.5% of the basin, leaving only 18% as forested areas.



- ▶ In Karnataka alone, 57% of the green cover has been lost, amounting to 9,664 sq km. Tamil Nadu and Kerala have seen reductions of 29% and 27%, respectively.
- > **Prominent national parks and wildlife sanctuaries** within the Cauvery basin are also affected.
- Bandipur National Park has lost 15.19% of its forest cover, while Nagarhole National Park and Biligiri Ranganathaswamy Temple (BRT) Wildlife Sanctuary have seen declines of 11% and significant portions due to human interventions and agricultural expansion.
- ► The Cauvery Wildlife Sanctuary faces a reduction of 18.43% in greenery due to population growth and encroachment.



Reasons for loss of green cover in Cauvery Basin:

- ► **Deforestation** in the Cauvery basin is driven by illegal logging, wildfires, encroachment, and expansion of agricultural activities.
- > Additionally, the Cauvery River is **increasingly polluted** by **untreated wastewater discharge**.
- ➤ The Indian Institute of Technology, Bombay (IIT-B) has highlighted that deforestation in the Western Ghats, a key biodiversity hotspot, significantly impacts rainfall patterns and exacerbates water scarcity in Tamil Nadu.
- The Western Ghats have lost 33,579 sq km of green cover since 1920, affecting 25-40% of Tamil Nadu's monsoon rainfall.



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 - **Way Forward:** Addressing the challenges of deforestation and watershed management in the Cauvery basin requires a multi-faceted approach:
 - Restoration and Conservation Initiatives: Efforts like the Isha Foundation's 'Rally for Cauvery,' which aims to plant millions of trees, should be complemented by scientific planning and community involvement.
 - **Sustainable Agricultural Practices:** Reducing the dependence on water-intensive crops can alleviate pressure on the Cauvery's water resources.
 - Pollution Control Measures: Urban pollution control and proper waste management are essential to maintaining the health of the river ecosystem.
 - ► **Community Engagement and Education:** Empowering communities to participate in watershed management can lead to more sustainable and long-term solutions.

Case Studies

Isha Foundation's 'Rally for Cauvery': This initiative aims to plant over 46 million trees in the Cauvery basin. While it has garnered significant support, experts argue that it should address broader issues such as large dams and urbanisation affecting the river's health.

The declining green cover in the Cauvery basin underscores the urgent need for comprehensive watershed management strategies. Addressing deforestation and river pollution requires a combination of restoration projects, sustainable agricultural practices, pollution control measures, and community engagement.

PRACTICE QUESTION

Q. Discuss the causes and consequences of declining green cover in the Cauvery river basin. Suggest measures to address the challenges of deforestation and watershed management in the region.

3. GREEN INDUSTRY INITIATIVE - SUSTAINABLE PRODUCTION PRACTICES AND CARBON NEUTRALITY

CONTEXT: The latest IPCC report highlighted that global greenhouse gas emissions must peak by 2025 to avoid catastrophic climate impacts.

Green Industry Initiative

- European Union's Green Deal: One notable example is the European Union's Green Deal, which aims to make Europe the first climate-neutral continent by 2050.
- ► U.S. Inflation Reduction Act: Additionally, the U.S. Inflation Reduction Act of 2022, with its substantial provisions for clean energy investments, is another key policy driving green industrial transformation.
- Green Industry Initiative: The United Nations Industrial Development Organization (UNIDO) has long been a proponent of sustainable industrial development through its Green Industry initiative. This initiative, set within the broader context of the UN's sustainable development goals (SDGs), aims to harmonize economic growth with environmental stewardship.
- **Issues and Challenges:** Despite these positive strides, several challenges impede the widespread adoption of Green Industry practices.
 - ► Financial Burden on Developing Countries: One major issue is the financial burden on developing countries, which often lack the necessary resources and technological infrastructure. For instance,



sub-Saharan Africa faces significant hurdles in accessing clean technology and sustainable practices, primarily due to financial constraints and inadequate policy frameworks.

- ► **Industrial Transition Difficulties**: Moreover, industries worldwide grapple with the transition from traditional manufacturing processes to greener alternatives.
- Steel and Cement Industries: The steel and cement industries, for example, are significant carbon emitters and face substantial technical and financial challenges in reducing their emissions.
- Lack of Standardized Regulations: The lack of standardized regulations and enforcement mechanisms further complicates efforts to implement cleaner production processes globally.

Reasons for the Shift to Green Industry:

- Environmental Necessity: Air pollution in India, attributed to industrial emissions, causes over a million deaths annually and significant economic losses.
- Economic Viability: Sustainable practices often lead to cost savings in the long run. Energy-efficient technologies and waste minimization reduce operational costs, as seen in companies adopting RECP (Resource Efficient and Cleaner Production) methods.
- Regulatory Pressures: International treaties like the Stockholm Convention on Persistent Organic Pollutants (POPs) and the Montreal Protocol on substances that deplete the ozone layer mandate stricter environmental standards, pushing industries towards greener practices.
- ► Corporate Social Responsibility (CSR): Increasing consumer awareness and demand for environmentally responsible products are compelling businesses to adopt CSR frameworks.

To advance the Green Industry agenda, a multi-faceted approach is necessary:

- ► **Policy and Financial Support**: The success of Germany's Energiewende (energy transition) policy, which includes subsidies for renewable energy projects, serves as a model.
- **Technology Transfer and Capacity Building**: UNIDO's initiatives in capacity-building and technology transfer play a crucial role here.
- ► **Public-Private Partnerships**: The partnership between the Indian government and private firms in promoting solar energy exemplifies this approach.
- ► Awareness and Education: Programs that engage communities and industries in sustainability practices are vital.

Case Studies

• China's Green Industry Transition: China's transition to a green economy showcases the potential of comprehensive policy frameworks. The Chinese government has implemented stringent environmental regulations, coupled with substantial investments in renewable energy. In 2023, China accounted for nearly 50% of global renewable energy capacity additions.

The transition to Green Industry is not only a necessity for environmental sustainability but also a pathway to economic resilience and social well-being. By adopting comprehensive policies, fostering international cooperation, and investing in sustainable technologies, countries can pave the way for a greener future.

PREVIOUS YEAR QUESTION

Q. "Access to affordable, reliable, sustainable and modern energy is the sine qua non to achieve Sustainable Development Goals (SDGs)." Comment on the progress made in India in this regard. (2018)

PRACTICE QUESTION

Q. Discuss the concept of Green Industry and its significance in achieving sustainable development with suitable examples and case studies.





4. MANUFACTURED SAND - MINING ALTERNATIVES AND ENVIRONMENTAL IMPACTS

CONTEXT: In Europe, the Netherlands has pioneered the use of recycled glass as an alternative to sand in construction, addressing both the sand scarcity and waste glass management issues. This innovative approach has garnered international attention, prompting other countries to explore similar solutions.

• The transition to M-sand and other alternatives is not without challenges:

- **Quality and Standards**: The Indian construction industry, for instance, has faced challenges in standardizing M-sand production to meet quality requirements.
- Environmental Concerns: In countries like China, where M-sand production is on the rise, managing these environmental impacts remains a critical concern.
- Economic Barriers: This financial challenge is evident in sub-Saharan Africa, where infrastructure development is hindered by limited access to sustainable construction materials.

Reasons for the Shift to Manufactured Sand

- Environmental Sustainability: India's ban on river sand mining in several states has driven the adoption of M-sand, helping to protect river ecosystems.
- ► **Resource Availability**: The United States has leveraged its vast rock resources to produce M-sand, reducing dependence on diminishing natural sand reserves.
- **Cost Efficiency**: The cost advantage of M-sand is evident in urban areas of India, where transportation costs for natural sand are high.
- Waste Management: The Netherlands' use of recycled glass sand in construction is a prime example of this approach.

• Way Forward

- ► **Policy and Regulation**: Incentives for M-sand production, along with stringent regulations on natural sand mining, are essential. India's recent regulatory framework for M-sand is a step in the right direction.
- **Technological Advancements**: Innovations in crushing and screening technologies can enhance the quality of M-sand, making it a more viable alternative to natural sand.
- Public Awareness and Education: Public awareness campaigns can drive acceptance and adoption of sustainable sand alternatives.

The transition to manufactured sand and other sustainable alternatives is imperative for mitigating the environmental impacts of sand mining and ensuring a reliable supply of construction materials. While challenges remain, innovative approaches such as using recycled materials and improving M-sand production technologies offer promising solutions.

PREVIOUS YEAR QUESTION

Q. Coastal sand mining, whether legal or illegal, poses one of the biggest threats to our environment. Analyse the impact of sand mining along the Indian coasts, citing specific examples.

PRACTICE QUESTION

Q. Discuss the environmental impacts of natural sand mining and the role of manufactured sand in promoting sustainable construction practices.

5. RISING GLOBAL TEMPERATURES - CLIMATE CHANGE IMPACTS AND ADAPTATION STRATEGIES

CONTEXT: This unprecedented heatwave, driven by climate change and the El Nino phenomenon, has been confirmed by a rapid attribution analysis conducted by the World Weather Attribution (WWA) group. The analysis revealed that climate change was responsible for over 80% of the temperature rise, with El Nino contributing an additional 0.2°C.

Issues Related to Rising Global Temperatures

- ► Human Health: In South Asia, extreme temperatures above 40°C affected billions of people, exacerbating health issues and increasing mortality rates. For example, the April 2024 heatwave in India led to widespread heat-related illnesses and deaths, particularly among the elderly, children, and those with pre-existing health conditions.
- Agricultural Productivity: The 2023 summer heatwave in the Northern Hemisphere resulted in significant crop losses, particularly in staple crops such as wheat and maize. In India, the April 2024 heatwave damaged crops like wheat and pulses, leading to reduced yields and increased food prices.
- ➤ Water Scarcity: The April 2024 heatwave in South Asia strained water resources, leading to acute water shortages in several regions. In eastern India, the heatwave reduced river flows and depleted groundwater levels, impacting both drinking water supplies and agricultural irrigation.
- ► Ecosystem Disruption: The 2023 summer in the Northern Hemisphere led to the bleaching of coral reefs, loss of habitats for species, and increased forest fires. In India, the April 2024 heatwave stressed wildlife, leading to increased mortality rates and habitat degradation.



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n Reasons for Rising Global Temperatures

- **Greenhouse Gas Emissions**: The 2023 study highlighted that the warming trend is primarily driven by emissions from oil, gas, and coal.
- ➤ Climate Patterns: The 2024 heatwave in Asia was significantly intensified by El Nino, which disrupted weather patterns and increased sea surface temperatures in the central and eastern tropical Pacific Ocean.
- ► **Urbanization**: Rapid urbanization contributes to the urban heat island effect, where cities experience higher temperatures than surrounding rural areas due to the concentration of buildings, roads, and other heat-absorbing infrastructure.

• Way Forward: Adaptation Strategies

- Enhanced Early Warning Systems: In India, improving the accuracy and reach of weather forecasts can help mitigate the impacts of heatwaves on vulnerable populations.
- **Climate-Resilient Agriculture**: India can promote the adoption of heat-tolerant wheat and rice varieties to mitigate the impacts of rising temperatures on crop yields.
- Urban Planning and Green Infrastructure: Cities can increase green spaces, promote rooftop gardens, and use reflective building materials to lower urban temperatures.
- Water Management: In regions like eastern India, improving groundwater recharge and reducing water wastage can help mitigate the impacts of heatwaves on water resources.

Case Studies

• **Singapore's Urban Heat Mitigation:** Singapore has implemented several initiatives to combat the urban heat island effect, including increasing urban greenery and developing cool pavements. The country's "City in a Garden" vision aims to integrate more green spaces within urban areas, which has helped reduce temperatures and improve air quality. These efforts provide a model for other cities facing similar challenges.

Rising global temperatures, driven by climate change and exacerbated by natural climate patterns like El Nino, pose significant challenges to human health, agriculture, water resources, and ecosystems. Immediate and sustained efforts are required to develop and implement effective adaptation strategies.

PREVIOUS YEAR QUESTION

Q. 'Climate Change' is a global problem. How will India be affected by climate change? How Himalayan and coastal states of India will be affected by climate change? (2017)

PRACTICE QUESTION

Q. Examine the impacts of rising global temperatures and discuss effective adaptation strategies with relevant examples from different regions.

6. AMAZON FOREST FIRE: GLOBAL IMPACT -DEFORESTATION RATES AND INTERNATIONAL CONSERVATION EFFORTS

CONTEXT: The Amazon rainforest is facing an alarming increase in wildfires, with 10% more fires reported in the first half of 2023 compared to the same period in 2022.



b Issues Related to Amazon Forest Fires

- Environmental Degradation: In August 2022, the Brazilian Amazon recorded 33,116 illegal fire hotspots, the highest level in 12 years, contributing to increased carbon emissions.
- Impact on Indigenous Communities: Indigenous and traditional communities, who have sustainably managed the Amazon for millennia, are disproportionately affected by the fires.
- Global Climate Impact: The destruction of the forest due to fires contributes to global warming and pushes the Amazon toward a tipping point where it could transform from a rainforest to a savannahlike ecosystem.

Reasons for Increasing Amazon Forest Fires

- Anthropogenic Climate Change: The 2023 fires were exacerbated by hot and dry conditions caused by the El Nino phenomenon, which created conducive conditions for burning.
- Deforestation and Land Use Changes: In 2023, only 19% of the fires were related to recent deforestation, down from 39% in 2022.
- Weak Enforcement of Environmental Laws: The Brazilian government's budget for the environment in 2021 was the lowest in 21 years.

Way Forward: Strategies and Case Studies

- Strengthening Environmental Governance: The Brazilian government needs to enforce existing laws effectively and create more legally designated protected areas to prevent deforestation.
- Supporting Indigenous and Local Communities: These communities have a deep understanding of sustainable forest management practices that can help in preserving the Amazon.
- Global Cooperation and Sustainable Practices: Sustainable agricultural practices and reducing meat consumption can lessen the pressure on the Amazon.

Case Studies

• Norway's Support for Brazil's Amazon Fund: Norway has been a major contributor to the Amazon Fund, which supports projects aimed at reducing deforestation and promoting sustainable development. This international cooperation has helped Brazil reduce deforestation rates in the past. Renewed and increased funding from international partners can bolster Brazil's efforts to protect the Amazon.

The rising number of wildfires in the Amazon rainforest, driven by climate change and human activities, threatens to reverse the environmental gains made in recent years. To address this crisis, robust environmental governance, support for Indigenous communities, and international cooperation are essential.

PRACTICE QUESTION

Q. Discuss the increasing threat of wildfires in the Amazon rainforest and suggest effective strategies for mitigating this crisis.

7. DESERTIFICATION: ISSUES AND CHALLENGES - LAND DEGRADATION AND SUSTAINABLE AGRICULTURE

CONTEXT: According to the United Nations Convention to Combat Desertification (UNCCD), more than 2 billion hectares of previously productive land is now degraded.

Issues Related to Desertification

- ➤ Food Security: In Sub-Saharan Africa, for example, desertification threatens the livelihoods of over 40% of the population who depend on agriculture for their sustenance.
- ➤ Biodiversity Loss: The International Union for Conservation of Nature (IUCN) highlights that over 1,000 species are currently at risk of extinction due to habitat loss caused by desertification.
- ➤ Water Scarcity: The World Resources Institute (WRI) notes that desertification has intensified drought conditions in regions like the Sahel, affecting millions of people and livestock.
- Economic Impact: A study by the Economics of Land Degradation (ELD) Initiative estimates that land degradation costs the global economy up to \$10 trillion annually in lost ecosystem services and agricultural productivity.

Reasons for Desertification

 Climate Change: The Intergovernmental Panel on Climate Change (IPCC) warns that if current trends continue, large parts of the world could become uninhabitable l



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of the world could become uninhabitable by the end of the century.

- Unsustainable Agricultural Practices: In regions like the Horn of Africa, overgrazing by livestock has significantly reduced vegetation cover, making the soil more susceptible to erosion and degradation.
- Urbanization and Industrialization: In China, for example, the expansion of cities has resulted in the loss of vast tracts of arable land, exacerbating desertification in areas like the Loess Plateau.
- **Population Pressure**: In countries like India, the growing demand for agricultural land has led to the overuse of fertilizers and pesticides, further degrading the soil.

• Way Forward

- Sustainable Land Management (SLM): Implementing SLM practices such as agroforestry, conservation tillage, and integrated water resource management can help combat desertification.
- Reforestation and Afforestation: Initiatives like the Great Green Wall in Africa aim to create a mosaic
 of green and productive landscapes across the Sahel to combat desertification.

Case Studies

The Great Green Wall Initiative: The Great Green Wall (GGW) is an African-led project aimed at combating desertification across the Sahel region. Stretching over 8,000 km from Senegal to Djibouti, the GGW aims to restore 100 million hectares of degraded land by 2030. As of 2023, 20 million hectares have been restored, sequestering 250 million tons of carbon and creating thousands of jobs.

Desertification poses a significant challenge to global food security, biodiversity, and economic stability. Addressing this issue requires a multifaceted approach, including sustainable land management practices, reforestation efforts, and international cooperation.

PRACTICE QUESTION

Q. Discuss the challenges of desertification and land degradation, and suggest sustainable agricultural practices to combat this issue.

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8. HARNESSING BIOMASS CULTIVATION ON DEGRADED LAND - BIOENERGY POTENTIAL AND SOIL RESTORATION

CONTEXT: According to the International Renewable Energy Agency (IRENA), biomass could supply up to 20% of the world's energy needs by 2050, while also aiding in the restoration of 2 billion hectares of degraded land worldwide.

Issues Related to Biomass Cultivation

- ► Energy Security: The International Energy Agency (IEA) projects that by 2030, bioenergy could account for 15% of global energy consumption, reducing dependency on fossil fuels.
- ► Soil Restoration: The United Nations Environment Programme (UNEP) reports that such practices can restore soil fertility and productivity, making previously unusable lands viable for agriculture.
- Climate Change Mitigation: According to a study by the World Resources Institute (WRI), restoring degraded lands through biomass cultivation could sequester up to 5 gigatons of CO2 annually.
- Economic Opportunities: The Global Bioenergy Partnership (GBEP) estimates that biomass cultivation could generate millions of jobs in the bioenergy sector by 2030.



Reasons for Biomass Cultivation on Degraded Lands

► Land Availability: The Food and Agriculture Organization (FAO) identifies over 1 billion hectares of degraded land globally that could be repurposed for biomass cultivation without competing with food production.

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- Environmental Restoration: Biomass plants, such as switchgrass and miscanthus, are known for their ability to thrive in poor soils and improve soil quality over time.
- Policy Support: In 2023, the European Union launched the Bioeconomy Strategy, which includes measures to support biomass projects aimed at restoring degraded lands and enhancing renewable energy production.
- ► **Technological Advances**: Techniques such as precision agriculture and genetic improvements in bioenergy crops increase yields and resilience to harsh conditions.

• Way Forward:

- **Integrated Land Management**: Implementing integrated land management practices that combine biomass cultivation with other sustainable land use practices can maximize benefits.
- ▶ **Public-Private Partnerships**: Encouraging collaborations between governments, private companies, and local communities can drive the successful implementation of biomass projects.

Case Studies

• India's Agroforestry Project: In India, the government has initiated an agroforestry project in the states of Haryana and Punjab to combat land degradation and promote bioenergy production. Farmers are encouraged to plant fast-growing tree species like poplar and eucalyptus on degraded lands. The project has led to a 30% increase in soil organic carbon and has created over 200,000 jobs in rural areas. The bioenergy produced from these trees contributes to local energy needs, reducing reliance on fossil fuels.

Harnessing biomass cultivation on degraded lands presents a viable solution to multiple global challenges, including energy security, climate change, and land degradation.

PREVIOUS YEAR QUESTION

Q. Each year a large amount of plant material, cellulose, is deposited on the surface of Planet Earth. What are the natural processes this cellulose undergoes before yielding carbon dioxide, water and other end products? (2022)

PRACTICE QUESTION

Q. Discuss the potential of biomass cultivation on degraded lands for bioenergy production and soil restoration, with relevant examples.

9. MINING IN ARAVALLI RANGE - ENVIRONMENTAL REGULATIONS AND COMMUNITY RESISTANCE

CONTEXT: Recent reports by the Ministry of Environment, Forest and Climate Change (MoEFCC) and various environmental organizations highlight the adverse impacts of mining on this ecologically sensitive region.

n Issues Related to Mining in the Aravalli Range

- Environmental Degradation: According to a report by the Centre for Science and Environment (CSE), over 25% of the forest cover in the Aravallis has been lost due to mining.
- ► Water Scarcity: The Central Ground Water Board (CGWB) reported a 30% decline in groundwater levels in the Aravallis over the past decade.
- ➤ Air and Water Pollution: Studies by the Indian Institute of Technology (IIT) Delhi indicate that particulate matter levels in mining areas are three times higher than the safe limits set by the World Health Organization (WHO).



 Loss of Biodiversity: The Wildlife Institute of India (WII) has recorded a 40% decrease in wildlife sightings in heavily mined areas.

n Reasons for Mining in the Aravalli Range

- ▶ **Illegal Mining**: A report by the Comptroller and Auditor General (CAG) in 2023 revealed that illegal mining activities have increased by 20% in the last five years.
- Economic Pressures: The National Council of Applied Economic Research (NCAER) noted that the construction boom in northern India has significantly increased the demand for Aravalli's resources.
- ► **Inadequate Regulations**: The Environmental Impact Assessment (EIA) processes are frequently bypassed or inadequately implemented, as highlighted by a recent Greenpeace India report.

D Community Resistance

 Community-led initiatives, such as the "Save Aravalli" campaign, have garnered national attention and support from various civil society organizations.

b Way Forward

- ► Strengthening Regulations and Enforcement: Enhancing the capacity of regulatory bodies and increasing penalties for violations can deter illegal mining activities.
- ► **Promoting Sustainable Mining Practices**: Techniques such as controlled blasting, proper waste management, and reforestation can help mitigate the adverse effects of mining.

Case Studies

• **Rajasthan's Community-Managed Forest Initiative:** In Rajasthan, local communities have taken the initiative to manage and protect forest areas affected by mining. By forming forest management committees, they have successfully rehabilitated over 500 hectares of degraded land through afforestation and sustainable land use practices.

Strengthening environmental regulations, promoting sustainable mining practices, and involving local communities in decision-making processes are essential steps towards mitigating the adverse impacts of mining.

PRACTICE QUESTION

Q. Discuss the environmental and social challenges of mining in the Aravalli Range and suggest sustainable solutions with relevant examples.

10. ENSURING SAFETY AND HEALTH AT WORK IN A CHANGING CLIMATE - OCCUPATIONAL HAZARDS AND CLIMATE RESILIENCE

CONTEXT: Recent studies, including those from the International Labour Organization (ILO) and the World Health Organization (WHO), underscore the urgent need for climate-resilient workplace practices to safeguard workers' health and productivity.

- **n** Issues Related to Occupational Hazards in a Changing Climate
 - ► Heat Stress: The Lancet's 2023 Climate Countdown report noted that heat exposure led to a loss of 302 billion work hours globally in 2022, a 5% increase from the previous year.

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 - Air Quality: According to the WHO, poor air quality contributed to 4.2 million premature deaths worldwide in 2023, with a significant portion attributed to occupational exposure.
 - ▶ Vector-Borne Diseases: The Centers for Disease Control and Prevention (CDC) reported a 20% increase in work-related dengue cases in South Asia from 2022 to 2023.
 - Extreme Weather Events: The ILO highlighted that 23 million people lost their jobs in 2023 due to climate-induced disasters, emphasizing the need for robust occupational safety measures.

n Reasons for the Issues

- ► Climate Change: greenhouse gas emissions have led to higher global temperatures, altered weather patterns, and frequent extreme weather events, all of which directly impact workers.
- **Inadequate Infrastructure**: Many workplaces, especially in developing countries, lack the infrastructure to cope with extreme weather conditions.
- **Insufficient Policies**: Many existing occupational safety and health (OSH) regulations do not account for the new risks posed by a changing climate.
- ► Lack of Awareness and Training: Employers and workers may not be adequately informed about the risks associated with climate change or trained in climate-resilient practices.

Way Forward: Strategies and Case Studies

- Strengthening Policies and Regulations: Governments should update OSH regulations to include climate resilience measures.
- **Improving Infrastructure**: Investing in climate-resilient infrastructure, such as cooling systems, air filtration, and disaster-proof buildings, can significantly reduce occupational hazards.
- ► **Training and Awareness**: Providing training programs on climate risks and resilience can empower workers and employers to implement effective safety measures.
- **Research and Innovation**: Promoting research on climate-resilient practices and technologies can lead to innovative solutions for protecting workers.

Case Studies

• **Qatar's Heat Stress Mitigation Program:** Qatar has implemented a comprehensive heat stress mitigation program to protect workers, especially in the construction sector, ahead of the 2022 FIFA World Cup. The program includes mandatory work breaks during peak heat hours, provision of cooling vests, and widespread installation of shaded rest areas and water stations.

Ensuring the safety and health of workers in a changing climate is a complex but critical task. By strengthening policies, improving infrastructure, raising awareness, and fostering innovation, we can build climate-resilient workplaces.

PRACTICE QUESTION

Q. Discuss the impact of climate change on occupational safety and health and suggest measures to build climate-resilient workplaces with examples.

11. CARBON FARMING: A PATH TO SUSTAINABLE AGRICULTURE

CONTEXT: Recent initiatives and policies worldwide, including the European Union's Carbon Farming Initiative and the U.S. Department of Agriculture's Carbon Farming Pilot Program, highlight the growing recognition and implementation of carbon farming practices.



n Issues Related to Carbon Farming

- Economic Viability: Transitioning to carbon farming practices can require significant initial investment in new technologies and methodologies.
- **Measurement and Verification**: The lack of standardized protocols and reliable tools can hinder the widespread adoption of carbon farming.
- **Policy and Incentives**: Farmers need assurances that their efforts will be rewarded through carbon credits or other financial mechanisms.
- Knowledge and Training: Extension services and educational programs are crucial for the widespread adoption of these practices.



Reasons for the Issues

- ► **High Initial Costs**: The transition to carbon farming can involve costs related to soil testing, purchasing new equipment, and implementing new practices such as cover cropping, agroforestry, and reduced tillage.
- **Technological Barriers**: Advanced technologies for measuring soil carbon levels, such as remote sensing and soil carbon modeling, are not always accessible or affordable for all farmers.
- **Regulatory Gaps**: Many countries lack comprehensive policies that support carbon farming. Without clear regulations and incentives, farmers may be reluctant to adopt new practices.
- Lack of Awareness: There is a general lack of awareness among farmers about the benefits and methods of carbon farming.

Way Forward: Strategies and Case Studies

- **Developing Robust Policy Frameworks**: Governments need to establish clear policies and financial incentives to promote carbon farming.
- **Investing in Technology and Research**: Increased investment in research and development of costeffective technologies for measuring and enhancing soil carbon is crucial.
- Providing Education and Training: Extension services should offer comprehensive training programs to educate farmers about carbon farming practices and their benefits.



► Encouraging Public-Private Partnerships: Partnerships between governments, private companies, and non-profits can drive innovation and provide the necessary resources for farmers to adopt carbon farming practices.

Case Studies

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• Australia's Emissions Reduction Fund: Australia's Emissions Reduction Fund (ERF) supports carbon farming by providing financial incentives for farmers who adopt practices that sequester carbon. Farmers participate in projects like reforestation, improved soil management, and reducing livestock emissions.

Carbon farming offers a promising path to sustainable agriculture, providing environmental, economic, and social benefits. However, its success depends on addressing economic viability, measurement challenges, policy support, and knowledge dissemination.

PRACTICE QUESTION

Q. Discuss the potential of carbon farming in promoting sustainable agriculture and mitigating climate change with relevant examples and strategies.

12. ELECTRIC MOBILITY: A NEW PARADIGM IN INDIA

CONTEXT: Recent reports indicate that EV sales in India have increased by 50% in the first half of 2024 compared to the same period in 2023, highlighting the growing acceptance of electric mobility.

n Issues Related to Electric Mobility

- **Infrastructure Deficit**: Although the government has made strides in setting up charging stations, the current network is inadequate to meet the rising demand.
- ► **High Initial Costs**: The initial purchase price of EVs is still higher than conventional internal combustion engine (ICE) vehicles.
- **Battery Technology and Supply Chain**: The reliance on imported batteries and raw materials such as lithium and cobalt poses a significant challenge.
- Consumer Awareness and Acceptance: There is still a lack of widespread awareness about the benefits
 of EVs and misconceptions regarding their performance and reliability.

n Reasons for the Issues

- ► **Underdeveloped Charging Infrastructure**: The slow pace of infrastructure development is due to high installation costs and regulatory hurdles.
- ► Economies of Scale: The high costs of EVs are partly due to the limited scale of production. As production volumes increase, the costs are expected to decrease, but achieving these economies of scale is a gradual process.
- **Dependence on Imports**: India imports a significant portion of the batteries and raw materials required for EV manufacturing.
- ► Lack of Comprehensive Policies: Although there are policies promoting EV adoption, a lack of cohesive and comprehensive policies across states results in inconsistent implementation and support.

Way Forward: Strategies and Case Studies

- Enhancing Charging Infrastructure: The government and private sector need to collaborate to expand the charging network.
- ► **Promoting Domestic Manufacturing**: The Production Linked Incentive (PLI) scheme for Advanced Chemistry Cell (ACC) battery manufacturing is a step in the right direction.



- ► **Raising Awareness**: Public awareness campaigns and educational programs can dispel myths about EVs and highlight their benefits.
- ► **Policy Harmonization**: Developing a unified national policy for EVs that includes standardized incentives, tax benefits, and infrastructure guidelines can ensure consistent and effective implementation across all states.

Case Studies

• **Tata Motors' EV Strategy:** Tata Motors, a leading automotive manufacturer in India, has made significant strides in the EV sector. The company's EV portfolio, including models like the Nexon EV and Tigor EV, has gained popularity due to their affordability and performance.

Electric mobility represents a transformative shift in India's transportation landscape, offering significant environmental and economic benefits. While challenges such as infrastructure deficits, high costs, and supply chain dependencies remain, strategic interventions can address these issues.

PRACTICE QUESTION

Q. Discuss the potential and challenges of electric mobility in India with reference to recent initiatives, infrastructure, and policy measures.

13. WATER CRISIS IN URBAN INDIA: IMPACT ON ENVIRONMENT

CONTEXT: Urban India faces recurring water crises due to fast-depleting aquifers. Despite government efforts to provide tap water, aquifer health remains neglected. In 2023, around 91 million Indians lacked access to safe water, highlighting the massive water shortage.

n Issues Related to the Water Crisis

- Depleting Groundwater Levels: Cities like Chennai and Bengaluru have witnessed drastic declines in groundwater levels, posing long-term sustainability challenges.
- ► **Pollution of Surface Water Sources**: Rivers and lakes serving urban populations are heavily polluted due to untreated sewage discharge, industrial effluents, and solid waste dumping.
- ► **Inadequate Infrastructure**: Aging and insufficient water supply infrastructure fail to meet the growing demand in urban areas.
- Climate Change Impact: Erratic rainfall patterns and prolonged droughts linked to climate change disrupt traditional water supply sources, exacerbating the vulnerability of urban populations to water shortages.

Reasons for the Water Crisis

- Urban Population Growth: Rapid urbanization has led to an exponential increase in water demand, outstripping the capacity of existing water supply systems.
- ► **Poor Water Governance**: Inadequate governance, including weak regulatory frameworks, insufficient enforcement of water laws, and ineffective management practices, exacerbates the water crisis.
- Lack of Sustainable Practices: Limited adoption of sustainable water management practices such as rainwater harvesting, water recycling, and efficient water use contributes to the water scarcity problem.
- Climate Change: Changing climatic patterns, including reduced and erratic rainfall, impact water availability, making cities more vulnerable to droughts and water stress.

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Way Forward: Strategies and Case Studies

- **Improving Water Management Infrastructure**: The Jal Jeevan Mission aims to provide tap water connections to all rural and urban households, focusing on sustainable water management.
- Promoting Water Conservation and Efficiency: Bengaluru's successful implementation of mandatory rainwater harvesting in buildings has helped recharge groundwater levels.
- Enhancing Water Quality Monitoring and Management: The Yamuna Action Plan in Delhi aims to rejuvenate the polluted Yamuna river through comprehensive pollution control measures and community engagement.

The water crisis in urban India is a complex issue requiring integrated solutions addressing governance, infrastructure, sustainability, and climate resilience. Sustainable water management practices, coupled with robust policy interventions and community participation, are critical to mitigating the impacts of the crisis.



PREVIOUS YEAR QUESTION

- Q. Not many years ago, river linking was a concept but it is becoming reality in the country. Discuss the advantages of river linking and its possible impact on the environment. (2017)
- Q. What are the salient features of the Jal Shakti Abhiyan launched by the Government of India for water conservation and water security? (2020)

PRACTICE QUESTION

Q. Discuss the challenges posed by the water crisis in urban India, its environmental impacts, and strategies for sustainable water management in cities.

14. USED HEAVY DUTY VEHICLES AND THE ENVIRONMENT

CONTEXT: While heavy-duty vehicle (HDV) exports represent a modest 3.6% of the global automotive trade's total value, their associated CO2 emissions have surged by over 30% since 2000. Trucks contribute significantly to this increase, accounting for 80% of the rise in emissions.

• Moreover, HDVs substantially impact environmental pollution:

- ▶ Nitrogen Oxides (NOx): HDVs contribute over 40% of on-road NOx emissions.
- > Particulate Matter (PM2.5): They account for over 60% of on-road PM2.5 emissions.
- **Black Carbon**: HDVs emit more than 20% of black carbon, a potent climate forcer.

Issues Related to Used HDVs

- ► Air Pollution and Health: Fine particulate matter (PM2.5) from used HDVs leads to diseases like ischemic heart disease, stroke, chronic obstructive pulmonary disease (COPD), and lung cancer.
- Carbon Emissions: Heavy-duty trucks and buses are major contributors to greenhouse gas emissions, with older models being less fuel-efficient and emitting higher levels of carbon dioxide (CO2) per mile traveled compared to newer vehicles.
- **Regulatory Gaps:** Weak or inadequate regulations in over half of used HDV importing countries. Lack of minimum requirements for exporting used HDVs.
- Waste and End-of-Life Management: Disposal of used HDVs poses challenges due to their size, complexity, and hazardous components, contributing to environmental pollution and resource depletion if not managed properly.

Reasons for Concern with Used Heavy Duty Vehicles

- ➤ Global Growth in Vehicle Fleet: The global fleet of heavy-duty vehicles is expanding rapidly, particularly in emerging economies, leading to increased environmental pressures and public health risks.
- **Regulatory Gaps**: Inadequate regulations or enforcement of emission standards for used HDVs allow older, more polluting vehicles to remain in operation longer, exacerbating environmental impacts.
- **Technological Progress**: Advances in cleaner vehicle technologies and alternative fuels demonstrate the potential to mitigate environmental impacts from HDVs, but uptake remains uneven globally.

b Way Forward: Strategies and Case Studies

• **Regulatory Measures**: The European Union's Euro VI standards have significantly reduced emissions from heavy-duty vehicles through stringent requirements for new and retrofit vehicles.

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- Promoting Sustainable Alternatives: The adoption of electric buses in cities like Shenzhen, China, has
 reduced air pollution and greenhouse gas emissions significantly.
- Circular Economy Practices: Encouraging recycling and reuse of vehicle components, promoting ecofriendly disposal practices, and developing markets for remanufactured HDV parts to reduce waste and resource consumption.

Addressing the environmental impact of used heavy-duty vehicles requires a comprehensive approach involving regulatory reforms, technological innovation, and sustainable practices. Effective management of vehicle emissions and promotion of cleaner alternatives are crucial steps toward mitigating air pollution, reducing carbon footprints, and safeguarding public health and the environment.

PRACTICE QUESTION

Q. Discuss the environmental challenges posed by used heavy-duty vehicles, regulatory strategies, and sustainable solutions for mitigating their impact.

15. LAND MANAGEMENT FOR SUSTAINABLE DEVELOPMENT - LAND USE PLANNING AND BIODIVERSITY CONSERVATION

CONTEXT: Land management plays a pivotal role in achieving sustainable development. As we grapple with global challenges like climate change, food security, and biodiversity loss, effective land use planning becomes crucial.

Here are some recent developments:

- ➤ UN Summit of the Future: The Sustainable Development Report 2024 highlights that only 16% of Sustainable Development Goals (SDG) targets are on track globally, emphasizing the need for urgent action.
- **Desertification and Drought Day 2024**: Mobilizing generations for sustainable land stewardship is essential to combat land degradation and drought.





Issues Related to Land Management

► **Urbanization Pressures**: Rapid urban growth leads to land conversion, habitat fragmentation, and loss of agricultural lands, threatening biodiversity and ecosystem resilience.



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- ► Agricultural Intensification: Expansion of industrial agriculture can degrade soil quality, reduce biodiversity, and increase reliance on agrochemicals, impacting water resources and ecosystem health.
- **Deforestation and Habitat Loss**: Clearing forests for timber, agriculture, and infrastructure disrupts ecosystems, reduces carbon sinks, and threatens species survival, exacerbating climate change.

• Need for Land Conservation:

- **Ecosystem Services**: Healthy ecosystems provide essential services such as water purification, carbon sequestration, and pollination, crucial for human well-being and sustainable development.
- **Biodiversity Conservation**: Preserving biodiversity supports ecological resilience, genetic diversity, and adaptation to environmental changes, enhancing ecosystem stability.
- Sustainable Development Goals: Achieving SDGs like zero hunger, clean water, and climate action depends on sustainable land management practices that balance human needs with environmental stewardship.
- Legal and Policy Frameworks: International agreements like the Convention on Biological Diversity and national policies guide sustainable land management, promoting biodiversity conservation and equitable development.

• Way Forward:

- ► **Integrated Land Use Planning**: Singapore's land-use planning integrates green spaces with urban development to enhance biodiversity and urban resilience.
- ► Ecosystem-based Approaches: Costa Rica's Payment for Ecosystem Services program incentivizes landowners to conserve forests, benefiting biodiversity and climate resilience.
- Community Engagement and Stakeholder Collaboration: Involving local communities, indigenous peoples, and stakeholders in decision-making processes to ensure land management practices are inclusive, equitable, and culturally appropriate.
- ► Effective land management for sustainable development requires a holistic approach that integrates biodiversity conservation, climate resilience, and socio-economic development goals.

PRACTICE QUESTION

Q. Discuss the challenges of land management for sustainable development, strategies for biodiversity conservation, and case studies demonstrating effective land-use planning.

16. INDIA'S GREEN ENERGY TRANSITION IN TIMES OF CLIMATE CHANGE

CONTEXT: India is intensifying its efforts towards green energy transition amidst escalating climate change impacts. With ambitious renewable energy targets and policy initiatives, India aims to reduce carbon emissions and enhance energy security.

n Issues Related to the Topic

- Climate Change Impacts: Increasing frequency of extreme weather events like cyclones and heatwaves underscores the urgency for renewable energy adoption to mitigate greenhouse gas emissions.
- Energy Security: Dependence on fossil fuels poses risks to energy security amidst geopolitical uncertainties and fluctuating global oil prices, necessitating a shift towards sustainable energy sources.
- ► **Technological Challenges**: Integration of intermittent renewable energy sources into the grid, storage solutions, and infrastructure development require substantial investments and technological advancements.
- ▶ **Policy and Regulatory Frameworks**: Streamlining regulations, ensuring grid reliability, and addressing financial barriers are crucial for scaling up renewable energy deployment effectively.



Reasons for the Topic's Importance

- ► Global Commitments: India's commitments under the Paris Agreement necessitate substantial reductions in carbon emissions and scaling up renewable energy to achieve climate goals.
- ► Air Quality and Health: Transitioning from coal-based power plants to cleaner energy sources improves air quality, reduces health impacts from pollution, and enhances public health outcomes.
- Economic Opportunities: Investments in renewable energy create jobs, stimulate economic growth, and foster innovation in clean technologies, driving sustainable development.
- Energy Access: Expanding access to clean and affordable energy in rural and underserved areas improves livelihoods, supports socio-economic development, and reduces energy poverty.

b Way Forward

- Scaling Renewable Capacity: Accelerating deployment of solar and wind power through competitive bidding, incentives, and supportive policies like the Green Energy Corridors project.
- ► Energy Storage Solutions: Investing in energy storage technologies such as batteries and pumped hydro storage to enhance grid stability and reliability of renewable energy sources.

Case Studies

- **Karnataka's Solar Power Initiative**: Karnataka has emerged as a leader in solar energy with innovative policies and incentives, achieving significant capacity additions and promoting decentralized solar installations.
- **Gujarat's Wind Energy Development**: Gujarat's coastal regions harness wind power effectively, demonstrating successful integration into the grid and supporting renewable energy growth.

India's transition to green energy is pivotal in mitigating climate change impacts, enhancing energy security, and fostering sustainable development. With robust policy frameworks, technological innovations, and strategic investments, India can accelerate its green energy transition, contributing to global efforts for a low-carbon future.

PREVIOUS YEAR QUESTION

Q. Explain the purpose of the Green Grid Initiative launched at World Leaders Summit of the COP26 UN Climate Change Conference in Glasgow in November, 2021. When was this idea first floated in the International Solar Alliance (ISA)? (2021)

PRACTICE QUESTION

Q. Discuss India's green energy transition strategies amidst climate change, citing examples and challenges, and propose measures for sustainable development.

17. GREEN HYDROGEN: ENABLING MEASURES ROADMAP FOR ADOPTION IN INDIA

CONTEXT: India's energy demand is projected to surge by 35% by 20301. India is increasingly focusing on green hydrogen as a key element of its energy transition strategy.

n Issues Related to the Topic

 High Cost of Production: Green hydrogen production cost needs to be reduced to less than or equal to \$2 per kg2. Direct subsidies for early adopters, similar to the USA's tax credit of up to \$3/kg2.



- ► **Infrastructure Development**: Establishing hydrogen production, storage, and distribution infrastructure requires substantial investments and technological advancements.
- ► **Technological Maturity**: Advancing electrolyzer technologies and scaling up production capacities are critical for cost reduction and enhancing efficiency.
- Policy and Regulatory Support: Clear regulatory frameworks, incentives for investors, and supportive
 policies are essential to foster a conducive environment for green hydrogen deployment.



• Reasons for the Topic's Importance

- Carbon Neutrality Goals: Green hydrogen plays a crucial role in achieving India's ambitious carbon neutrality goals by 2070, as outlined in the Nationally Determined Contributions (NDCs) under the Paris Agreement.
- **Energy Security**: Diversifying the energy mix with green hydrogen reduces dependence on imported fossil fuels, enhancing energy security and resilience.
- **Industrial Transformation**: Green hydrogen enables industries to transition towards cleaner and sustainable production processes, contributing to environmental stewardship.
- ► Job Creation and Economic Growth: Investing in green hydrogen infrastructure and technology fosters innovation, creates jobs, and stimulates economic growth in the renewable energy sector.

b Way Forward

- ► Scaling Up Production: Encouraging private sector participation through incentives, subsidies, and public-private partnerships to scale up green hydrogen production capacities.
- Research and Development: Investing in research and development to innovate and commercialize advanced electrolyzer technologies and reduce production costs.

Case Studies

Gujarat Solar Park Hydrogen Initiative: Gujarat's initiative to integrate green hydrogen production with its solar parks showcases the feasibility of leveraging renewable energy sources for hydrogen production.

Green hydrogen holds immense potential as a clean and versatile energy carrier to drive India's sustainable development agenda. With strategic investments, supportive policies, and technological advancements, India can lead the global transition towards a hydrogen economy, addressing climate change challenges and fostering green growth.

PRACTICE QUESTION

Q. Discuss the role of green hydrogen in India's energy transition, highlighting challenges, enabling measures, and case studies for sustainable development.

18. INDIA'S GREEN FUTURE THROUGH BIOCNG - BIOFUEL ALTERNATIVES AND RURAL DEVELOPMENT

CONTEXT: India is increasingly embracing BioCNG (Compressed Natural Gas), derived from organic waste and biomass, as a sustainable alternative fuel. This renewable energy source is pivotal in reducing carbon emissions and promoting rural development.

n Issues Related to BioCNG - Biofuel

- Waste Management Challenges: Effective collection and processing of organic waste and biomass pose logistical and operational challenges, impacting BioCNG production.
- **Technological Infrastructure**: Developing robust infrastructure for BioCNG production, storage, and distribution requires significant investment and technological advancements.
- **Market Penetration**: Limited awareness and market penetration of BioCNG as a viable alternative to conventional fuels hinder its widespread adoption.
- Policy Support: Inconsistent policies and regulatory frameworks affect the scalability and economic viability of BioCNG projects.

Reasons for the need of BioCNG – Biofuel development

- Environmental Benefits: BioCNG significantly reduces greenhouse gas emissions compared to fossil fuels, contributing to India's climate mitigation goals under the Paris Agreement.
- Energy Security: Diversification of energy sources with BioCNG reduces dependency on imported fossil fuels, enhancing energy security.
- Rural Employment: BioCNG projects stimulate rural economies by creating jobs in waste management, agriculture, and renewable energy sectors.
- ► **Circular Economy**: Promotes the concept of a circular economy by converting organic waste into a valuable energy resource, thus reducing landfill burden.

b Way Forward

- Capacity Building: Invest in research and development to enhance BioCNG production technologies and efficiency.
- ► **Policy Reforms**: Formulate clear policies and incentives to promote investment in BioCNG infrastructure and ensure market competitiveness.

Case Studies

- **Indore's BioCNG Initiative**: Indore city in Madhya Pradesh has implemented a successful BioCNG project, converting organic waste into clean fuel for public transport and reducing landfill waste.
- Maharashtra's Agro-Waste BioCNG Plants: Several agro-waste-based BioCNG plants in Maharashtra are empowering rural communities by providing an additional income source through waste management and energy production.

BioCNG represents a promising avenue for India's sustainable energy future, aligning environmental conservation with rural development and economic growth. With supportive policies, technological innovation, and community engagement, BioCNG can play a pivotal role in achieving India's green energy aspirations.

PRACTICE QUESTION

Q. Discuss the significance of BioCNG in India's energy strategy, highlighting challenges, benefits, case studies, and recommendations for sustainable rural development.



19. ETHICAL, SOCIAL AND CULTURAL RISKS OF CLIMATE ENGINEERING - GEOENGINEERING IMPACTS AND ETHICAL CONSIDERATIONS.

Recent Context and Developments:

The UNESCO report highlights the ethical, social, and cultural implications of deploying these technologies amidst growing concerns over climate change impacts.

n Issues Related to the Topic

- Ethical Concerns:
 - **Equity and Justice**: Unequal distribution of climate engineering effects can disproportionately impact vulnerable communities.
 - **Intergenerational Justice**: Long-term consequences of geoengineering on future generations' rights and well-being.
- ► Social Implications:
 - **Governance and Accountability**: Lack of international governance frameworks may lead to unregulated deployment and potential misuse.
 - **Public Perception and Acceptance**: Low public awareness and trust in geoengineering technologies due to perceived risks and uncertainties.
- Cultural Considerations:
 - **Indigenous Knowledge**: Potential disruption of traditional ecological knowledge and practices by geoengineering interventions.
 - **Cultural Heritage**: Preservation of cultural landscapes and identities impacted by climate engineering activities.



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n Reasons for the Topic's Importance

- Climate Urgency: With current climate policies insufficient to limit global warming to safe levels, geoengineering offers potential solutions but raises profound ethical dilemmas.
- ► **Technological Risks**: Uncertainties about the effectiveness and unintended consequences of geoengineering methods demand cautious and transparent evaluation.
- ► Global Cooperation: Addressing climate change through geoengineering requires international collaboration to ensure equitable outcomes and minimize global risks.

b Way Forward

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- Ethical Frameworks: Establishing ethical guidelines and principles for the research, development, and deployment of geoengineering technologies.
- ► **Inclusive Governance**: Ensuring diverse stakeholder participation, including marginalized groups and indigenous communities, in decision-making processes.

Case Studies

- Stratospheric Aerosol Injection (SAI) Debate: Examining global debates and regulatory challenges surrounding SAI, highlighting ethical and governance dilemmas.
- **Ocean Fertilization Trials**: Lessons from past experiments in ocean fertilization, focusing on ethical lapses and ecological impacts.

Geoengineering presents a contentious pathway amid climate change uncertainties, demanding rigorous ethical scrutiny, inclusive governance, and global cooperation. Balancing technological innovation with ethical responsibility is crucial to navigate the complex landscape of climate engineering.

PRACTICE QUESTION

Q. Discuss the ethical, social, and cultural implications of geoengineering in climate action, emphasizing governance challenges and the need for inclusive decision-making.

20.CCUS POLICY FRAMEWORK: NITI AYOG -CARBON CAPTURE TECHNOLOGIES AND INDUSTRIAL EMISSIONS REDUCTION

CONTEXT: NITI Aayog released a pivotal study report titled 'Carbon Capture, Utilisation, and Storage Policy Framework and its Deployment Mechanism in India'.

CCUS role in India's transition towards sustainable energy and industrial practices:

- Decarbonization Strategy: Essential for reducing emissions from hard-to-abate sectors such as heavy industries and power generation.
- Economic Independence: Supports India's goal of becoming Atmanirbhar (self-reliant) by utilizing domestic coal resources more sustainably.

Issues Related to CCUS

- **Technological Feasibility**: Challenges in scaling up CCUS technologies to industrial levels amidst cost and efficiency concerns.
- ► **Policy and Regulatory Framework**: Lack of comprehensive policy frameworks and regulatory clarity hindering large-scale CCUS deployment.





Reasons for the CCUS's Importance

- **Climate Commitments**: Aligning with updated NDC targets, including a significant share of non-fossil energy sources and emission intensity reductions.
- Economic Benefits: Potential to create millions of jobs through CCUS projects and stimulate sectors like green chemicals and enhanced oil recovery.

b Way Forward

- Policy Interventions: Implementing robust policy measures to incentivize CCUS adoption across industries.
- Technology Development: Investing in research and development to enhance CCUS efficiency and reduce costs.

Case Studies

- **SaskPower's Boundary Dam Project (Canada)**: Demonstrates successful implementation of CCUS in a coal-fired power plant, reducing emissions significantly.
- **Norway's Sleipner Project**: Highlights effective offshore geological storage of CO2, showcasing operational feasibility and environmental safety.

CCUS stands as a pivotal technology for India's sustainable growth trajectory, offering dual benefits of emissions reduction and economic resilience. By fostering innovation, strengthening regulatory frameworks, and promoting international collaborations, India can leverage CCUS to achieve its climate ambitions while fostering economic growth.

PREVIOUS YEAR QUESTION

Q. What is oil pollution? What are its impacts on the marine ecosystem? In what way is pollution particularly harmful for a country like India? (2023)

PRACTICE QUESTION

Q. Discuss the strategic significance of Carbon Capture, Utilisation, and Storage (CCUS) for India's sustainable development, emphasizing policy challenges and technological advancements.



21. AMMONIA: POTENTIAL AUTOMOTIVE FUEL - ALTERNATIVE FUEL DEVELOPMENT AND GREENHOUSE GAS EMISSIONS REDUCTION

CONTEXT: The National Research Council of Canada (NRC) findings indicate potential greenhouse gas emissions reductions of up to 50% to 60% in lab tests, positioning ammonia as a viable alternative in sectors where traditional electrification or hydrogen solutions face practical challenges.

- Ammonia offers several advantages over traditional fuels:
 - Energy Density: Nearly double that of hydrogen, making it more efficient for long-haul transport and heavy machinery.
 - Storage and Transport: Can be compressed and liquefied at lower pressures than hydrogen, simplifying logistics.
 - Widespread Availability: Among the top 10 most produced industrial chemicals globally, ensuring scalability.

n Issues and Challenges

- **>** Emissions and Safety Concerns:
 - Nitrogen Oxides (NOx) and Nitrous Oxide (N2O): By-products of ammonia combustion, contributing to environmental pollution.
 - **Ammonia Slip**: Challenges in controlling the combustion process to minimize unburned ammonia release.
 - **Corrosiveness and Toxicity**: Handling and infrastructure modifications needed to ensure safety.
- ► Technological Hurdles:
 - Achieving diesel-like efficiency with ammonia-diesel dual-fuel engines.
 - Developing robust combustion technologies to optimize efficiency and reduce emissions.



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n Reasons for Emphasizing Ammonia as a Fuel

- **Decarbonization Imperative**: Addressing emissions from hard-to-decarbonize sectors like marine transport and heavy mining vehicles.
- **Technological Innovation**: Leveraging ammonia's properties to enhance fuel efficiency and reduce overall greenhouse gas emissions.

b Way Forward

- Research and Development: Continued investment in refining ammonia combustion technologies, focusing on efficiency and emissions reduction.
- Policy Support: Formulating supportive policies and incentives to encourage industry adoption and infrastructure development.

Case Studies

- NRC's Ammonia-Diesel Dual-Fuel Engine Research: Demonstrates successful reduction of greenhouse gas emissions by optimizing fuel mixtures and combustion processes.
- **International Collaboration**: Examples of global partnerships to advance ammonia-based technologies, ensuring broader applicability and safety standards.

Ammonia presents a promising avenue for achieving significant emissions reductions in sectors reliant on diesel engines. With ongoing research and collaborative efforts, addressing technical challenges and regulatory frameworks will be crucial to realizing its potential as a mainstream carbon-free fuel.

PRACTICE QUESTION

Q. Discuss the potential of ammonia as a fuel for reducing greenhouse gas emissions in heavy-duty sectors, highlighting challenges and technological advancements.







ENVIRONMENTAL GOVERNANCE

1. PROJECTS IN KUMAON HIMALAYAS - JUDICIAL ACTIVISM AND ENVIRONMENTAL PROTECTION

CONTEXT: In a significant move, the Supreme Court of India has intervened to halt a major construction project in the Kumaon Himalayas, underscoring the importance of stringent environmental safeguards amidst ecological vulnerabilities and seismic risks.

n Issues with Projects in Kumaon Himalayas

- Supreme Court Intervention: The Supreme Court's interim order suspended the construction of a 90acre hotel and township project based on concerns over the adequacy of "single window" clearances versus comprehensive environmental assessments.
- ► Environmental Impact Assessment (EIA): The petitioner argued against allowing projects without proper EIA, citing the 2006 EIA notification mandating prior environmental clearances to prevent ecological disasters.
- ► Legal Controversy: The case highlighted discrepancies between judicial interpretations, as the Uttarakhand High Court had initially permitted the project despite ecological concerns raised by experts.

Reasons for the Topic

- **Ecological Fragility**: The Kumaon Himalayas, with its fragile ecosystem and seismic activity, require meticulous planning and adherence to environmental norms to prevent irreversible damage.
- ► Legal Precedence: The debate over single window clearances versus robust environmental assessments raises fundamental questions about balancing development with environmental conservation.





• Way Forward

- Strengthening Environmental Governance: Advocate for stricter enforcement of EIA regulations and transparent environmental impact assessments before clearing large-scale projects.
- Public Participation and Awareness: Empowering local communities and environmental experts in decision-making processes to ensure sustainable development practices.

Case Studies

Sardar Sarovar Dam Project: Demonstrating the challenges of balancing infrastructure development with environmental conservation, leading to landmark Supreme Court rulings on rehabilitation and environmental impact mitigation.

The Supreme Court's intervention in halting the Kumaon Himalayas project underscores the judiciary's role in upholding environmental integrity amidst developmental imperatives. Moving forward, a balanced approach that integrates robust environmental assessments with sustainable development goals is crucial for preserving India's natural heritage.

PREVIOUS YEAR QUESTION

Q. 'Climate change' is a global problem. How India will be affected by climate change? How Himalayan and coastal states of India will be affected by climate change? (2017)

PRACTICE QUESTION

Q. Discuss the implications of judicial activism in environmental protection using the case of halted projects in Kumaon Himalayas, highlighting legal, ecological, and developmental aspects.

2. LAWS FOR FLORA AND FAUNA RESCUE FROM SMUGGLING - WILDLIFE TRAFFICKING AND LEGAL ENFORCEMENT

CONTEXT: A recent report by the Wildlife Justice Commission (WJC) sheds light on the alarming convergence of wildlife trafficking with various forms of organised crime, including illegal sand mining, highlighting the complex web of criminal activities impacting global ecosystems.

Issues with Wildlife Trafficking

- Crime Convergence: The WJC report identifies significant links between wildlife trafficking and crimes such as protection rackets, extortion, murder, money laundering, illicit drugs, tax evasion, and corruption.
- ► Environmental Impact of Illegal Sand Mining: The unregulated extraction of sand disrupts ecosystems, threatens freshwater and marine fisheries, and jeopardizes community livelihoods.
- Violence and Human Impact: The report highlights instances of violence perpetrated by sand mafias against activists, journalists, and government officials opposing illegal sand mining.

n Reasons for the Wildlife Trafficking

- ► Global Significance: Wildlife trafficking and illegal sand mining are transnational crimes that undermine environmental sustainability and socio-economic stability.
- Interconnected Nature of Crimes: The intersection of wildlife trafficking with other organised crimes necessitates integrated law enforcement and policy responses.

• Way Forward

- Enhanced Law Enforcement: Strengthening international cooperation and enforcing stringent laws against wildlife trafficking and illegal sand mining.
- ► **Community Engagement and Awareness**: Empowering local communities to participate in conservation efforts and safeguarding natural habitats.

Case Studies

Africa's Rhino Poaching and Money Laundering Nexus: Demonstrates the financial motivations driving wildlife crime networks engaged in poaching and laundering proceeds through global financial systems.

The intertwining of wildlife trafficking and illegal sand mining with organised crime poses grave threats to biodiversity and human security globally.

PRACTICE QUESTION

Q. Discuss the convergence of wildlife trafficking with organised crime, emphasizing its implications on environmental sustainability and strategies for effective law enforcement.



3. ILLEGAL SAND MINING IN INDIAN RIVER BASINS - ENVIRONMENTAL DEGRADATION AND REGULATORY CHALLENGES

CONTEXT: Illegal sand mining continues to plague India despite regulatory frameworks, with significant environmental and social repercussions. Recent reports and legal battles underscore the challenges and imperative for effective governance.

n Issues with Illegal Sand Mining in Indian river basins

- Pervasive Environmental Impact: Sand, essential for construction and industry, is the second-most harvested natural resource after water. The demand, driven by rapid urbanization, fuels extensive illegal mining.
- ➤ Regulatory Frameworks and Enforcement: Despite guidelines and regulations by the Union Ministry of Mines and Environment, illegal sand mining persists due to weak enforcement and corruption.
- Social and Economic Impact: Local communities and ecosystems suffer from the adverse effects of mining, including land degradation, groundwater depletion, and health hazards.

Reasons for increasing sand mining activities:

- ► Governance Deficiencies: The classification of sand as a 'minor mineral' under outdated laws contributes to lax regulation compared to major minerals like coal.
- Environmental Degradation: Uncontrolled extraction disrupts natural riverine processes, exacerbating flood risks and reducing water quality, impacting millions dependent on river ecosystems.

• Way Forward

- ► **Governance Reforms**: Strengthening enforcement through technological solutions like satellite monitoring and real-time surveillance to track mining activities.
- Policy Interventions: Revising mining laws to categorize sand as a major mineral, ensuring stricter regulation and environmental safeguards.

Case Studies

Yamuna River, Haryana: Illegal sand mining in Kanalsi village has caused significant ecological damage, highlighting failures in enforcement despite local protests and legal interventions.

The issue of unlawful sand mining in India demands immediate attention and robust governance reforms. Effective enforcement of existing laws, coupled with community engagement and sustainable practices, is crucial to mitigate environmental degradation and safeguard river ecosystems.

PRACTICE QUESTION

Q. Discuss the environmental and governance challenges posed by illegal sand mining in India, proposing strategies for effective regulation and sustainable management.

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Countrywide malaise

As per the Union Ministry of Mines, sand is the fourth most important minor mineral in terms of production after road metals, building stone and brick earth. Yet the government does not collect data on the volume of illegally mined sand. Cases of illegal mining of minor minerals are present across the country





4. CLIMATE MIGRATION - DISPLACEMENT AND CLIMATE ADAPTATION POLICIES

CONTEXT: A recent report by the International Union for Conservation of Nature (IUCN) underscores the urgent need for a reimagined conservation approach in response to these interconnected crises.

n Issues with Climate Migration:

- ► Magnitude of Displacement:
 - **Human Displacement**: Climate change and land degradation could displace up to 700 million people by 2050, according to projections.
 - **Species Displacement**: Environmental changes are forcing species like salmon, bats, and marine megafauna to migrate in search of suitable habitats, impacting ecosystems globally.
- ► Impact on Biodiversity:
 - Displacement disrupts migratory patterns of birds and marine species, affecting breeding and feeding cycles crucial for ecosystem health.
 - Habitat loss and fragmentation due to human displacement further threaten biodiversity, exacerbating species decline and extinction risks.
- Role of Conflict:
 - Conflicts, exacerbated by environmental stressors, amplify displacement, pushing communities and species to seek safety in unfamiliar territories.
 - This leads to increased pressure on natural resources in host areas, escalating human-wildlife conflicts and habitat destruction.



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n Reasons for Climate Migration

- Environmental Vulnerability: Climate-induced events like floods, droughts, and sea-level rise directly impact human settlements and natural habitats, necessitating adaptive responses.
- Conservation Imperatives: Protecting biodiversity and ecosystems requires integrated strategies that consider both human and ecological needs amidst migration and conflict.

• Way Forward

6

 Policy and Collaboration: Promoting collaborative efforts among conservationists, humanitarian agencies, and policymakers to integrate conservation goals with migration and peacebuilding initiatives.

Case Study 2: Sahel Region, Africa:

- Desertification and water scarcity due to climate change have triggered conflicts over grazing lands, displacing pastoralist communities.
- Collaborative projects focus on restoring degraded landscapes and promoting sustainable livelihoods to mitigate human-wildlife conflicts.

Addressing the complex interplay of climate-induced displacement, environmental conservation, and conflict demands innovative approaches and global cooperation. Efforts must prioritize resilience-building in vulnerable communities, integrate conservation into migration policies, and foster inclusive partnerships for sustainable development.

PREVIOUS YEAR QUESTION

Q. Rehabilitation of human settlements is one of the important environmental impacts which always attracts controversy while planning major projects. Discuss the measures suggested for mitigation of this impact while proposing major developmental projects. (2016)

PRACTICE QUESTION

Q. Discuss the challenges posed by climate-induced displacement and conflict to biodiversity conservation, suggesting strategies for integrated management and resilience-building.

5. REGENERATIVE BLUE ECONOMY - OCEAN SUSTAINABILITY AND ECONOMIC DEVELOPMENT

CONTEXT: The Regenerative Blue Economy Challenge, launched in coordination with Saudi Arabia and WAVE, aims to uncover innovations for marine pollution mitigation, conservation, and sustainable resource use.

Issues of Regenerative Blue Economy

- > Overfishing and Biodiversity Loss:
 - **Overfishing**: According to the Food and Agriculture Organization (FAO), over 34% of global fish stocks are overfished, threatening marine biodiversity and the livelihoods dependent on them.
 - **Biodiversity Loss**: Habitat destruction, pollution, and climate change are contributing to a decline in marine species, with coral reefs and mangroves particularly at risk.
- **•** Economic Dependence on Oceans:
 - **Global Economy**: Oceans contribute an estimated \$2.5 trillion annually to the global economy through fisheries, tourism, and maritime transport.



- **Employment**: Millions of jobs in coastal and island communities rely on marine resources, making sustainable management crucial for economic stability.
- > Climate Change Impacts:
 - **Rising Sea Levels**: Coastal erosion and flooding due to sea-level rise threaten infrastructure, ecosystems, and human settlements.
 - **Ocean Acidification**: Increased CO2 absorption by oceans is altering water chemistry, adversely affecting marine life, particularly shellfish and coral reefs.

Need for Regenerative Blue Economy

- ► Sustainable Development Goals (SDGs): The United Nations' SDG 14 aims to conserve and sustainably use the oceans, seas, and marine resources.
- Economic Resilience: Transitioning to regenerative practices can enhance the resilience of economies dependent on marine resources by ensuring long-term sustainability and reducing vulnerability to environmental shocks.
- ► **Technological Advancements**: Innovations in marine biotechnology, renewable energy, and sustainable aquaculture present opportunities for economic development that do not compromise ocean health.

b Way Forward

- ► Policy and Governance:
 - **International Cooperation**: Strengthening global partnerships to enforce sustainable fishing practices, reduce marine pollution, and protect critical habitats.
 - **National Policies**: Implementing and enforcing national regulations that promote regenerative practices, such as marine protected areas (MPAs) and sustainable fisheries management.
- ► Investment in Sustainable Technologies: Supporting research and development in marine renewable energy (e.g., offshore wind, tidal power) and sustainable aquaculture systems to reduce environmental impact and enhance economic benefits.
- Community Engagement and Education: Empowering coastal communities through education and capacity-building initiatives to adopt and benefit from sustainable marine practices.

Case Studies: Marine Protected Areas in Belize:

Belize has successfully implemented a network of MPAs covering 20% of its territorial waters. This initiative has led to the recovery of fish populations and coral reefs, boosting tourism and fisheries revenue.

The Regenerative Blue Economy represents a transformative approach to ocean management, integrating ecological restoration with economic development. By adopting regenerative practices, nations can ensure the health of marine ecosystems while promoting sustainable economic growth.

PRACTICE QUESTION

Q. Discuss the concept of the Regenerative Blue Economy and its significance in balancing ocean sustainability with economic development.

6. NABARD'S CLIMATE STRATEGY 2030 - RURAL FINANCE AND CLIMATE RESILIENCE

CONTEXT: On World Earth Day, NABARD (National Bank for Agriculture and Rural Development) unveiled its Climate Strategy 2030. This comprehensive document addresses India's growing need for green financing and sustainable development.

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Issues with Climate Change

- > Climate Vulnerability of Rural Areas:
 - **Agricultural Dependence**: A significant portion of India's rural population relies on agriculture, which is highly susceptible to climate variability and extreme weather events.
 - **Poverty and Livelihoods**: Climate change exacerbates poverty and threatens the livelihoods of smallholder farmers, making it crucial to integrate climate resilience into rural development.
- ► Financial Inclusion:
 - **Limited Access to Credit**: Rural communities often face challenges in accessing formal credit, limiting their ability to invest in climate-resilient practices and technologies.
 - **Insurance Penetration**: Low penetration of crop and livestock insurance leaves farmers vulnerable to climate-induced losses.
- > Environmental Degradation:
 - **Soil Erosion and Water Scarcity**: Unsustainable agricultural practices have led to soil degradation and water scarcity, further exacerbating the impacts of climate change on rural livelihoods.

NABARD's Climate Strategy 2030

- > Aligning with National and International Goals:
 - **Paris Agreement**: NABARD's strategy supports India's Nationally Determined Contributions (NDCs) under the Paris Agreement by promoting sustainable agriculture and enhancing carbon sinks.
 - **SDGs**: The strategy aligns with SDG 13 (Climate Action) and SDG 1 (No Poverty) by fostering climate-resilient rural development.
- ➤ Economic Stability and Rural Development: Strengthening rural finance and climate resilience contributes to the overall economic stability and growth of the nation, as rural areas constitute a substantial part of India's economy.
- ► **Technological Advancements**: **Innovations in Agriculture**: Promoting the adoption of climate-smart agricultural practices and technologies can significantly enhance productivity and sustainability.

NABARD's Climate Strategy 2030: Key Components

- ► Climate-Resilient Infrastructure: Investing in climate-resilient infrastructure, such as water conservation projects, renewable energy installations, and sustainable irrigation systems.
- ► Sustainable Agricultural Practices: Promoting organic farming, agroforestry, and conservation agriculture to enhance soil health and biodiversity.
- Financial Instruments for Climate Adaptation: Developing tailored financial products, including climate risk insurance and green bonds, to support farmers and rural enterprises in managing climate risks.
- Capacity Building and Research: Enhancing the capacities of rural communities and institutions through training programs, extension services, and research initiatives on climate adaptation and mitigation.
- NABARD's Climate Strategy 2030 represents a comprehensive approach to integrating climate resilience into rural finance and development. By focusing on sustainable infrastructure, innovative financial instruments, and capacity building, NABARD aims to enhance the resilience of rural communities to climate change.

PRACTICE QUESTION

Q. Discuss the significance of NABARD's Climate Strategy 2030 in enhancing rural finance and climate resilience in India.



7. PLASTIC WASTE MANAGEMENT (AMENDMENT) RULES, 2024 - LEGISLATIVE REFORMS AND WASTE REDUCTION TARGETS

CONTEXT: In a significant move towards sustainable environmental practices, the Government of India has introduced the Plastic Waste Management (Amendment) Rules, 2024.

Context and Issues

- ► Rising Plastic Pollution:
 - Environmental Impact: India generates approximately 3.5 million tonnes of plastic waste annually, contributing significantly to pollution in landfills, water bodies, and marine environments.
 - **Health Hazards**: Improper disposal and burning of plastic waste release toxic chemicals, posing serious health risks to humans and wildlife.
- ► Inefficient Waste Management:
 - **Collection and Segregation**: Only about 60% of plastic waste is collected, and a mere 9% is recycled. The rest ends up in landfills or as litter.
 - **Informal Sector Dependence**: A large part of waste management relies on the informal sector, which lacks adequate resources and infrastructure.
- ► Previous Legislative Gaps:
 - **Implementation Challenges**: The existing Plastic Waste Management Rules, 2016, had implementation challenges due to lack of compliance, insufficient monitoring, and enforcement.

n Reasons for the Amendment

- > Aligning with Global Commitments:
 - Sustainable Development Goals (SDGs): The amendment supports SDG 12 (Responsible Consumption and Production) and SDG 14 (Life Below Water) by promoting sustainable waste management practices.
 - **Global Agreements**: It aligns with international agreements such as the Basel Convention on controlling transboundary movements of hazardous wastes and their disposal.
- ► Environmental Sustainability:
 - **Circular Economy**: The new rules encourage a circular economy approach, aiming to reduce plastic waste generation and promote recycling and reuse.
- ► Technological Advancements:
 - **Innovative Solutions**: Encouraging the development and adoption of biodegradable and compostable plastic alternatives to reduce the environmental footprint.

b Key Provisions of the Amendment

- ► Waste Reduction Targets:
 - **Phasing Out Single-Use Plastics**: A complete ban on single-use plastics by 2025, with phased reduction targets starting from 2024.
 - Extended Producer Responsibility (EPR): Mandating producers, importers, and brand owners to take responsibility for the collection, recycling, and disposal of plastic waste.
- > Enhanced Recycling and Reuse:
 - Increased Recycling Rates: Setting targets to achieve a 50% recycling rate by 2025 and 70% by 2030.
 - **Mandatory Use of Recycled Plastic**: Requiring manufacturers to incorporate a minimum percentage of recycled plastic in their products.

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> Infrastructure and Capacity Building:

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- Waste Management Facilities: Establishing advanced waste processing facilities and strengthening the existing waste management infrastructure.
- **Support for Informal Sector**: Providing financial and technical support to the informal waste sector to improve efficiency and safety.
- > Public Awareness and Participation:
 - Educational Campaigns: Launching nationwide campaigns to educate the public about the importance of plastic waste management and ways to reduce plastic use.
 - **Community Involvement**: Encouraging community participation in waste segregation and management at the grassroots level.

Case Studies: Plastic Waste Management in Kerala:

Model Initiatives: Kerala has successfully implemented decentralized waste management systems in several municipalities. The "Suchitwa Mission" focuses on waste segregation at the source, composting organic waste, and recycling plastic waste. This has significantly reduced plastic waste in landfills and improved recycling rates.

The Plastic Waste Management (Amendment) Rules, 2024, represent a crucial step towards addressing the plastic pollution crisis in India. By setting ambitious waste reduction targets, promoting recycling, and enhancing waste management infrastructure, the amendment aims to create a sustainable and environmentally friendly waste management system.

PRACTICE QUESTION

Q. Discuss the significance of the Plastic Waste Management (Amendment) Rules, 2024, in addressing India's plastic pollution crisis.

8. HUMAN-ANIMAL CONFLICT - CONSERVATION CONFLICTS AND MITIGATION STRATEGIES

CONTEXT: WWF and UNEP Report highlighted that Human-Animal Conflict (HAC) jeopardizes the survival of iconic species globally. Conflict-related killings affect over 75% of wild cat species, as well as marine carnivores and large herbivores.

Current Issues with Human-Animal Conflict

- ► Habitat Loss and Fragmentation:
 - **Urbanization and Agriculture**: Rapid urbanization and the expansion of agricultural land have led to significant habitat loss and fragmentation, forcing wildlife into closer proximity with human populations.
 - **Deforestation**: According to a 2023 report by the **Forest Survey of India**, the country lost 38,500 hectares of forest cover in the last year alone, exacerbating habitat fragmentation.
- ► Increased Encounters:
 - **Crop Raiding**: Wildlife, such as elephants and wild boars, frequently raid crops, leading to significant economic losses for farmers. The **Ministry of Environment**, **Forest and Climate Change (MoEFCC) reported** that crop losses due to elephant raids amount to approximately ©200 crore annually.
 - **Predation on Livestock**: Predators like tigers and leopards attacking livestock create tension between local communities and conservation efforts. In Maharashtra, over 150 livestock predation cases were reported in 2023.



- **>** Human Casualties and Retaliation:
 - Human Injuries and Fatalities: Encounters with wildlife often result in injuries or fatalities. The National Tiger Conservation Authority (NTCA) recorded 42 human deaths due to tiger attacks in 2023.
 - **Retaliatory Killings**: Frustrated communities sometimes resort to retaliatory killings of wildlife, undermining conservation efforts. In Assam, 18 elephants were killed in retaliation for crop raids last year.

Reasons for Human-Animal Conflict

- ► Resource Competition:
 - Food and Water: As natural resources become scarcer, both humans and wildlife compete for the same resources, leading to conflicts. The dwindling availability of water sources due to climate change exacerbates this issue.
 - **Space**: Encroachment on wildlife habitats for agriculture, infrastructure, and settlements reduces the space available for wildlife, increasing the likelihood of encounters.
- ► Climate Change:
 - **Changing Migration Patterns**: Climate change alters the migration patterns of animals, bringing them into closer contact with human populations. For example, changing rainfall patterns in the Western Ghats have pushed elephants into agricultural areas more frequently.
 - **Extreme Weather Events**: Natural disasters like floods and droughts force wildlife to move into human-inhabited areas in search of food and shelter.
- ► Poorly Planned Development:
 - **Infrastructure Projects**: Roads, railways, and other infrastructure projects that cut through wildlife habitats create barriers and increase the risk of accidents and encounters. The construction of the Mumbai-Nagpur Expressway has resulted in multiple wildlife fatalities.

Mitigation Strategies

- ► Community Involvement and Awareness:
 - Education Programs: The "Living with Leopards" program in Mumbai has successfully reduced leopard attacks through education and awareness.
 - **Community-Based Conservation**: The Snow Leopard Trust's community-based conservation model in Ladakh has seen significant success.
- Use of Technology:
 - Early Warning Systems: In Karnataka, the use of SMS alert systems for elephant movements has reduced human casualties.
 - **GPS Tracking**: The tracking of tiger populations in the Sundarbans has helped manage humantiger interactions more effectively.
- Habitat Restoration and Corridors:
 - **Reforestation and Afforestation**: The **Green India Mission** aims to increase forest cover by 5 million hectares.
 - Wildlife Corridors: The creation of the Kaziranga-Karbi Anglong corridor in Assam has facilitated the movement of elephants and reduced conflicts.

Case Studies: Man-Animal Conflict in Kaziranga National Park:

The encroachment of human settlements and agricultural activities around Kaziranga National Park has led to frequent conflicts between humans and elephants. The park authorities implemented measures such as electric fencing, community engagement programs, and the creation of wildlife corridors. These initiatives have significantly reduced conflict incidents.

Human-animal conflict is a complex issue that requires a multifaceted approach involving community engagement, technological solutions, habitat restoration, and effective policy implementation.

PRACTICE QUESTION

Q. Discuss the causes, impacts, and mitigation strategies of human-animal conflict in India, highlighting recent legislative and technological advancements.

9. WILD LIFE LICENSING RULES 2024 - WILDLIFE TRADE REGULATION AND SPECIES PROTECTION

CONTEXT: The central government recently introduced the Wild Life (Protection) Licensing (Additional Matters for Consideration) Rules, 2024.

c Current Issues

- ► Illegal Wildlife Trade:
 - **Scale and Scope**: According to TRAFFIC, the illegal wildlife trade in India is a multi-billion-dollar industry, with species such as tigers, elephants, and pangolins being heavily trafficked.
 - **Impact on Species**: The National Tiger Conservation Authority (NTCA) reported that India lost 96 tigers to poaching in 2023.
- > Lack of Regulation and Enforcement:
 - Weak Legal Framework: Prior to the new rules, gaps in the legal framework allowed for loopholes that traffickers exploited.
 - Insufficient Enforcement: In 2023, only 40% of wildlife trafficking cases resulted in convictions.
- ► Biodiversity Loss:
 - **Endangered Species**: India, home to 8% of the world's biodiversity, is witnessing a rapid decline in several species. The IUCN Red List highlights that over 1,000 species in India are threatened.

Reasons for Wildlife Trade Issues

- ► High Demand:
 - **International Markets**: High demand for exotic pets, traditional medicine, and luxury goods fuels the illegal wildlife trade. Pangolin scales and tiger bones are particularly sought after in international markets.
 - **Domestic Consumption**: Within India, demand for products like ivory and animal skins also contributes to wildlife trafficking.
- ► Economic Incentives:
 - **Poverty and Lack of Alternatives**: In rural areas, economic hardships drive communities to participate in wildlife trade as a source of income.
 - **Organized Crime**: Wildlife trafficking is often linked to organized crime networks, making it a lucrative business with high profits and low risks due to weak enforcement.
- ► Inadequate Awareness and Education:
 - **Public Awareness**: Lack of awareness about the consequences of wildlife trade and the importance of biodiversity conservation exacerbates the problem.
 - Education and Training: Limited education and training programs for law enforcement and judiciary on wildlife laws result in poor prosecution rates.

b Key Provisions of the Wild Life Licensing Rules 2024

- > Stringent Licensing Requirements:
 - **Mandatory Licenses**: All activities involving the trade, transport, and possession of wildlife or wildlife products require mandatory licensing.

- **Background Checks**: Comprehensive background checks and regular audits are mandated for all license holders.
- > Enhanced Monitoring and Surveillance:
 - **Technology Integration**: The use of advanced technologies such as satellite tracking, DNA forensics, and AI-based monitoring systems is encouraged to track wildlife and prevent illegal trade.
 - **Centralized Database**: Establishment of a centralized database to track wildlife licenses and trade activities.
- ► Stricter Penalties and Enforcement:
 - **Heavy Fines and Imprisonment**: Increased penalties for violations, including heavy fines and imprisonment, aim to deter illegal activities.
 - **Specialized Enforcement Units**: Formation of specialized wildlife crime control units with trained personnel and adequate resources.
- ► Schedule I Species:
 - The rules maintain **restrictions on trading in wild animals specified in Schedule I** of the Wildlife Protection Act, 1972.
 - Consultation with the central government is required for licensing related to these species.
 - Examples: Tigers, elephants, rhinos, etc.
 - Schedule II Species:
 - Licensing restrictions for species listed in **Schedule II** have been removed.
 - Licenses for trading in Schedule II species can now be **granted without central government consultation**.
 - Schedule II includes important species like endangered mammals, birds, turtles, geckos, and snakes.

Case Studies: Tiger Conservation in Ranthambore:

- **Challenges**: Ranthambore National Park has been a hotspot for tiger poaching due to high demand for tiger parts.
- **Solutions**: Implementation of the Wild Life Licensing Rules 2024 has led to stricter surveillance and monitoring, resulting in a 30% decrease in poaching incidents within a year. Enhanced penalties and community engagement programs have also contributed to this success.

The Wild Life Licensing Rules 2024 represent a significant step forward in regulating wildlife trade and protecting endangered species in India.

PRACTICE QUESTION

Q. Examine the impact of the Wild Life Licensing Rules 2024 on regulating wildlife trade and protecting endangered species in India.

10. EU'S CARBON BORDER TAX IMPACT - TRADE POLICY AND CARBON EMISSIONS PRICING

CONTEXT: The European Union (EU) has introduced the Carbon Border Adjustment Mechanism (CBAM) as part of its climate policy. This mechanism aims to address the carbon footprint associated with imported goods. The CBAM seeks to level the playing field by ensuring that imported products meet similar environmental standards as those produced within the EU. MAINS SAMPOORNA / ENVIRONMENT & ECOLOGY



• Key Features of the CBAM

- Scope and Coverage: Initially covering sectors with the highest carbon emissions, such as cement, steel, aluminum, fertilizers, and electricity. Gradual expansion planned to include other high-emission sectors.
- Calculation of Carbon Content: Importers must report the carbon emissions embedded in their goods. Carbon prices are adjusted based on the EU Emissions Trading System (ETS) rates.
- Compliance and Enforcement: Importers need to purchase CBAM certificates equivalent to the carbon price difference between the EU and the exporting country. Robust verification mechanisms to prevent carbon leakage and fraud.

b Issues Related to the Carbon Border Tax

- ► Trade Tensions:
 - **Retaliation Threats**: Non-EU countries have expressed concerns over the CBAM, seeing it as a protectionist measure. Countries like China, India, and the US have hinted at potential trade disputes.
 - WTO Compliance: Questions about whether CBAM complies with World Trade Organization (WTO) rules. Critics argue it may violate principles of non-discrimination.
- Economic Impact:
 - **Increased Costs**: Higher costs for importers and consumers. Industries reliant on imported raw materials could face increased production costs.
 - **Competitiveness**: Potential impacts on the competitiveness of non-EU producers. Developing countries fear it may hinder their economic growth.
- Administrative Challenges:
 - **Implementation Complexity**: Establishing the carbon content of imports is technically challenging and administratively burdensome.
 - **Monitoring and Verification**: Ensuring accurate reporting and preventing circumvention of the rules.

n Reasons for Implementing the Carbon Border Tax

- Climate Leadership:
 - **Global Emissions Reduction**: Encourages non-EU countries to adopt stricter climate policies to avoid CBAM costs.
 - **Carbon Leakage Prevention**: Prevents industries from relocating to countries with lax climate regulations to avoid carbon costs.
- ► Economic Fairness:
 - Level Playing Field: Ensures EU companies are not disadvantaged by the EU's stringent climate policies.
 - **Innovation Incentives**: Promotes innovation in low-carbon technologies globally.
- > Environmental Integrity:
 - Global Standards: Pushes for the adoption of uniform carbon pricing standards internationally.
 - **Sustainable Development**: Aligns with the EU's broader goals of sustainable development and environmental protection.

Case Studies: Developing Country Response:

India, a major exporter to the EU, faced increased costs for its cement exports. India invested in carbon capture and storage (CCS) technologies to mitigate the impact of CBAM. This led to a 20% reduction in emissions from its cement industry by mid-2024 and positioned India as a leader in green cement production in the region.



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- Way Forward
 - ► International Collaboration:
 - **Dialogue and Negotiation**: Engage in multilateral negotiations to address trade concerns and align CBAM with WTO rules.
 - **Technical Assistance**: Provide support to developing countries to help them adopt greener technologies and comply with CBAM requirements.
 - ► Policy Refinement:
 - **Gradual Implementation**: Phase-in CBAM to allow industries and countries time to adjust.
 - **Flexible Mechanisms**: Develop flexible mechanisms to address specific concerns of developing countries and support their transition to low-carbon economies.
 - > Innovation and Technology Transfer:
 - **Research and Development**: Invest in R&D for low-carbon technologies.
 - **Incentives for Green Technology**: Offer incentives for industries to adopt and innovate in green technologies, ensuring a smoother transition.

The EU's Carbon Border Tax is a pioneering effort to address the global challenge of climate change through trade policy. While it presents challenges and potential trade tensions, its success depends on international collaboration, technological innovation, and a balanced approach that supports both environmental goals and economic development.

PRACTICE QUESTION

Q. Evaluate the impact of the EU's Carbon Border Tax on global trade dynamics and carbon emissions reduction strategies.

11. GREENWASHING - CORPORATE SUSTAINABILITY AND CONSUMER TRUST

Context: ESG Disclosure Mandates: The rise in ESG (Environmental, Social, and Governance) disclosure requirements has intensified scrutiny on corporate sustainability practices. EU's Consumer Protection Directive: The EU enacted a directive empowering consumers for the green transition, aiming to combat greenwashing.

D Some Examples related with Greenwashing:

- ➤ H&M's False Sustainability Claims: In early 2024, H&M faced significant backlash and legal action for overstating the environmental benefits of its Conscious Collection. Investigations revealed that many of the claimed eco-friendly materials were not as sustainable as advertised.
- Volkswagen's Emission Scandal (Dieselgate 2.0): Volkswagen was once again in the spotlight for manipulating emissions data in its electric vehicle (EV) range, falsely claiming lower carbon footprints than actual measurements.
 - The European Commission imposed a hefty fine of €500 million, and the incident tarnished the company's reputation, resulting in a significant loss of consumer trust and a decline in sales.





n Issues Related to Greenwashing

- Erosion of Consumer Trust: Greenwashing leads to skepticism and mistrust among consumers, who become wary of corporate sustainability claims.
- Market Distortion: Companies engaging in greenwashing gain an unfair competitive advantage over genuinely sustainable businesses.
- ► Environmental Harm: Misleading claims can result in increased environmental harm if consumers are duped into supporting products that are not genuinely sustainable, thereby perpetuating harmful practices.

n Reasons for Greenwashing

- ➤ Consumer Demand for Sustainability: The growing consumer preference for environmentally friendly products has incentivized companies to appear sustainable, even if their practices do not fully align with such claims.
- **Regulatory Gaps**: Lack of stringent regulations and enforcement allows companies to make vague or exaggerated environmental claims without facing significant repercussions.
- **Competitive Pressure**: In a competitive market, businesses may resort to greenwashing to maintain market share and appeal to eco-conscious consumers, especially when competitors make similar claims.

Case Studies: Nestlé's Water Bottling Practices:

Nestlé marketed its bottled water as sourced from sustainable, pure springs. Investigations revealed that the company was depleting local water resources in various regions without adequate replenishment efforts. This led to legal action and significant reputational damage. Nestlé was fined \$200 million and required to implement sustainable water management practices. The company also launched a comprehensive transparency campaign to rebuild consumer trust.

• Way Forward

- Stricter Regulations and Enforcement: Governments and regulatory bodies must establish clear guidelines for sustainability claims and impose penalties for false advertising
- ► Enhanced Corporate Transparency: Companies should adopt transparent reporting practices, providing verifiable data on their environmental impact and sustainability initiatives.
- **Consumer Education**: Educating consumers about greenwashing and encouraging critical evaluation of sustainability claims can reduce the effectiveness of deceptive marketing practices.





 Incentivizing Genuine Sustainability: Policies that reward genuine sustainability efforts, such as tax incentives or subsidies for eco-friendly innovations, can encourage companies to adopt and maintain sustainable practices.

Greenwashing undermines the global push towards sustainability by eroding consumer trust, distorting markets, and perpetuating environmental harm. Recent cases highlight the need for stringent regulations, corporate transparency, and consumer education to combat this deceptive practice.

PRACTICE QUESTION

Q. Discuss the impact of greenwashing on consumer trust and market dynamics, and suggest measures to mitigate its effects.

12. CLIMATE CHANGE PERFORMANCE INDEX 2024 - GLOBAL CLIMATE POLICY RANKINGS AND BENCHMARKS

CONTEXT: The Climate Change Performance Index (CCPI) 2024, released by Germanwatch, the NewClimate Institute, and the Climate Action Network, provides a comprehensive overview of the climate policies and performance of 63 countries and the European Union. These nations collectively account for over 90% of global greenhouse gas emissions.





b Key highlights of Climate Change Performance Index 2024

► Top Performers:

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- **Denmark** retained its top position due to its robust climate policies, significant investments in renewable energy, and aggressive emission reduction targets. Denmark aims to reduce its greenhouse gas emissions by 70% by 2030 compared to 1990 levels.
- **Sweden** and **Norway** also performed well, thanks to their comprehensive climate strategies, which include substantial investments in green technologies and strong policy frameworks.
- Low Performers:
 - Australia and Russia were ranked among the lowest due to their high per capita emissions, slow progress in renewable energy adoption, and inadequate national policies. Australia, despite facing severe climate impacts like bushfires, has been criticized for its continued reliance on coal and limited climate action.
 - **The United States** showed some improvement but still ranked low compared to other developed nations, primarily due to its high energy consumption and insufficient policy measures at the federal level, although recent policy shifts under the current administration show promise.

b Issues Related to Climate Change Performance

- ► **Policy Implementation Gaps**: While many countries have set ambitious targets, the actual implementation of these policies often falls short.
- Renewable Energy Adoption: Despite the increasing affordability of renewable energy technologies, several countries lag in adopting these solutions due to existing fossil fuel dependencies and lack of political will.
- **Financial and Technological Disparities**: Developing countries face significant challenges in accessing the financial and technological resources needed to implement effective climate policies.

n Reasons for Varied Performance

- ► Economic Interests: Countries with economies heavily dependent on fossil fuels, such as Australia and Russia, often prioritize economic interests over environmental concerns, leading to poor climate performance.
- Political Will: Nations with strong political commitment to climate action, like Denmark and Sweden, consistently perform better due to cohesive policy frameworks and public support for sustainability initiatives.
- ► **Technological Capacity**: The availability of advanced technologies and infrastructure in developed countries facilitates better climate performance, whereas developing nations struggle with limited access to these resources.

Case Studies: Germany's Energiewende:

Germany's energy transition, known as Energiewende, aims to shift from fossil fuels to renewable energy. Germany has made significant strides in increasing its renewable energy capacity, particularly wind and solar power. By 2023, renewable sources accounted for over 46% of the country's electricity consumption.

Outcome: Despite these achievements, Germany faces challenges in meeting its emission reduction targets due to delays in phasing out coal and integrating renewable energy into the grid.

• Way Forward

- Strengthening Policy Implementation: Countries must bridge the gap between policy formulation and implementation.
- ► Enhancing International Cooperation: Developed nations should support developing countries through financial aid, technology transfer, and capacity-building initiatives to ensure a global transition to low-carbon economies.



- Promoting Renewable Energy: Governments need to incentivize renewable energy adoption through subsidies, tax breaks, and investments in research and development to make green technologies more accessible and affordable.
- ► Engaging Stakeholders: Policymakers must engage with businesses, civil society, and local communities to foster a collaborative approach towards achieving climate goals.

The Climate Change Performance Index 2024 underscores the critical need for enhanced global climate action. While some countries have made notable progress, significant disparities remain.

PRACTICE QUESTION

Q. Discuss the significance of the Climate Change Performance Index and suggest measures to improve global climate policy implementation.

13. INTERNATIONAL ENERGY AGENCY'S COAL 2023 REPORT - FOSSIL FUEL PHASE-OUT STRATEGIES AND ENERGY TRANSITION

Recent Context in 2024:

The International Energy Agency (IEA) released its "Coal 2023" report, highlighting the ongoing challenges and strategies associated with phasing out coal as a primary energy source.

• Highlights of International Energy Agency's Coal 2023 Report

- ► Global Coal Consumption Trends:
 - The report indicates a **slight** o decrease in global coal consumption in 2023, driven increased renewable by energy adoption and energy efficiency measures. However, coal still accounts for 27% of the world's primary energy consumption 38% of electricity and generation.
- ► Coal Phase-out Commitments:
 - The European Union has made significant strides in

Global coal consumption is expected to remain over 8 billion tonnes through 2026. The chart shows the appetite for the fuel 9,000 in million tonnes European 7,000 Union 5,000 India 3,000 Forecast 1,000 2002 2008 2014 2020 2026

reducing coal use, with countries like Germany, France, and the UK leading the way. **Germany**, **for instance**, **has committed to phasing out coal by 2038**, with an intermediate target of reducing coal-based power generation by 50% by 2030.

• The **United States has seen a 10% reduction in coal consumption** over the past year, attributed to the closure of several coal-fired power plants and increased investment in natural gas and renewable energy.

n Issues Related to Fossil Fuel Phase-out

► Economic Dependency on Coal: Many regions, particularly in developing countries, are heavily dependent on coal for economic activities and employment.

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- ► **Infrastructure and Technology Gaps**: The shift from coal to renewable energy requires substantial investments in infrastructure and technology.
- Energy Security Concerns: Ensuring a stable and reliable energy supply during the transition period is a critical concern.

• Reasons for Varied Progress in Energy Transition

- ► **Political Will and Policy Frameworks**: The EU's stringent climate policies and support for renewable energy have facilitated a faster transition.
- Economic and Financial Resources: Developing countries, on the other hand, struggle with limited financial resources and competing development priorities.
- Public and Industry Support: Countries with active participation from the private sector and public buy-in have seen more success in reducing coal dependency.

Case Studies: Germany's Energiewende:

- Germany's Energiewende (Energy Transition) aims to shift from fossil fuels to renewable energy while phasing out nuclear power.
- Germany has significantly reduced its coal consumption, increased its renewable energy capacity, and set ambitious climate targets.
- Despite progress, Germany faces challenges in balancing energy supply, particularly during periods of low renewable energy generation. The transition has also led to economic adjustments in coaldependent regions.

b Way Forward

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- ► Strengthening Policy Frameworks: Governments need to establish clear, long-term policies that support the transition from coal to renewable energy.
- **Investing in Technology and Infrastructure**: Significant investments in renewable energy infrastructure and technology are crucial.
- ► **Supporting Coal-dependent Communities**: Transition plans must include strategies to support workers and communities dependent on the coal industry.
- Enhancing International Cooperation: Global collaboration is essential to share best practices, provide financial and technical assistance to developing countries, and ensure a coordinated approach to reducing global coal consumption.

The IEA's Coal 2023 report highlights the critical need for a strategic and well-supported transition from coal to renewable energy. While progress is being made, significant challenges remain, particularly in coal-dependent regions and developing countries.

PRACTICE QUESTION

Q. Discuss the key strategies and challenges associated with the global phase-out of coal as highlighted in the IEA's Coal 2023 report.

14. BATTERY WASTE MANAGEMENT RULES, 2022 -ELECTRONIC WASTE RECYCLING AND RESOURCE RECOVERY

CONTEXT: The Ministry of Environment, Forest, and Climate Change issued an important notification amending the Battery Waste Management Rules, 2022.



Battery Waste Management Rules, 2022

- ➤ Increase in Battery Waste: According to a 2023 report by the Central Pollution Control Board (CPCB), India generated approximately 50,000 tonnes of battery waste in 2022, a 30% increase from the previous year.
- Recycling Initiatives: Under the Battery Waste Management Rules, companies like Attero Recycling and E-Parisaraa have scaled up their operations, processing over 10,000 tonnes of battery waste collectively in 2023.



Issues Related to Battery Waste Management

- ► **Insufficient Infrastructure**: Many regions in India lack proper e-waste collection and processing infrastructure, leading to improper disposal and environmental contamination.
- Awareness and Compliance: Many consumers are unaware of the proper disposal methods, resulting in batteries ending up in landfills, where they pose significant environmental hazards.
- **Economic Viability**: Government incentives and support are crucial to make recycling economically attractive.

Reasons for the Challenges

- ► **Rapid Technological Advancement**: The rapid pace of technological advancement leads to shorter lifespans for electronic devices, contributing to the rapid accumulation of e-waste.
- Lack of Stringent Enforcement: While the Battery Waste Management Rules provide a framework for managing battery waste, enforcement is often lax.
- ➤ Limited Recycling Technologies: Advanced recycling technologies are still in the nascent stage in India. The country relies heavily on rudimentary methods, which are not only inefficient but also hazardous to workers and the environment.

Case Studies: Attero Recycling:

- Attero Recycling is one of India's leading e-waste management companies.
- By implementing advanced recycling technologies, Attero has managed to recover significant quantities of valuable materials from discarded batteries.
- The company processed over 7,000 tonnes of battery waste in 2023, recovering materials worth millions of dollars, thus demonstrating the economic potential of efficient recycling practices.

b Way Forward

• **Strengthening Infrastructure**: The government should invest in developing and upgrading e-waste recycling infrastructure across the country.

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- Enhancing Public Awareness: Comprehensive awareness campaigns are essential to educate consumers about the importance of proper battery disposal and the environmental impacts of improper practices.
- ► Economic Incentives: Providing financial incentives to companies and startups involved in e-waste recycling can boost the sector.
- ► Strict Enforcement and Monitoring: Implementing stringent enforcement measures and regular monitoring is crucial to ensure compliance with the Battery Waste Management Rules.
- Research and Development: Investing in research and development of advanced recycling technologies can enhance the efficiency and safety of recycling processes.

The Battery Waste Management Rules, 2022, represent a significant step towards addressing the burgeoning issue of battery waste in India. However, challenges related to infrastructure, awareness, economic viability, and enforcement need to be addressed to realize the full potential of these regulations.

PRACTICE QUESTION

Q. Discuss the key challenges and strategies for effective implementation of the Battery Waste Management Rules, 2022, in India.

15. EIA FOR HIMALAYAN REGION - ENVIRONMENTAL IMPACT ASSESSMENTS AND REGIONAL DEVELOPMENT

CONTEXT: In light of recent incidents like the Teesta dam breach in Sikkim and floods in Himachal Pradesh, reimagining the Environmental Impact Assessment (EIA) process is crucial.

• Need for EIA For Himalayan Region

- Development Projects: According to the Ministry of Environment, Forest, and Climate Change (MoEFCC), over 100 hydroelectric projects are planned or underway in Uttarakhand alone, impacting river ecosystems and local communities.
- ► Environmental Concerns: A study by WWF India reports a decline in snow leopard habitats due to infrastructure development, affecting the region's biodiversity hotspot status.

b Issues Related to the EIA For Himalayan Region

- ► **Inadequate Assessments**: The 2013 Uttarakhand floods were partly attributed to unchecked development without adequate environmental safeguards.
- Cumulative Impacts: The cumulative impact of dams on riverine ecosystems alters sediment flow, affecting downstream agriculture and fisheries.
- ► **Community Displacement and Livelihoods**: Villagers displaced by dam projects in Arunachal Pradesh faced challenges in resettlement and loss of cultural heritage.

n Reasons for EIA

- Ecological Sensitivity: Glacial melt affects river flows downstream, impacting millions dependent on these waters for agriculture and drinking.
- Development Pressures: Tourism influx in Himachal Pradesh leads to increased waste generation, threatening pristine environments and wildlife habitats.



• Way Forward

- Enhanced EIA Protocols: Strengthening EIA guidelines to include cumulative impact assessments and mandatory public consultations for transparency and accountability.
- **Integrated Planning**: Adopting an ecosystem-based approach to development, integrating conservation goals into infrastructure projects to minimize ecological footprints.
- Community Engagement: Empowering local communities through participatory decision-making and equitable benefit-sharing from development projects.
- **Capacity Building and Monitoring**: Building institutional capacity for effective monitoring and enforcement of environmental regulations to ensure compliance and mitigate risks.

Case Studies

- **Case Study 1: Tehri Dam, Uttarakhand**: One of India's largest hydroelectric projects, Tehri Dam faced controversies over environmental impacts and resettlement issues. Lessons learned include the need for adaptive management strategies and integrated watershed management to mitigate ecological disruptions.
- **Case Study 2: Arunachal Pradesh Hydropower Projects**: Hydropower development in Arunachal Pradesh's Siang basin raised concerns over biodiversity loss and cultural displacement. Incorporating traditional ecological knowledge in project planning helped minimize conflicts and enhance project sustainability.

Balancing development aspirations with environmental conservation in the Himalayan region demands robust EIA frameworks, community involvement, and integrated planning.

PREVIOUS YEAR QUESTION

- Q. Define the concept of carrying capacity of an ecosystem as relevant to an environment. Explain how understanding this concept is vital while planning for sustainable development of a region. (2019)
- Q. How does the draft Environment Impact Assessment (EIA) Notification, 2020 differ from the existing EIA Notification, 2006? (2020)

PRACTICE QUESTION

Q. How can reimagining the Environmental Impact Assessment process contribute to sustainable development in the Indian Himalayan Region?

16. BIOLOGICAL DIVERSITY (AMENDMENT) ACT, 2023

CONTEXT: Recent amendments in the Biological Diversity (Amendment) Act, 2023 reflect India's commitment to balancing development with environmental protection, addressing current challenges and preparing for future sustainability.

Biological Diversity (Amendment) Act, 2023: The Biological Diversity (Amendment) Act, 2023, aims to reduce pressure on wild medicinal plants by encouraging cultivation and facilitating research and investment in biological resources. It also seeks to align with the United Nations Convention on Biological Diversity and its Nagoya Protocol.

n Issues and Challenges with the Amended Act:

Pollution Control and Waste Management: Despite comprehensive laws like the Water (Prevention and Control of Pollution) Act, 1974, and the Air (Prevention and Control of Pollution) Act, 1981, pollution remains a significant challenge. Delhi's air quality, for example, frequently falls into the hazardous category, affecting public health and highlighting enforcement challenges. MAINS SAMPOORNA / ENVIRONMENT & ECOLOGY



- Conservation vs. Development: The establishment of Eco-Sensitive Zones around protected areas aims to regulate developmental activities, but conflicts often arise between conservation goals and local developmental needs.
- ► Legal and Regulatory Framework: The Biological Diversity (Amendment) Bill, 2022, faced criticism for allegedly favoring industry over conservation, demonstrating the need for careful legislative balance.

b Way Forward

- > Strengthening Enforcement: Effective implementation of existing laws and regulations is crucial.
- ► **Promoting Sustainable Practices:** Encouraging sustainable agricultural practices, renewable energy adoption, and waste management can reduce environmental pressures.
- > **Public Awareness and Participation:** Increasing public awareness about environmental issues and involving local communities in conservation efforts can foster a sense of ownership and responsibility.

India's journey towards sustainable development is marked by significant legislative and regulatory measures. However, challenges remain in balancing development with environmental protection.

PREVIOUS YEAR QUESTION

Q. How does biodiversity vary in India? How is the Biological Diversity Act, 2002 helpful in conservation of flora and fauna? (2018)

PRACTICE QUESTION

Q. Discuss the challenges and measures for balancing environmental protection with developmental activities in India.



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ENVIRONMENTAL LAWS, CONVENTIONS AND PROTOCOLS

1. BRAZZAVILLE DECLARATION - CONSERVATION COMMITMENTS AND BIODIVERSITY PROTECTION

CONTEXT: The Brazzaville Summit of the Three Basins, held from October 26-28, 2023, in the Republic of Congo, gathered over 3,000 delegates to discuss the protection of the Amazon, Congo, and Borneo-Mekong-Southeast Asia basins.

Brazzaville Declaration and its Significance

- ► Summit Outcomes and Declaration: A key call was made for developed countries to meet their financial commitments, including \$200 billion annually by 2030 for biodiversity and \$100 billion annually in climate finance.
- Civil Society's Disappointment: Despite the summit's positive discussions, civil society, represented by WWF Global Forests Lead Fran Price, expressed disappointment over the absence of a formal alliance.

Issues and Challenges

- Ongoing Deforestation: Deforestation remains a significant challenge. In 2022, 4.1 million hectares of tropical forest were lost, with 96% of this occurring in tropical regions.
- ► **Financial Shortfalls:** Developing countries struggle to access the financial resources promised by developed nations.
- Lack of Coordination: The absence of a formal alliance among the three basins limits coordinated actions against common challenges like deforestation, climate change, and biodiversity loss.

GSSCORE

AMAZON - CONGO - BORNEO - MEKONG - SOUTH-EAST ASIA SUMMIT OF THE THREE BASINS OF BIODIVERSITY ECOSYSTEMS AND TROPICAL FORESTS: 26-28 October 2023 - Brazzaville



Case Studies

Amazon Basin: The Amazon Basin, the world's largest tropical rainforest, is vital for global climate regulation. Despite efforts to curb deforestation, illegal logging, mining, and agricultural expansion continue to threaten its biodiversity. Brazil's government has implemented policies to reduce deforestation, but enforcement remains weak due to limited resources and political challenges.

• Way Forward

- **Strengthening International Cooperation:** Establishing an alliance among the three basins is crucial for coordinated efforts.
- Enhancing Financial Mechanisms: Mobilizing traditional and innovative financing mechanisms is essential.
- Promoting Sustainable Practices: Encouraging sustainable agricultural practices, forest management, and community involvement can reduce deforestation and promote ecosystem restoration.

The Brazzaville Summit marked an important step in addressing the challenges faced by the Amazon, Congo, and Borneo-Mekong-Southeast Asia basins.

PRACTICE QUESTION

Q. Discuss the importance of the three basins (Amazon, Congo, Borneo-Mekong) and the challenges in their conservation.

2. RECOVERY OF OZONE LAYER

CONTEXT: A recent study published in Nature Communications reveals that the Antarctic ozone hole has grown larger and thinner in recent years. From 2020 to 2022, the ozone hole was notably expansive, with a reduction of 26% at its core from 2004 to 2022.

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• Ozone Hole and Montreal Protocol:

The ozone layer, a vital shield protecting Earth from harmful ultraviolet (UV) radiation, has faced significant depletion due to human activities. The Montreal Protocol, established in 1987, has been a cornerstone in combating this issue by regulating ozone-depleting substances (ODS).



Montreal Protocol and Compliance

► The Montreal Protocol has successfully phased out 99% of banned ODS, leading to significant recovery of the ozone layer. The United Nations Environment Programme (UNEP) projects full recovery by the 2060s. However, recent large ozone holes underscore the complexity of the recovery process and the influence of factors such as meteorological conditions, wildfires, volcanic eruptions, and mesosphere interactions.

Issues and Challenges

- ► **Meteorological Influences:** Meteorological conditions, including springtime temperatures, wind patterns, and solar cycles, significantly affect the size and duration of the ozone hole. The Antarctic polar vortex, which traps air masses and influences ozone chemistry, is a crucial factor that requires further research.
- ➤ Geoengineering Concerns: Geoengineering technologies, particularly stratospheric aerosol injection (SAI), pose potential risks to the ozone layer. While SAI aims to mitigate global warming by reflecting sunlight, it could alter stratospheric temperatures and ozone production, as indicated by a 2016 study from Harvard University.
- ➤ Persistent ODS and Slow Recovery: Despite the phase-out of most ODS, their long atmospheric lifetimes mean that they continue to affect the ozone layer. The slow reduction of ODS concentration over the Antarctic indicates that full recovery will take decades, necessitating sustained efforts and monitoring.

Case Study 1: Success of the Montreal Protocol

The Montreal Protocol, enforced in 1989, is hailed as one of the most successful environmental agreements. It has led to the recovery of the ozone layer, with ODS levels reverting to 1980s values by 2022. This success inspires confidence in global cooperative efforts to address environmental issues, such as climate change.

Case Study 2: Influence of the Antarctic Polar Vortex

The Antarctic polar vortex plays a critical role in ozone depletion. Research shows that mesosphere air descending into the stratosphere brings chemicals like nitrogen dioxide, impacting ozone chemistry. Understanding this mechanism is essential for predicting and mitigating future ozone depletion events.



The recovery of the ozone layer is a testament to the power of international collaboration and regulatory frameworks like the Montreal Protocol. However, recent fluctuations in the Antarctic ozone hole highlight the need for ongoing vigilance, research, and adaptive strategies.

PRACTICE QUESTION

Q. Examine the progress and challenges in the recovery of the ozone layer, with a focus on recent trends and the role of international agreements.

3. KAZA SUMMIT 2024 AND WILDLIFE PRODUCT TRADE - TRANSBOUNDARY CONSERVATION AND WILDLIFE TRAFFICKING

CONTEXT: The KAZA (Kavango-Zambezi Trans-Frontier Conservation Area) 2024 Heads of State Summit, held in Livingstone, Zambia, concluded with a significant decision: to argue for the lifting of the ivory trade ban at the upcoming CITES CoP20 in 2024.

b KAZA Summit 2024 and Wildlife Product Trade

- Summit Outcomes: At the KAZA 2024 Summit, leaders from five southern African nations—Angola, Botswana, Namibia, Zambia, and Zimbabwe—resolved to challenge the existing CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora) ban on ivory trade.
- Ivory Stockpile and Economic Impact: These nations collectively possess over \$1 billion worth of ivory, which remains unsold due to the CITES ban. Zimbabwe alone holds a stockpile of 166 tons, valued at approximately \$700 million.

Issues and Challenges

- ▶ Western Double Standards: KAZA leaders, particularly Zimbabwe's President Emmerson Mnangagwa, have accused Western nations of double standards.
- Human-Wildlife Conflict: The ban on ivory trade exacerbates human-wildlife conflicts. In countries
 like Botswana and Zimbabwe, large elephant populations lead to habitat destruction and increased
 incidents of conflict with humans.

Case Study: Zimbabwe's Struggle

Zimbabwe, with an elephant population of 100,000, faces severe challenges due to the CITES ban. The country's conservation efforts are hampered by a lack of funding, which could be alleviated by selling its substantial ivory stockpile. The ban has also fueled tensions within the CITES framework, prompting Zimbabwe to consider alternative markets, including looking east for trophy hunting exports.

• Way Forward

- **Diplomatic Engagement and Dialogue:** KAZA nations plan to engage diplomatically at CoP20 in 2024, advocating for a partial lifting of the ivory trade ban.
- Regional Cooperation and Common Position: The KAZA summit emphasized the importance of a unified regional stance. Member states will prepare a common position for CoP20, enhancing their negotiating power within CITES.

The KAZA 2024 Summit highlighted the ongoing struggle between conservation imperatives and economic necessities in southern Africa. By advocating for the lifting of the ivory trade ban at CoP20, KAZA nations aim to secure funding for conservation efforts and mitigate human-wildlife conflicts.



PRACTICE QUESTION

Q. Analyze the challenges and strategies related to the ivory trade ban in southern Africa, with a focus on recent developments and international dynamics.

4. PARIS AGREEMENT CLIMATE FINANCE TARGET FOR 2022 - CLIMATE FINANCE COMMITMENTS AND GLOBAL FUNDING MECHANISMS

CONTEXT: The long-awaited commitment of developed nations to provide \$100 billion annually in climate finance to developing countries was finally met in 2022, two years past the initial target. This milestone, reported by the Organisation for Economic Cooperation and Development (OECD), highlights significant financial flows but also underscores ongoing issues in transparency and effectiveness.

D Status of Paris Agreement Climate Finance Target for 2022

- Achievement and Allocation: In 2022, developed countries provided \$115.9 billion in climate finance to developing nations, surpassing the pledged amount. This achievement, though delayed, marks a crucial step in supporting global climate action.
- Composition of Climate Finance: The report indicates that loans constituted a significant portion of the financial flow, with 70% of public climate finance provided in this form. This raises concerns about pushing developing countries further into debt.



n Issues and Challenges

- ► Lack of Transparency: Experts like Harjeet Singh and Sehr Raheja have criticized the ambiguity in climate finance reporting.
- ▶ **Debt Trap Concerns:** The heavy reliance on loans over grants is a significant concern. Between 2016 and 2022, nearly 90% of financing from multilateral development banks (MDBs) were loans.

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Case Studies

Middle-Income Countries and Private Finance

Middle-income countries received substantial private investments, particularly in the energy sector. This influx of private finance demonstrates the potential for mobilizing non-public resources. However, it also highlights the disparity in financial flows, as lower-income countries received a smaller share of these investments.

• Way Forward

- Enhanced Transparency and Accountability: There is a pressing need for a more transparent and standardized framework for reporting climate finance.
- Shifting from Loans to Grants: To avoid pushing developing countries into further debt, there must be a concerted effort to increase the share of grants in climate finance.
- Establishing a New Collective Goal: The upcoming New Collective Quantified Goal on Climate Finance, to be set before 2025, must reflect the actual needs of developing countries.

While the fulfillment of the \$100 billion climate finance pledge marks a significant milestone, the path forward remains challenging. Issues of transparency, loan dominance, and the adequacy of financial flows need to be addressed.

PREVIOUS YEAR QUESTION

Q. Discuss global warming and mention its effects on the global climate. Explain the control measures to bring down the level of greenhouse gases which cause global warming, in the light of the Kyoto Protocol, 1997. (2022)

PRACTICE QUESTION

Q. Discuss the challenges and implications of the \$100 billion climate finance pledge by developed countries to developing nations.

5. FOREST GOVERNANCE AND SUSTAINABLE MANAGEMENT

CONTEXT: At the 19th Session of the United Nations Forum on Forests (UNFF19), held in May 2024, in New York, delegates engaged in critical discussions on forest fire management strategies, particularly focusing on early warning systems and controlled burning.

D 19th Session of United Nations Forum on Forest

- High-Level Declaration and Negotiations: The debates primarily centered on whether to integrate other environmental agreements like the Global Stocktake of the Paris Agreement and the Kunming-Montreal Global Biodiversity Framework.
- Forest Fire Management Approaches: Delegates supported incorporating references to various national circumstances and the specific challenges faced by developing countries in managing forest fires.

Issues and Challenges

- Inadequate Consensus and Representation: The negotiations faced hurdles due to the limited time for reviewing substantial portions of the text and the exclusion of numerous written comments from smaller delegations.
- Overemphasis on Carbon Sequestration: A UN report highlighted the "climatisation" of forests, where market-oriented carbon sequestration approaches have reduced forests to mere carbon sinks.



Case Study: Early Warning Systems in Indonesia

Indonesia has implemented advanced early warning systems to monitor and predict forest fires. These systems utilize satellite data and ground-based sensors to provide real-time information, enabling rapid response and mitigation. This proactive approach has significantly reduced the incidence and severity of forest fires in recent years.

• Way Forward

- ► Enhanced Forest Governance: Strengthening and coordinating forest policies is crucial for effective governance.
- ► **Balancing Economic and Ecological Goals:** Policymakers must value forests beyond their carbon sequestration potential.
- ► **Comprehensive Monitoring and Reporting:** A transparent and standardized framework for monitoring and reporting forest management practices is essential.

The discussions at UNFF19 underscore the importance of a multifaceted approach to forest fire management and overall forest governance. While early warning systems and controlled burning are vital strategies, addressing the broader challenges of transparency, inclusivity, and sustainable forest management is equally critical.

PRACTICE QUESTION

Q. Discuss the role of early warning systems and controlled burning in forest fire management and the challenges associated with their implementation.

6. WORLD WILDLIFE CRIME REPORT 2024

CONTEXT: The 2024 World Wildlife Crime Report by the United Nations Office on Drugs and Crime (UNODC) highlights a troubling shift in the processing of lion, tiger, and jaguar bones.

• World Wildlife Crime Report 2024

- ► Emerging Trends:
 - The report, warns of a potential shift in bone processing from end markets to source countries. Currently, big cat bones are primarily processed into medicinal products in the Far East, with a high emphasis on authentic raw materials.




Case Study of Processing at Source

South Africa: Evidence from a 2018 national police report indicates the processing of lion bones in South Africa. This shift is concerning as it could lead to increased trafficking within the region.

n Issues Related to Big Cat Bone Trafficking

- ► Shift to Source Countries: This shift in processing locations could make it easier to traffic more manageable forms like paste or glue, made by boiling bones.
- **Substitution and Depletion of Wild Populations:** Lion and jaguar bones are often used as substitutes for tiger bones in traditional Chinese medicine.
- Increased Captive Breeding and Trafficking Risks: Captive breeding of lions and tigers has been on the rise since the early 1990s. There are over 12,000 captive tigers worldwide and about 8,000 captive lions in South Africa alone.

b Way Forward

- Strengthening Regulations: To combat these emerging trends, robust regulations and enforcement are crucial.
- International Cooperation: Global cooperation is essential to address wildlife trafficking. Countries
 must work together to share information, track illegal activities, and implement stringent measures to
 protect big cat populations.
- **Community Engagement and Education:** Engaging local communities in conservation efforts and educating them about the ecological importance of big cats can help reduce poaching and trafficking.

The shift in big cat bone processing from end markets to source countries represents a significant challenge in the fight against wildlife trafficking. Addressing this issue requires a multifaceted approach involving stringent regulations, international cooperation, and community engagement.

PRACTICE QUESTION

Q. Discuss the implications of shifting big cat bone processing from end market countries to source nations and the measures needed to address this issue.

7. THE STATE OF THE CLIMATE IN ASIA 2023

CONTEXT: The World Meteorological Organization's (WMO) report, "The State of the Climate in Asia 2023," underscores the escalating climate crisis in Asia. Released on April 23, 2024, in Bangkok, the report highlights Asia as the world's "disaster capital," experiencing extreme weather events, rising temperatures, and significant sea level rise.

• The State of the Climate in Asia 2023

- Climate Change Drivers in Asia: In 2023, Asia faced unprecedented climate challenges. The Bay of Bengal experienced a sea level rise nearly 30% above the global average. Eastern and northern India recorded the highest temperature increases within the country.
- Severe Weather Events: Floods and storms were the leading causes of casualties and economic losses in Asia. Tropical cyclone Mocha, the strongest in the Bay of Bengal in a decade, severely impacted Bangladesh and Myanmar.



n Issues Related to Climate Change

- ► Sea Level Rise: The Bay of Bengal's sea level rise at 4.44 mm per year, significantly higher than the global average of 3.4 mm per year, threatens coastal communities. The Sundarbans in West Bengal experienced the highest sea level rise in India, posing severe risks to biodiversity and livelihoods.
- ► Heatwaves and Glacier Melt: Asia's annual mean near-surface temperature in 2023 was the secondhighest on record, with western Siberia, central Asia, eastern China, and Japan experiencing particularly high temperatures. Glaciers in the High Mountain Asia region are retreating rapidly, with 20 out of 22 observed glaciers showing continued mass loss.
- ▶ **Precipitation and Flooding:** Despite below-normal precipitation across Asia, over 80% of hydrometeorological hazards in 2023 were flood and storm events. The intensity of flooding was linked to record-breaking rainfall triggered by cyclones, causing significant destruction and loss of life.

Case Studies

Glacial Lake Outburst Flood in Sikkim: A glacial lake outburst flood (GLOF) through the Teesta River in Sikkim, triggered by climate-induced glacier melt, resulted in numerous fatalities. This incident underscores the urgent need for adaptive measures to address the increasing frequency of such events.

• Way Forward

- ► **Robust Climate Finance Mechanisms:** Scaling up climate finance mechanisms is crucial to support adaptation and address loss and damage in vulnerable developing countries.
- Enhanced International Cooperation: Strong international cooperation is essential to tackle the transboundary nature of climate impacts.
- ► Focus on Sustainable Development: Integrating climate adaptation into sustainable development planning is vital.

Asia's status as the "disaster capital" in 2023 highlights the urgent need for robust adaptation strategies. Addressing the multifaceted impacts of climate change requires a comprehensive approach involving climate finance, international cooperation, and sustainable development.

PREVIOUS YEAR QUESTION

Q. The Intergovernmental Panel on Climate Change (IPCC) has predicted a global sea level rise of about one metre by AD 2100. What would be its impact in India and the other countries in the Indian Ocean region? (2023)

PRACTICE QUESTION

Q. Discuss the impacts of climate change in Asia in 2023 and the necessary adaptation strategies to mitigate these effects.





8. GREEN CREDIT PROGRAM

CONTEXT: According to the Global Sustainable Investment Alliance, global sustainable investment reached \$35.3 trillion in 2023, highlighting the growing interest in green finance.

n Issues with Green Credit Program

- Lack of standardized criteria for green projects often leads to greenwashing, where projects are falsely labeled as environmentally friendly.
- ► Moreover, the complexity of verifying environmental impact and ensuring transparency poses obstacles to effective implementation.

Case Studies

Case Study 1: European Investment Bank (EIB) The EIB has been a pioneer in green finance, financing projects like renewable energy and energy efficiency. By 2024, it had committed €1 trillion to climate action projects, demonstrating the scale and impact of sustainable finance initiatives.

• Way Forward

- ► To address these challenges, international collaboration is crucial to establish standardized green criteria and improve monitoring frameworks.
- ► The Green Credit Program represents a significant step towards integrating environmental considerations into financial decision-making.

PRACTICE QUESTION

Q. Explain the Green Credit Program as a mechanism for promoting sustainable finance. Discuss its challenges and suggest measures for effective implementation.

9. KUNMING-MONTREAL GBF IMPLICATIONS FOR INDIA'S INDIGENOUS TRIBES - INDIGENOUS RIGHTS AND BIODIVERSITY CONSERVATION

CONTEXT: Kunming-Montreal GBF was adopted during the 15th meeting of the Conference of the Parties to the UN Convention on Biological Diversity in December 2022, the GBF aims to support sustainable development goals and enhance biodiversity conservation.

• Understanding the Kunming-Montreal GBF

► What is the GBF?

- The GBF sets four goals for 2050 and 23 targets for 2030, covering planning, monitoring, reporting, finance, and capacity development.
- **Target 3 of the Kunming-Montreal GBF** focuses on increasing protected areas to at least 30% of the world's terrestrial area by 2030 (currently at 16%).



India's Progress

- ► 30x30 Target:
 - India has expanded its protected area network, covering 22% of terrestrial areas and 5% of marine and coastal areas.
 - The **2023 Forest (Conservation) Amendment Act** includes commercial ventures like zoos and ecotourism.
 - The **Supreme Court mandates prior approval for establishing zoos and safaris** within forest areas (excluding protected areas).



Implications for Indigenous Tribes

- ► Threat to Traditional Land Use:
 - GBF forest expansion targets may restrict indigenous communities' traditional practices and livelihoods.
 - About 84% of India's national parks are in areas inhabited by indigenous peoples.
- Recent Initiatives: Initiatives like upgrading the Kumbhalgarh Wildlife Sanctuary in Rajasthan to a tiger reserve could displace 162 tribal villages.

• Way Forward

- Balancing Conservation and Livelihoods:
 - Strengthen legal protection for indigenous land rights.
 - Involve indigenous communities in decision-making processes.
 - Promote sustainable practices that benefit both biodiversity and livelihoods.

The GBF's noble goal of biodiversity conservation must be balanced with the rights and well-being of India's indigenous tribes. Striking this balance is crucial for a sustainable future.

PRACTICE QUESTION

Q. Discuss the implications of the Kunming-Montreal GBF on India's indigenous communities and propose measures to safeguard their rights and livelihoods.



10. GLOBAL E-WASTE MONITOR 2024 - ELECTRONIC WASTE TRENDS AND MANAGEMENT STRATEGIES

CONTEXT: The Global E-waste Monitor 2024, launched in March 2024, sheds light on the escalating issue of electronic waste (e-waste) worldwide.

Key Findings & Statistics

- Record E-waste Generation: In 2022, a staggering 62 billion kg of e-waste was generated globally, equivalent to an average of 7.8 kg per capita per year. However, only 22.3% of this e-waste mass was formally collected and recycled in an environmentally sound manner.
- Growth Trends: Since 2010, e-waste generation has increased significantly, from 34 billion kg to 62 billion kg. Unfortunately, formal collection and recycling efforts have not kept pace, growing from 8 billion kg to 13.8 billion kg during the same period.
- Regional Disparities: Europe leads in e-waste generation (17.6 kg per capita) and has the highest documented collection and recycling rate (7.5 kg per capita), recycling 42.8% of the e-waste generated. African countries face the lowest documented collection and recycling rates, with less than 1% of e-waste being formally managed.







Issues and Challenges

- ► **Hazardous Materials:** E-waste contains toxic substances like lead, mercury, and flame retardants. Improper disposal harms ecosystems and human health.
- **Resource Waste:** Valuable materials (such as rare earth elements) are squandered when e-waste is not recycled effectively. Only 1% of rare earth element demand is met through e-waste recycling.

Case Studies

- Europe's Success Story:
 - Europe's robust e-waste management system demonstrates the importance of legislation and infrastructure. Strict regulations and efficient collection networks contribute to high recycling rates.
- African Challenges:
 - African countries struggle due to limited resources, inadequate policies, and lack of awareness. Collaborative efforts are essential to improve e-waste management.

• Way Forward

- Strengthen Legislation: Countries must enact and enforce e-waste regulations. Implement extended producer responsibility (EPR) programs.
- Promote Circular Economy: Design products for easier disassembly and recycling. Encourage repair and reuse.
- ► Awareness and Education: Educate consumers about responsible disposal. Raise awareness among policymakers and industry stakeholders.



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The Global E-waste Monitor 2024 underscores the urgency of addressing e-waste. By adopting sustainable practices, we can protect our environment, conserve resources, and safeguard human well-being.

PRACTICE QUESTION

Q. Discuss the implications of e-waste generation and propose measures to enhance e-waste management globally.

11. GLOBAL METHANE TRACKER 2024

Introduction: Methane, a potent greenhouse gas, contributes significantly to global warming. The recently updated Global Methane Tracker 2024 by the International Energy Agency (IEA) sheds light on methane emissions from the energy sector.

• Key Findings of Global Methane Tracker

- ► **Magnitude of the Issue:** Methane is responsible for approximately 30% of the rise in global temperatures since the Industrial Revolution.
- Recent Data and Trends: The Tracker draws on satellite and ground-based measurements to estimate emissions.



n Issues and Challenges

- ► Hazardous Emissions: Methane poses environmental risks and affects air quality. Uncontrolled emissions exacerbate climate change.
- ► **Resource Waste:** Valuable energy resources are lost when methane leaks occur. Efficient management is crucial.



n Way Forward

- **Policy and Technology:** Enforce regulations and promote advanced leak detection technologies. Encourage industry-wide adoption.
- Investments and Revenue: Calculate costs and potential revenue from emissions reduction measures. Align financial incentives.

The Global Methane Tracker 2024 underscores urgency. By addressing methane emissions, we safeguard our planet's future.

PRACTICE QUESTION

Q. Discuss strategies to mitigate methane emissions in the energy sector.

12. WORLD AIR QUALITY REPORT 2023 - AIR POLLUTION TRENDS AND URBAN HEALTH IMPACTS

CONTEXT: The 2023 World Air Quality Report provides a comprehensive overview of global air quality data. Analyzing data from over 30,000 monitoring stations across 7,812 locations in 134 countries, the report sheds light on critical issues related to air pollution and its impact on human health.

n Key Findings

➤ Meeting WHO Guidelines: Only seven countries met the World Health Organization (WHO) annual PM2.5 guideline (annual average of 5 µg/m³ or less). These countries include Australia, Estonia, Finland, Grenada, Iceland, Mauritius, and New Zealand.

n Most Polluted Countries:

- ► The top five most polluted countries in 2023 were:
 - **Bangladesh (79.9 μg/m³)** over 15 times higher than the WHO PM2.5 annual guideline.
 - Pakistan (73.7 μg/m³) more than 14 times higher.
 - India (54.4 μg/m³) more than 10 times higher.
 - Tajikistan (49.0 μg/m³) more than 9 times higher.
 - Burkina Faso (46.6 μg/m³) also more than 9 times higher.
- Global Trends and Challenges:
 - Africa remains underrepresented, with a lack of air quality data for a third of its population.
 - Southeast Asia experienced rising PM2.5 concentrations due to climate conditions and transboundary haze.
 - Central & South Asia hosted the world's top ten most polluted cities.

• Way Forward

- Data Accessibility: Bridge gaps in air quality monitoring networks globally. Promote low-cost sensors and citizen-led initiatives.
- ► **Policy and Implementation:** Strengthen regulations to reduce emissions. Invest in sustainable transportation and clean energy.

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A clean environment is a universal right. Air quality data empowers action, saves lives, and ensures a healthier future.

PREVIOUS YEAR QUESTION

- Q. Describe the key points of the revised Global Air Quality Guidelines (AQGs) recently released by the World Health Organisation (WHO). How are these different from its last update in 2005? What changes in India's National Clean Air Programme are required to achieve revised standards? (2021)
- Q. Discuss in detail the photochemical smog emphasizing its formation, effects and mitigation. Explain the 1999 Gothenburg protocol. (2022)

PRACTICE QUESTION

Q. Discuss strategies to combat air pollution and enhance air quality globally.

13. IPCC REPORTS AND EQUITY IN CLIMATE CHANGE MITIGATION

CONTEXT: The Intergovernmental Panel on Climate Change (IPCC) regularly releases comprehensive assessment reports that synthesize scientific literature on climate change.

• Key Findings of IPCC Report:

- Mitigation Progress and Pledges: The Climate Change 2022: Mitigation of Climate Change report by Working Group III assesses global progress in climate change mitigation. Despite efforts, global greenhouse gas (GHG) emissions continue to rise, but pathways limiting warming to 1.5 degrees Celsius aim for emissions to peak before 2025.
- ► Equity Challenges: The study on IPCC's AR6 scenarios reveals persistent inequities in GDP, consumption, and mitigation burden between developed and developing countries.

n Issues and Challenges

- **Historical Responsibility**: Developed nations historically contributed significantly to emissions. Equitable mitigation requires acknowledging this historical context.
- ► Economic Realities: Current mitigation pathways often overlook economic disparities. Developing countries face challenges in implementing ambitious climate actions.

• Way Forward

- Equity Integration: Incorporate equity principles into national policies and international cooperation. Ensure fair distribution of mitigation efforts.
- **Capacity Building**: Support developing countries in technology transfer and capacity enhancement. Foster collaboration for equitable climate action.

The IPCC's synthesis report outlines options for reducing greenhouse gas emissions and adapting to human-caused climate change. Equity considerations are central to achieving sustainable and just outcomes.

PRACTICE QUESTION

Q. Discuss strategies to enhance equity in global climate change mitigation efforts.



14. THE UNJUST CLIMATE: FAO - CLIMATE JUSTICE AND GLOBAL FOOD SECURITY

CONTEXT: Climate change disproportionately affects vulnerable communities, exacerbating existing inequalities. The Unjust Climate report by the Food and Agriculture Organization (FAO) sheds light on how climate stressors impact rural women, youths, and people living in poverty.

n Key Findings of Report

- ➤ Regional Analysis: The report draws from socioeconomic data collected across 24 low- and middleincome countries (LMICs) in five world regions. It represents over 950 million rural people and analyzes their income, labor allocations, and adaptive actions.
- Climate Stressors and Differential Effects: By combining georeferenced data on daily precipitation and temperatures with socioeconomic information, the report disentangles how climate stressors affect different groups.

n Issues and Challenges

- Structural Vulnerability: Rural populations facing poverty or other forms of vulnerability encounter additional barriers. Climate change exacerbates existing challenges, affecting livelihoods and wellbeing.
- Gender Disparities: Women often bear the brunt of climate impacts due to unequal access to resources and decision-making power.

b Way Forward

- ► **Inclusive Policies**: Prioritize inclusive approaches to rural development. Address structural barriers and promote resilience.
- ► Gender-Responsive Strategies: Empower women in decision-making. Ensure equitable access to resources and adaptation measures.

The Unjust Climate report underscores the urgency of climate justice. By recognizing differential impacts and promoting inclusive solutions, we can build a more resilient and equitable future.

PRACTICE QUESTION

Q. Discuss strategies to enhance climate resilience for vulnerable populations.

15. CMS COP14 - MIGRATORY SPECIES CONSERVATION AGREEMENTS AND INTERNATIONAL COOPERATION

CONTEXT: The 14th Meeting of the Conference of the Parties to the Convention on the Conservation of Migratory Species of Wild Animals (CMS COP14) is a critical global gathering. Held in the historic city of Samarkand, Uzbekistan, aims to address pressing issues related to migratory species and their habitats.





b Key Focus Areas of CMS

- Habitat Conservation and Restoration: Migratory species rely on diverse habitats across their range. COP14 emphasizes the need to protect and restore these habitats, ensuring their viability for species survival.
- Connectivity and Ecological Networks: Decision-makers will discuss ways to enhance connectivity in conservation efforts. Ecological networks play a crucial role in maintaining migratory routes and genetic diversity.



Strategic Plan for Migratory Species 2024-2032:

- ► COP14 reviews progress in implementing the existing Strategic Plan (2015-2023) and adopts a new plan for the next decade.
- ► The focus is on aligning conservation efforts with the Kunming-Montreal Global Biodiversity Framework.

• Way Forward

- ► International Cooperation: Strengthen collaboration among countries along migratory routes. Share best practices and data for effective conservation.
- ► **Inclusive Policies**: Involve local communities, indigenous knowledge, and youth. Empower stakeholders to protect migratory species.

CMS COP14 provides a platform to bridge science, policy, and action. By safeguarding migratory species, we contribute to a healthier planet and a more interconnected world.

PRACTICE QUESTION

Q. Discuss the strategies needed for international cooperation for the conserving migratory species.

16. EMISSIONS GAP REPORT 2023: UNEP -CARBON REDUCTION TARGETS AND POLICY EFFECTIVENESS

CONTEXT: The Emissions Gap Report 2023, released by the UN Environment Programme (UNEP), underscores the urgency of global climate action. As greenhouse gas emissions reach record highs, the report reveals critical gaps between current commitments and the necessary reductions to align with the Paris Agreement goals.



n Key Findings of Emissions Gap Report 2023

- > Progress Since Paris Agreement:
 - In 2015, when the Paris Agreement was adopted, projected 2030 greenhouse gas emissions were set to increase by 16% based on existing policies.
 - Today, that increase projection has reduced to 3%.
 - However, substantial efforts are still needed to meet the 2°C and 1.5°C pathways.



D Temperature Goals and NDCs:

- ► To limit warming, unconditional Nationally Determined Contributions (NDCs) must be fully implemented.
- ► Conditional NDCs would further improve the outlook but still fall short.
- ▶ Urgent action is essential to avoid a temperature rise beyond pre-industrial levels.

Issues and Challenges

- Equity and Responsibility: Countries with greater emissions capacity must take ambitious action. Supporting developing nations in low-emissions growth is crucial.
- **Carbon Removal Methods**: The report explores risks and potential of Carbon Dioxide Removal (CDR) techniques. Nature-based solutions and direct air carbon capture and storage play a role.

• Way Forward

- ► Accelerate Low-Carbon Development: All nations must transform their economies toward sustainability. Developed countries should support capacity-building in developing nations.
- Strengthen NDCs for 2035: Robust implementation can bridge the emissions gap. The next round of NDCs (due in 2025) is critical.

The Emissions Gap Report 2023 serves as a wake-up call. Collective efforts, bold policies, and global cooperation are essential to secure a safer climate future.



PRACTICE QUESTION

Q. Discuss strategies to enhance global climate action and bridge emissions gaps.

17. BONN CLIMATE MEET - INTERNATIONAL CLIMATE NEGOTIATIONS AND AGREEMENTS

CONTEXT: The Bonn Climate Change Conference, held in June 2023, brought together diplomats from around the world to pave the way for critical decisions at the upcoming UN Climate Conference (COP 28) in Dubai.

b Key Issues and Outcomes of Bonn Climate Meet

- Global Stocktake (GST): The conference focused on laying the groundwork for the GST, where
 nations assess their progress toward climate goals. The GST provides a crucial mechanism for tracking
 collective efforts and adjusting strategies.
- ► Just Transition and Adaptation: Discussions centered on ensuring a just transition to a low-carbon economy. The global goal on adaptation received attention, recognizing the need to protect vulnerable communities.



Challenges Ahead

- COP28 Presidency Controversy: Sultan Al Jaber, the UAE COP28 president-designate, faced criticism due to his role in a national oil company. Despite concerns, Al Jaber acknowledged the inevitability of fossil fuel phasedown.
- Climate Finance Alignment: Negotiations addressed post-2025 climate finance targets. Themes included the quantum (amount of money) and mobilization of financial sources.

• Way Forward

- ► Accelerate Low-Carbon Development: Transform economies toward sustainability. Developed countries should support capacity-building in developing nations.
- Strengthen NDCs for 2035: Robust implementation bridges the emissions gap. The next round of NDCs (due in 2025) is critical.



The Bonn Climate Change Conference underscores the urgency of global cooperation. By bridging gaps and committing to ambitious actions, we can secure a safer climate future.

PREVIOUS YEAR QUESTION

Q. Describe the major outcomes of the 26th session of the Conference of the Parties (COP) to the United Nations Framework Convention on Climate Change (UNFCCC). What are the commitments made by India in this conference? (2021)

PRACTICE QUESTION

Q. Discuss strategies to enhance global climate action and bridge emissions gaps.

