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ENVIRONMENT
& ECOLOGY
FOR CIVIL SERVICES EXAMINATION

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THE COACH

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- **Diagnosis** of candidates based on background, level of preparation and task completed.
- **Customized solution** based on Diagnosis.
- One to One **Mentorship.**
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- **PYQ** (Previous year questions) Drafting session.
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- **MOCK Test** with comprehensive & swift assessment & feedback.

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INTRODUCTION

Ecosystem

- A defined geographical area where **living organisms** (plants, animals, microbes) interact with **non-living factors** (climate, soil, water, landscape).
- Functions as a **self-regulating and self-sustaining unit of life**.
- **Example – Coral Reef Ecosystem:**
  - Corals act as shelter and food providers for many marine species.
  - Fish and other organisms maintain ecological balance of the reef.
  - Supports **immense biodiversity**, making it crucial for ocean health.

Ecology

- The **scientific study** of how organisms interact with:
  - Their **physical environment**.
  - **Other organisms** around them.
- Focuses on relationships, energy flow, and survival strategies.
- **Example – Bees & Flowers:**
  - Bees collect nectar → food source.
  - While foraging, bees transfer pollen → helps in plant reproduction.
  - Relationship is **mutualistic** (both species benefit).

FUNCTIONS OF ECOSYSTEM

- **Productivity:** Ecosystems convert energy from the sun into biomass, supporting the growth and reproduction of plants and providing food for other organisms.
- **Energy Flow:** Ecosystems transfer energy from one organism to another through feeding relationships, driving the flow of nutrients and sustaining life **with the help of Food Web and Food Chain.**
- **Nutrient Cycling:** Ecosystems continuously recycle and redistribute nutrients, ensuring their availability for different organisms and maintaining a balanced nutrient cycle. Example: Nitrogen Cycle
- **Decomposition:** Ecosystems break down dead organic matter, recycling nutrients back into the soil and making them available for new growth.
- **Stability:** Ecosystems exhibit resilience and balance, maintaining their structure and functions despite disturbances, allowing organisms to thrive.
- **Support of Life:** Ecosystems provide habitats, food, water, and other resources necessary for the survival and well-being of diverse species, contributing to the overall support of life on Earth.

THREATS TO ECOSYSTEMS AND BIODIVERSITY

- **Habitat Loss and Fragmentation:** Destruction and fragmentation of habitats disrupt ecosystems, displacing species and reducing their ability to survive.
- **Climate Change:** Rising temperatures disrupt ecosystems, leading to habitat loss, altered migration patterns, and increased extinction risks.
- **Pollution:** Human-induced pollution contaminates ecosystems, affecting plants, animals, and food chains.
- **Invasive Species:** Non-native species disrupt ecosystems, outcompeting native species and causing imbalances in ecological relationships.
- **Loss of Keystone Species:** Their loss disrupts ecosystem balance and stability, with cascading effects on other species.
- **Land Use Change:** Conversion of habitats for human activities such as unsustainable agricultural practices leads to habitat loss, fragmentation, and species displacement.
- **Disease and Pathogens:** Outbreaks can cause mass mortality, disrupt food webs, and alter ecosystem dynamics.

- **Genetic Pollution:** The introduction of genetically modified organism (GMO) affects native species' genetic diversity and survival.
- **Lack of Environmental Awareness:** Insufficient understanding and conservation efforts contribute to ecosystem degradation and loss.
- **Unsustainable Development:** Practices and policies lead to ecosystem degradation, loss of biodiversity, and long-term environmental consequences which leads to **overexploitation**.

WAY FORWARD
- **Climate Change Mitigation and Adaptation:** Implement measures to reduce greenhouse gas emissions, transition to renewable energy sources, and develop climate resilience strategies to mitigate the impacts of climate change on ecosystems and species.
- **Strengthen Legal Protection and Enforcement:** Enhance legislation and enforcement mechanisms to combat illegal wildlife trade, poaching, and unsustainable resource extraction, ensuring the conservation of vulnerable species.
- **Collaborative Conservation Initiatives:** Foster partnerships and collaborations among governments, organizations, communities, and indigenous peoples to implement integrated conservation approaches and promote sustainable development practices.
- **Sustainable Development Planning:** Integrate biodiversity considerations into land-use planning, infrastructure development, and urban design, ensuring that economic development is balanced with environmental conservation.
- **A Balanced Approach:** A balance between conservation efforts and development should be sought in ecosystem conservation strategies.
- **Research and Monitoring:** Support scientific research, monitoring, and data collection to better understand ecosystems, assess biodiversity status, and inform evidence-based conservation strategies.
- **International Cooperation:** Foster international cooperation, knowledge sharing, and collaboration to address global challenges in conserving ecosystems and biodiversity, ensuring coordinated efforts across borders.

TSR SUBRAMANIAN COMMITTEE REPORTS ON ENVIRONMENT
• **Creation of Indian Environment Service (IES):** To recruit qualified and skilled human resources in the environment sector.   • **Widening Environment Protection Act:** The Air Act and the Water Act are to be subsumed within the Environment Protection Act.

Addressing the threats to ecosystems and biodiversity requires a comprehensive and collaborative approach. By promoting sustainable practices, protecting critical habitats, mitigating climate change, and engaging communities, we can safeguard ecosystems.

GREEN GDP

Green GDP, in simple terms, refers to a measure of economic growth that considers the impact on the environment. It considers not only the traditional economic factors but also factors related to sustainability and the use of natural resources.

Green GDP aims to provide a more holistic view of economic development by considering the environmental costs and benefits associated with economic activities, helping to promote sustainable growth that balances both economic and environmental considerations.

Key Dimensions of Green GDP	Description
Green Economy	• A sustainable economy that aims to reduce environmental risks and promote sustainable development without harming the environment.
Green National Accounts	• Integration of environmental information into national accounts to measure the economic impact on the environment.
Environmental Accounting	• Includes physical accounting to assess resource state and monetary valuation to determine tangible and intangible values.
Natural Resources and Costs	• Green GDP considers the use of natural resources and associated costs, including healthcare expenses from pollution and livelihood losses due to environmental crises.

NEED FOR GREEN GDP
- **Assess Sustainability:** Green GDP considers resource depletion, pollution, and ecological damage, promoting sustainable practices for economic growth.
- **Informed Policy-making:** Green GDP provides policymakers with a comprehensive understanding to develop

strategies for sustainable development and environmental protection.
- **Raise Public awareness:** Green GDP educates individuals, businesses, and communities about the environmental impacts of economic activities, fostering responsible choices.
- **Optimize Resource Management:** Green GDP emphasizes efficient resource use, conservation, renewable energy, and waste reduction.
- **Enable international comparisons:** Green GDP facilitates accurate assessment of environmental sustainability among countries, promoting collaboration on global environmental challenges.

FACTORS CONTRIBUTING TO GREEN GDP
- **Sustainable Energy Production:** Increasing the share of renewable energy sources and reducing dependence on fossil fuels. **Example: National Solar Mission** aims to achieve 100 GW of solar power capacity.
- **Resource Efficiency:** Efficient use of resources to produce goods and services, minimizing waste and environmental impact. **Example: PAT Scheme** (Perform, Achieve and Trade): Targets improving energy efficiency in large industries.
- **Environmental Protection Expenditure:** Investing in measures to protect and preserve the environment, such as pollution control and conservation initiatives. **Example: Namami Gange Programme** investing in cleaning and protecting the Ganges River.
- **Sustainable Agriculture:** Adopting practices that promote soil health, biodiversity conservation, and reduce chemical inputs.
- **Waste Management:** Implementing effective waste management systems, including recycling and waste reduction strategies.
- **Green Infrastructure**: Developing and maintaining eco-friendly infrastructure, such as green buildings and sustainable transportation. **Example: Green Rating for Integrated Habitat Assessment (GRIHA)** Promoting eco-friendly construction.
- **Conservation of Natural Resources:** Preserving and restoring ecosystems, forests, and water bodies to ensure their sustainable use.
- **Circular Economy:** Embracing the principles of a circular economy, where resources are reused, recycled, or repurposed to minimize waste.
- **Sustainable Business Practices:** Encouraging businesses to adopt sustainable practices and consider environmental impacts in their operations.

CHALLENGES IN CALCULATING GREEN GDP
- **Insufficient Micro-Level Data:** There is not sufficient micro-level data on natural capital. For this, the expert group needs to look into solutions to bridge the data deficit.
- **Enhanced Budgetary Allocation:** The calculation of Green GDP is a complex process and hence there is a need for improved budgetary allocation to bridge the data gaps.
- **The Externalities of Economic Growth:** Which are not factored into conventional GDP numbers have a massive monetary value and have the possibility to create controversies.
- **Destabilizing Energy Production:** India is one of the largest importers of products such as fossil fuels whose sustainability is not known in future.
  - If pollution costs are included in the GDP, then it has the capacity to destabilize the current energy production mechanism.
- **Distortion:** In perceived economic growth China and Norway had already started experiments with green accounting.
  - However, China dropped it in 2007 (started in 2004) after it realised that factoring in environmental costs had a significant impact on the country's perceived "economic growth".

RBI Article Outlines A Green Method For Calculating India's GDP

- **India's Green GDP Growth:** A 91% increase over a decade. In 2022-23, the green GDP (G3) was estimated to be ₹172.9 trillion, compared to the conventional GDP of ₹269.5 trillion at current prices.
- **Calculation Method:** Green GDP is calculated by subtracting environmental damage costs and adding expenditure on environmental protection.
- **Recommendations:** Revamping the data dissemination platform, Establishing an in-house group for continuous monitoring and analysis, and Revamping financial policies to support environmental sustainability initiatives.

WAY FORWARD
- **Enhanced Data Collection:** Improve data collection systems for accurate and comprehensive environmental data.
- **Methodological Standardization:** Develop standardized methodologies for Green GDP calculations.
- **Strengthened Institutions:** Build capacity and provide support for Green GDP implementation.
- **Multi-Stakeholder Engagement:** Foster collaboration among government, academia, and civil society for addressing challenges.

- **Policy Integration:** Incorporate Green GDP findings into policy making and resource allocation.
- **International Cooperation:** Collaborate globally on Green GDP methodologies and data sharing.
- **Continuous Improvement:** Regularly update Green GDP methodologies and indicators.
- **Long-term Commitment:** Maintain a long-term vision for integrating Green GDP into national accounting systems.

There is a need for a comprehensive macroeconomic indicator which is consistent with the concept of sustainable development as GDP is mistakenly considered the primary indicator of human well-being, whereas it is the Green GDP that is a more accurate indicator or measure of societal well-being. The Green GDP accounting has to make efforts across the world to factor in environmental and social costs. If such is not the case, then this method won't be successful as no country wants to drop the growth figures.

KEYWORDS
Hotspot of biological diversity; Extension of Western Ghats; House of Biodiversity; Endemic species; Hydrological and watershed functions; Role of monsoon; Forest based industries; Forest based communities; Endemic Species; Fragile ecosystem; Tourist hotspot; Human-wildlife conflict; Encroachment by human settlements; Deforestation;

GROSS ENVIRONMENT PRODUCT (GEP)

There is a general agreement among the policy makers that the economic concepts of GDP, GNP or per capita income do not reflect the correct state of economic development of a state or country as these concepts do not reflect on the status of environment of the state/country impacted by economic growth.

Recently **Uttarakhand** initiated the valuation of its natural resources in the form of '**Gross Environment Product**' along the lines of Gross Domestic Product (GDP).

CONCEPT OF GROSS ENVIRONMENT PRODUCT (GEP)

- **GEP measures the value of ecosystem services** provided by natural areas such as forests, water bodies, and oceans.
- **It reflects the aggregated annual value** of these goods and services to people within a specific region (district, state, or national level).
- **GEP establishes a natural capital accounting framework,** integrating ecological benefits into traditional economic measures like GDP.
- **It provides a single monetary metric** summarizing the value of ecosystem services.

NEED FOR GEP

- **Recognition of ecosystem services**: Humankind benefits from a multitude of resources and processes that are supplied by the ecosystem, collectively termed as "Ecosystem Services".
- **Accounting for growth in GDP**: "Ecosystem services" is a reflective of the complex connections between the natural environment and human wellbeing.
- **Environmental protection**: There is a fundamental relationship between environmental protection and economic growth. This can make policymakers aware to support environmental protection.
- **GDP is inconclusive**: The economic concepts of GDP, GNP or per capita income do not reflect the correct state of economic development of a Country as these concepts do not reflect on the status of environment of the State/country impacted by economic growth.
- **Helps to save the effect of climate change**: It would help in the conservation of the environment and also help save us from the effects of climate change.
- **Accounting for future generation**: Degradation of ecosystem services, increased risks of non-linear changes and the exacerbation of poverty for some groups of people. These problems, unless addressed, will substantially diminish the benefits that future generations obtain from ecosystems.

ADVANTAGES OF GEP

- **Policy Formulation:** Forest areas account for a significant portion of land but contribute minimally to GDP, indicating their under-utilization in economic progress. **For example,** utilizing non-timber forest products and eco-tourism can boost economic benefits.
- **Bonus for Better Environment Protection:** Gross Ecosystem Product (GEP) can serve as a scientific basis for eco-compensation and public financial transfers. **For example,** regions protecting natural habitats could receive financial incentives.
- **Measure Anthropogenic Pressure on Ecosystem**: Many human welfare projects are not aligned with the sustainability of natural resources. **For example,** large infrastructure projects may disrupt local ecosystems, highlighting the need for better planning.
- **Measure Status of Ecosystem Services**: GEP can assess the status of ecosystem services, an essential indicator of sustainable development. **For example,** evaluating water purification and carbon sequestration services can guide conservation efforts.
- **Quantitative Indicator: GEP** can be used as a quantitative indicator for officials' performance appraisal and

auditing. **For example,** tracking improvements in local biodiversity can reflect the effectiveness of environmental policies.

PROBLEMS AND ISSUES IN IMPLEMENTATION OF GEP APPROACH
- **Policy Failure**: Lack of recognition of ecosystem services in economic decision making, development planning and resource allocation. Value of ecosystem services is either ignored or poorly understood.
- **Market Failure**: Inadequate or missing market for many ecosystems service. **For example**, Lack of a market for clean air provided by forests makes it difficult to assign a monetary value to their role in air purification.
- **Institutional Failure**: Insufficient compensation for ecosystem services. **For Example,** Farmers who implement sustainable agricultural practices to preserve soil fertility and prevent erosion often receive little to no compensation for the ecosystem services they provide.
- **Knowledge gaps**: Challenges to provide economic value of ecosystem services, regulating and supporting services.
- **Lack of clarity**: GEP is a new concept and less popular in world forums and has less clarity about its parameters and methodology which may become a hurdle in its implementation.

WAY FORWARD
- **Develop methodology**: Since it's a new concept there is a need to develop a methodology.
- **Biophysical and spatio-temporal dynamics**: Needs to be kept in mind while quantifying and valuing ecosystem services.
- **Ethical questions and social disparity**: Should be kept in mind as priority area while valuing the Ecosystem services.
- **Develop non-market method**: To strengthen and evaluate Ecosystem Services. Stress should be given on intangible assets, skills and knowledge specially the cultural values.
- **Measurement of factors**: like, water, soil, forest, biodiversity, emissions, degradation, pollution, etc signifying quality of environment should be included in the green accounting. **Better to go for Ecosystem services:** Instead to go for a new concept, it is important that the state should be steady in approach, focussing on Ecosystem Services, which has global acceptance and a strong knowledge base.

GLOBAL STANDARDS AND BEST PRACTICES

- **System of Environmental and Economic Accounts (SEEA):** guidebook developed by the United Nations to provide standards for incorporating natural capital and environmental quality into national accounting systems.
- The **Happy Planet Index (HPI)** created by the British New Economics Foundation (NEF) measures national welfare in the context of environmental sustainability.
- **Bhutan's Gross National Happiness (GNH)** has environmental preservation as one of the four policy objectives.

PREVIOUS YEAR QUESTIONS		
1.	**Define the concept of the carrying capacity** of an ecosystem as relevant to an environment. Explain how understanding this concept is vital while planning for the sustainable development of a region.	(2019)

2 ENVIRONMENTAL DEGRADATION

"Saving our planet, lifting people out of poverty, advancing economic growth... these are one and the same fight. We must connect the dots between climate change, water scarcity, energy shortages, global health, food security and women's empowerment. Solutions to one problem must be solutions for all." - **Ban Ki-moon**

INTRODUCTION

Environmental degradation refers to the decline of the natural environment, encompassing the depletion of vital resources like air, water, and soil, as well as the destruction of ecosystems, habitat loss, wildlife extinction, and pollution. It encompasses any detrimental change or disruption to the environment. **Environmental degradation manifests in various forms,** including the destruction of natural habitats and the depletion of essential resources, leading to an overall decline in environmental quality.

Recognized as one of the top ten threats by the United Nations High-level Panel on Threats, Challenges, and Change, environmental degradation is officially acknowledged as a critical global concern. According to the **United Nations International Strategy for Disaster Reduction,** it is defined as the diminishing capacity of the environment to fulfil both social and ecological needs and objectives.

FACT WISE

- **NITI Aayog**: 600 million people in India face high to extreme water stress with nearly 70% of water being contaminated. India is placed at 120th amongst 122 countries in the water quality index.
- **'United Nations World Water Development Report 2023: partnerships and cooperation for water'** states that Water scarcity in India is projected to increase from 933 million in 2016 to 1.7-2.4 billion people in 2050.
- **The Indian Space Research Organisation**: Land degradation and desertification are taking place over 30% of our land (2021).
- **The 2022 global environmental ranking by Yale and Columbia Universities**: It has put India at the bottom among 180 countries.
- **Budgetary Allocation: In the 2024-25 Budget, the Ministry of Environment, Forests, and Climate Change (MoEFCC) has been allocated ₹3,265.53 crore, reflecting a modest increase from ₹3,079.4 crore in the 2023-24 Budget.**
- **Highways vs. Environment:** The allocation for highways in the 2024-25 Budget is ₹2,70,435 crore, which is significantly higher than the budget for the MoEFCC, emphasising the disparity in funding priorities.
- **Climate Action Plan:** The Climate Action Plan continues to receive relatively low funding, with only ₹600 crore allocated for the National Green Hydrogen Mission, a substantial increase from ₹100 crore in the previous year but still limited compared to other sectors.

TYPES OF ENVIRONMENTAL DEGRADATION

Type	Description
Pollution	Emission of harmful substances and Discharge of pollutants Leading to respiratory diseases, acid rain, smog, waterborne diseases, and climate change
Soil Degradation	Erosion, compaction, salinization, etc., leading to reduced crop yields, desertification, and loss of ecosystem services.
Climate Change	Burning fossil fuels, deforestation, etc., causing rising temperatures, sea level rise, extreme weather events.
Land Degradation	Erosion, desertification, salinization, etc., leading to loss of arable land, reduced agricultural yields, and land degradation.
Marine Pollution	Plastic waste, oil spills, etc., causing habitat degradation, biodiversity loss, and harm to marine life.

CAUSES OF ENVIRONMENTAL DEGRADATION

Social Factors:

- **Overpopulation:** Rapid population growth strains natural resources, leading to deforestation and environmental degradation.
- **Poverty and Environmental Degradation:** Poverty is both a cause and effect of environmental degradation, as impoverished individuals heavily rely on natural resources and deplete them without access to alternative resources.

Economic Development Factors:

- **Landfills:** Landfills pose environmental and health risks due to excessive waste generation.
- **Industrial Wastes:** Industrial and hazardous wastes contribute to environmental health problems.
- **Deforestation:** Deforestation caused by urbanization, population growth, and agricultural practices releases carbon and reduces forest size.
- **Urbanization and Environmental Impact:** Rapid and unplanned urbanization in India contributes to environmental degradation and the deterioration of urban environments.

Ethical Factor:

- **Climate change at global level will hurt the poorest** on the planet, seriously reduce the quality of life for future generations, and threaten plants and animals around the world.
- **Water and air pollution, the depletion of natural resources**, loss of biodiversity, destruction of ecosystems, and global climate change are all part of the environmental ethics debate.

Institutional Factors:

- **Institutional Strengthening:** Enhancing the capacity of professionals and technical staffing for effective implementation of EIA.
- **Implementation Challenges:** Addressing the shortcomings in the implementation abilities of environmental organizations at the central and state levels.

Natural Factors:

- **Ecological Disruptions:** Avalanches, earthquakes, tidal waves, storms, and wildfires can devastate local animal and plant populations, making the area uninhabitable for them.
- **Land Degradation:** Both human activities and natural events like floods and forest fires contribute to land degradation, with approximately 40% of global agricultural land being severely degraded.

CONSEQUENCES OF ENVIRONMENTAL DEGRADATION

- **Health Risks:** Exposure to toxic air pollutants can lead to respiratory problems, with increased cases of illnesses and premature deaths in major cities. **Example**: Delhi's severe winter air pollution, worsened by vehicular emissions and crop burning, leads to respiratory illnesses, straining healthcare systems.
- **Biodiversity Loss:** Deforestation, global warming, overpopulation, and pollution contribute to the loss of biodiversity, disrupting ecosystem balance and functions. **Example**: Deforestation and habitat destruction in the Western Ghats threaten unique species, disrupting ecosystems and jeopardizing local livelihoods.
- **Ozone Depletion:** Production and emission of chlorofluorocarbons (CFCs) contribute to significant ozone layer depletion. **Example**: India's industrialization contributes to ozone layer depletion through the use of ozone-depleting substances like CFCs in consumer goods.
- **Poverty and Food Insecurity:** Environmental degradation leads to inadequate resources and poor-quality food, particularly impacting impoverished regions.
- **Atmospheric Changes:** Global warming, climate change, and ozone layer depletion increase the risk of natural disasters and impact weather patterns. **Example**: Himalayan glacial melt due to global warming alters weather patterns, increasing the risk of floods and landslides, affecting agriculture and infrastructure.
- **Economic Consequences:** The costs of environmental degradation, including restoration efforts, landfill clean-up, and species protection, have significant economic implications.

PREVENTIVE MEASURES TO REDUCE ENVIRONMENTAL DEGRADATION

- **Afforestation Initiatives:** Implementation of the Compensatory Afforestation Act (2016) ensures efficient utilization of funds for planned afforestation projects.
  - The **National Afforestation Programme (2017)** focuses on eco-restoration and extensive tree plantation drives to combat deforestation and land degradation.
- **Water Conservation Measures: Rainwater Harvesting initiatives** promote the recycling of rainwater for various purposes, including agriculture, domestic, and cooking needs.

- o Utilization of the **Water Resources Information System (WRIS) database** aids in identifying and conserving rivers and streams, crucial for maintaining water resources.
- ▪ **Resource Management Strategies**: Emphasize the "Reduce, Reuse, and Recycle" approach to promote resource conservation and minimize waste generation.
  - o Adoption of renewable energy sources such as CNG and solar power, along with energy-efficient LED lighting projects, helps in reducing carbon emissions and conserving energy.
- ▪ **Sustainable Agriculture Practices**: Encourage reduced fertilizer usage to mitigate health risks associated with chemical fertilizers and preserve soil fertility.
  - o Address population growth through population control measures to alleviate the pressure on natural resources and mitigate environmental degradation.
- ▪ **Conservation and Awareness Initiatives:** Preserve biodiversity by safeguarding endangered species through conservation efforts.
  - o Raise public awareness about the importance of environmental conservation and the adverse effects of environmental degradation through educational campaigns and programs like the Green Skill Development Programme (2017).

LAND DEGRADATION AND DESERTIFICATION

A recent publication by ISRO, titled the Desertification and Land Degradation Atlas, indicates a significant increase in land degradation and desertification over recent years. The atlas provides detailed state-wise data on degraded lands for 2018-19 and includes a comparative analysis from 2003-05 to 2018-19. During this period, 97.85 million hectares (29.7%) of India's total geographical area experienced land degradation, with desertification affecting 83.69 million hectares in 2018-19.

Land degradation: It is defined as a negative trend in land condition, caused by direct or indirect human-induced processes including anthropogenic climate change, expressed as long-term reduction or loss of at least one of the following: biological productivity, ecological integrity, or value to humans.

Desertification: The **UNCCD defines desertification** as "land degradation in arid, semi-arid and dry sub-humid areas resulting from multiple causes, including climatic variations and human activities."

### FACT-WISE: LAND DEGRADATION AND DESERTIFICATION

Land Degradation
- **About 29%** or about 96.4 million hectares of land in India are considered degraded.
- **Desertification and Land Degradation Atlas of India, ISRO**: With close to 30 per cent of its geographical area already affected, land degradation is definitely among India's most pressing environmental problems
- **Global Land Outlook Report:**
  - o Over 70% of the Earth's land area has been altered from its natural state due to human activities.
  - o The global annual cost of land restoration to achieve meaningful results is expected to reach at least $300 billion by 2030.

Desertification

- According to the Desertification and Land Degradation Atlas of India (2021), there is a cumulative increase of 1.05 million ha area under desertification from the timeframe 2011-13 to 2018-19.
- Rajasthan, with the Thar Desert, is the most affected state, with approximately 61.2% of its area facing desertification.
- According to the Government's data recently presented to the UNCCD, India lost 31%, or 5.65 million hectares (MHA), of grassland area in a decade.
- The extent of degraded land in India is over 105 million hectares or about 32% of India's area.
- More than 80% of the country's degraded land lies in just nine states.

Related Facts
- **International Engagement**: The "Delhi Declaration" of 2019 emphasized better access and stewardship over land and gender-sensitive transformative projects.
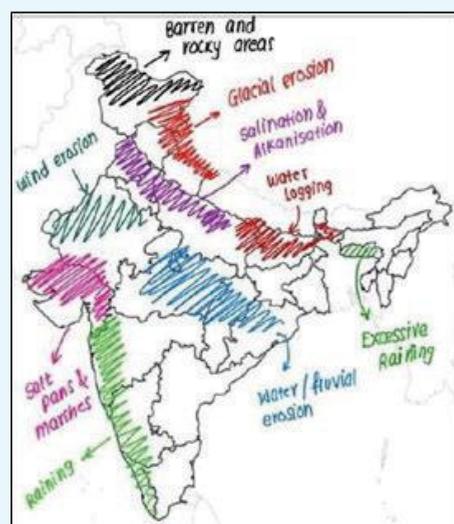
- **Increasing the forest cover:** According to the National Forest Policy of 1988, the goal is to raise it to **33.3% of the total area.** As of 2024, India's forest cover stands at 21.71% of the country's total geographical area, amounting to 713,789 square kilometres. This represents a slight increase from previous years, indicating ongoing efforts to enhance forest cover despite challenges.

CAUSES OF LAND DEGRADATION AND DESERTIFICATION

- **Loss of Soil Cover:** Loss of soil cover, primarily due to rainfall and surface runoff, constitutes a significant factor in desertification, accounting for 11.01% of the issue in the country.
  - Deforestation exacerbates soil degradation, while urbanization escalates resource demands.
- **Vegetation Degradation:** Vegetation degradation, characterized by the reduction in density, structure, species composition, or productivity of vegetation cover, contributes to **9.15% of desertification in the country.**

- **Water Erosion:** It is a major cause of land degradation in India, affecting 26.21 million hectares (Mha) of land as of 2024. It leads to Badland topography and the early stages of desertification. From 2011 to 2013, water erosion accounted for 10.98% of desertification in India, and this trend has continued in recent years.
- **Wind Erosion: Wind-driven sand encroachment** diminishes soil fertility, rendering the land prone to desertification, **constituting 5.46% of the issue in India.**
- **Climate Change:** Climate change exacerbates desertification by altering spatial and temporal patterns in temperature, rainfall, solar radiation, and winds, further aggravating the problem.

IMPACT OF LAND DEGRADATION

- **Economic Impact: Land degradation** threatens agricultural productivity, impacting rural livelihoods. **For example, Land degradation in states like** Rajasthan and Gujarat reduces agricultural output, affecting farmer incomes and exacerbating poverty.
- **Climate Change: Exacerbates climate change events**, worsening degradation. In India, deforestation in the **Western Ghats** contributes to soil erosion and loss of biodiversity, amplifying the region's vulnerability to extreme weather events like floods and landslides.
- **Water Scarcity: Deterioration in quantity and quality** of surface and groundwater resources increases vulnerability to water stress and drought. **In states like Maharashtra and Karnataka,** land degradation from unsustainable agricultural practices leads to groundwater depletion, exacerbating water scarcity for local communities.
- **Rights of Indigenous People: Insecure land tenure affects** communities' ability to fight climate change, endangering indigenous peoples' rights. **For instance, land degradation in tribal regions** threatens traditional livelihoods and cultural heritage, leading to forced migration and displacement.
- **Agricultural Productivity and Food Insecurity**: Decreased crop yields and food production increase dependence on imports and exacerbate food insecurity.
- **Biodiversity and Habitat Loss:** Loss of plant and animal species, destruction of ecosystems, and disruption of ecosystem services. **The degradation of the Sundarbans mangrove forests** in West Bengal, caused by deforestation and industrial pollution, threatens the habitat of endangered species like the Royal Bengal Tiger and disrupts coastal ecosystems, impacting local communities' livelihoods dependent on fishing and forestry.
- **Human Health:** Exposure to pollutants and contaminants from degraded land increases risks of respiratory illnesses and waterborne diseases.

GLOBAL EFFORTS TO COMBAT LAND DEGRADATION AND DESERTIFICATION

- **United Nations Convention to Combat Desertification (UNCCD):** Established in 1994 with the aim of protecting and restoring land for a safer, just, and sustainable future.
  - It is the only legally binding framework addressing desertification and drought effects, with 197 Parties, including India.
- **Bonn Challenge: A global initiative launched in 2011** to restore 150 million hectares of degraded and deforested landscapes by 2020 and 350 million hectares by 2030.
  - It surpassed the 150-million-hectare milestone in 2017 and continues to drive restoration efforts worldwide.

- The **Great Green Wall initiative** is a massive project spanning across multiple countries in Africa, aiming to combat desertification and land degradation in the Sahel region.
- **REDD+: Introduced as a concept in the early 2000s.** It is an initiative to reduce greenhouse gas emissions by addressing forest loss and degradation.
- **Glasgow Leaders' Declaration on Forests and Land Use:** The Glasgow Leaders' Declaration, signed by over 140 countries at COP26 in 2021, aims to halt and reverse forest loss and land degradation by 2030. However, recent data shows deforestation increased by 4-7% from 2021 to 2022, leading to a loss of 5.8-6.6 million hectares of forest.
  - The Forest and Climate Leaders' Partnership (FCLP), established at COP27 in 2022, aims to improve cooperation and accountability among countries. Despite these efforts, progress is lacking, with significant challenges in transparency and action.

NATIONAL EFFORTS TO COMBAT LAND DEGRADATION AND DESERTIFICATION
- **Integrated Watershed Management Programme:** Aimed at restoring ecological balance and creating rural employment by conserving and developing degraded natural resources.
  - Subsumed under Pradhan Mantri Krishi Sinchayee Yojana, implemented by NITI Ayog.
- **Desert Development Programme: Launched in 1995** to minimize adverse drought effects and rejuvenate natural resources in identified desert areas of India.
  - Targets hot desert regions like Rajasthan, Gujarat, and cold desert areas like Jammu & Kashmir, and Himachal Pradesh.
- **National Afforestation Programme: Implemented since 2000** for afforestation of degraded forest lands, aiming to enhance forest cover and ecosystem services.
  - Managed by the Ministry of Environment, Forest and Climate Change.
- **National Mission on Green India: Approved in 2014** with the objective of protecting, restoring, and enhancing India's diminishing forest cover within a 10-year timeframe.
- **Flagship Schemes: Initiatives like Pradhan Mantri Fasal Bima Yojana, Soil Health Card Scheme, and Pradhan Mantri Krishi Sinchayee Yojana** formulated to address land degradation issues through sustainable agricultural practices and soil conservation measures.

Land Degradation Neutrality (LDN)

- According to **UNCCD**, Land/Soil Degradation Neutrality (LDN) is a concept that aims to achieve a **balance between land degradation and land reclamation or conservation efforts.**
- It involves implementing measures to prevent, halt, or reverse land degradation, while also **restoring and rehabilitating degraded lands** to ensure that the overall amount and quality of land resources remain stable or improve over time.
- LDN targets are set at national or subnational levels to track progress towards achieving land degradation neutrality, often as part of broader sustainability goals such as the Sustainable Development Goals (SDGs).

WAY FORWARD
- **Multifunctional landscape approach**: Balancing stakeholder needs across landscapes to optimize biodiversity conservation while meeting human demands.
- **Farming for multiple benefits:** Shifting agricultural practices to support a wide range of social, environmental, and economic benefits, optimizing ecosystem services.
- **Managing the rural-urban interface:** Designing sustainable cities within the broader landscape to reduce environmental impacts and enhance resource efficiency.
- **Creating an enabling environment for scaling local successes**: Engaging stakeholders, ensuring land tenure security, promoting gender equality, and providing sustained investment and infrastructure.
- **No net loss of healthy and productive land:** Incentivizing sustainable consumption and production of natural resources to prevent land degradation, such as reducing food waste and greenhouse gas emissions.
- **Using alternative fuels:** Encouraging rural households to adopt alternative fuel sources and fuel-efficient devices to reduce pressure on forests, with a need for sustainable uptake and success of initiatives like the Ujjwala scheme.

- **KEY WORDS:** Land desertification; Forest cover; Vegetation degradation; Wind and water erosion; Anthropogenic factors; Endanger food resources; Afforestation; Alternative fuels use; Preventing overgrazing; Sustainable agriculture; Overexploitation of Resources.

Some successful practices
• **Sustainable Agriculture in Jamni Village, Telangana**: Cultivation of vegetable gardens on plots smaller than half an acre, utilizing dung, household waste, and ashes as organic fertilizers. • **Community Land Management in Ghana:** Formation of community groups trained in sustainable land management, leading to the implementation of participatory land use plans and the restoration of 30 hectares of degraded woodland.

SOIL POLLUTION

Soil pollution is defined as the presence of toxic chemicals (pollutants or contaminants) in the soil, in very high concentrations to pose a risk to human health and the ecosystem. A **soil pollutant** is any factor which deteriorates the quality, texture, and mineral content of the soil or which disturbs the biological balance of the organisms in the soil.

CAUSES OF SOIL POLLUTION

- **Industrial Wastes:** Untreated industrial pollutants lead to soil contamination and impair soil fertility and biological activity.
- **Fertilizers, Pesticides, and Manures:** Overuse of toxic chemicals like DDT and endosulfan contaminates soil, despite some being banned in several countries.
- **Plastics: Non-recyclable plastic** waste accumulates in landfills, degrades slowly, and releases toxic compounds that pollute soil and water.
- **Mining Activities:** Dust from mining operations settles on the soil, leading to contamination.
- **Landfills: Garbage, including non-recyclable** materials, pollutes the soil in landfill areas.
- **Construction Activities:** Waste from construction, such as wood, metal, and plastics, pollutes soil, especially on city outskirts.
- **Microbeads: Tiny plastic particles** in personal care products pollute soil, leading to significant contamination.

IMPACT OF SOIL POLLUTION

- **On the Environment:** Contaminated soil releases pollutants into groundwater and food chains, affecting all forms of life.
- **On Soil: Pollution affects** soil biodiversity, reduces its organic matter, filtering capacity, and leads to nutrient imbalances.
- **On Agriculture:** Reduces crop yield and food security while harming soil microbes and reducing soil fertility.
- **On Human Health:** Exposure to polluted soil can cause various health issues, from headaches to severe conditions like organ damage and cancer.

GOVERNMENT MEASURES

- **Soil Health Card (SHC) Scheme:** Assesses soil health and guides farmers for necessary amendments.
- **Pradhan Mantri Krishi Sinchayee Yojana:** Prevents soil erosion and promotes rainwater harvesting.
- **National Mission on Sustainable Agriculture:** Promotes sustainable agriculture practices.
- **PM-PRANAM Scheme:** Reduces the use of chemical fertilizers by incentivizing states to adopt alternatives.
- **Paramparagat Krishi Vikas Yojana (PKVY):** Encourages eco-friendly and low-cost technologies for chemical-free agricultural products.

Solid Organic Carbon (SOC)

Solid organic carbon (SOC) plays a crucial role in maintaining healthy soil and a sustainable environment. Let's delve deeper into its key aspects:

What is it?

SOC refers to the non-living organic material present in the solid fraction of soil. It originates from the decomposition of dead plants, animals, and microbial residues.

Why is it important?

Soil Health: SOC acts as a key building block for healthy soil, contributing to:

- **Improved soil structure:** SOC helps create aggregates that bind soil particles, improving drainage and aeration.

- **Increased water holding capacity:** SOC acts like a sponge, absorbing and retaining water for plants.
- **Enhanced nutrient cycling:** SOC provides essential nutrients for plants and microbial decomposition.

What are the threats to SOC?
- **Unsustainable land management practices:** Deforestation, intensive agriculture, and overgrazing can significantly deplete SOC levels.
- **Climate change:** Rising temperatures can accelerate decomposition rates and further reduce SOC stocks.

How can we protect and increase SOC levels?
- **Adopting sustainable agricultural practices:** This includes minimal tillage, cover cropping, and using compost and manure.
- **Promoting afforestation and reforestation:** Increasing vegetation cover helps add organic matter to the soil, enhancing SOC.
- **Conservation efforts:** Protecting existing forests and natural ecosystems is vital for maintaining healthy SOC levels.

WAY FORWARD
- **Reusing Materials:** Encourages reusing glass, plastic, paper, and fabric to reduce waste.
- **Recycling and Recovery:** Promotes recycling of paper, plastics, and glass to minimize pollution.
- **Reforesting:** Restores forest cover to prevent soil erosion and wasteland formation.
- **Crop Rotation and Mixed Cropping:** Enhances soil fertility and prevents nutrient depletion.
- **Solid Waste Management:** Implements proper strategies for managing solid waste disposal.

SDG Target 15 on land degradation neutrality aims to combat desertification, restore degraded land and soil, including areas affected by desertification, drought, and floods, and achieve a land degradation-neutral world by 2030.

CONCLUSION

Environmental degradation poses significant challenges to the health of our planet and the well-being of its inhabitants. Human activities, such as **industrialization, urbanization, deforestation, and pollution,** have led to widespread environmental damage, including loss of biodiversity, depletion of natural resources, and degradation of ecosystems.

By adopting a holistic approach to environmental management and conservation, we can mitigate the impacts of environmental degradation, preserve the integrity of our natural ecosystems, and ensure a sustainable future for generations to come.

PREVIOUS YEAR QUESTIONS		
1.	Coastal sand mining, whether legal or illegal, poses one of the biggest threats to our environment. Analyze the impact of sand mining along the Indian coasts, citing specific examples.	2019
2.	What are the consequences of illegal mining? Discuss the Ministry of Environment and Forests' concept of "GO AND NO GO" zones for coal mining.	2013

3 ENVIRONMENTAL POLLUTION

INTRODUCTION

Environmental Pollution refers to any addition of unwanted material in the environment due to human activities that lead to undesirable changes in the environment and ecology. For example, sewage water being released in clean water sources like tanks, rivers, etc. is an example of water pollution.

Pollutants can be solid, liquid or gaseous substances present in greater concentration than in natural abundance and are produced due to human activities or due to natural happenings. Recognized as a major global threat by the United Nations, environmental degradation diminishes the capacity of the environment to meet social and ecological needs. It includes the destruction of natural habitats and the depletion of vital resources, leading to significant declines in environmental quality.

MAJOR TYPES OF ENVIRONMENTAL POLLUTION

- Air Pollution
- Water Pollution
- Marine Pollution
- Plastic Pollution
- Soil Pollution
- Radioactive Pollution

AIR POLLUTION

The World Health Organization (WHO) defines Air pollution as contamination of the indoor or outdoor environment by any chemical, physical or biological agent that modifies the natural characteristics of the atmosphere. According to the WHO, 9 out of 10 people worldwide breathe air containing high levels of pollutants and seven million people die worldwide each year as a result of air pollution.

CURRENT SITUATION OF AIR POLLUTION IN INDIA

- **Severe Crisis:** India faces a severe air pollution crisis, significantly affecting public health and the economy.
- **Exceeding NAAQS parameters**: 436 cities/towns with a population of more than 1 lakh in 2019 exceeded the National Ambient Air Quality Standard (NAAQS) of 40 micrograms per metric cube ($\mu g/m3$).
- **Most Polluted Cities:** Nine of the top 10 most polluted cities are in India, up from six the previous year. Meanwhile, 42 cities in the top 50 are in India, up from 39; and an astounding 83 cities in the top 100 are Indian (2023 released by a Swiss firm, IQAir)
- **High PM2.5 Levels:** Particulate matter (PM2.5) levels exceed WHO recommended limits by more han ten times.
- **Health Impacts:** High pollution levels are shortening life expectancy by about 10 years in some cities. **PM2.5** particles pose serious health risks due to their ability to penetrate deep into the lungs and bloodstream.
- **Economic Cost:** The cost of air pollution in India exceeds USD 150 billion annually.

CHILDREN MOST VULNERABLE
They breathe faster than adults, taking in more pollutants

WHAT POLLUTION CAN CAUSE

99% of children under 5 are exposed to dangerous levels of PM2.5

FOR FETUSES
- Raised risk of preterm birth
- Underdeveloped lung, other organs
- Increased risk of infant mortality

FOR INFANTS
- Eye, lungs and skin allergies and infections
- Conditions like cough, pnuemonia
- Chances of long-term cognitive impairment

FOR PRE-TEENS & TEENS
- Chronic coughs, bronchitis and/or asthma attacks
- Increased risk of cardiovascular disease and leukaemia

SOURCES OF AIR POLLUTION

- **Combustion Of Fossil Fuels**: The combustion of fossil oil creates SOx and NOx and these are believed to have a bad effect on the environment, the atmosphere and the ozone layer.
- **Industrial Pollution**: Manufacturing industries release a huge amount of carbon monoxide, organic compounds, hydrocarbons, and chemicals into the air, thereby depleting the quality of air.
- **Waste Incineration**: Waste incineration creates and/or releases harmful chemicals and pollutants, including-Air pollutants such as particulate matter, which cause lung and heart diseases.
- **Agricultural Processes**: Fumes from nitrogen-rich fertilizers and animal waste combine in the air with combustion emissions to form solid particles in the air.

KEYWORDS: Public Trust Doctrine; 5Ps (SDGs): People, Planet, Prosperity, Peace, and Partnerships; Intergenerational Equity; Absolute Liability Principle; Global Stocktaking; Psychiatric Disorders; Outdoor Air Pollution; Productivity Losses And Degraded Quality Of Life; Mean Acidifying Emissions; Stationary Sources;

Emission Factors; Gas chamber; Public health emergency; Graded Response Action Plan (GRAP).

CONSEQUENCES OF AIR POLLUTION

- **Adverse Health Impacts:** It increases the risk of respiratory infections, heart disease and lung cancer. It kills 800 people every hour or 13 every minute. This accounts for more than 3 times the amount of people who die from malaria, tuberculosis and AIDS combined each year.
- **Socio Economic Impacts**: It impairs cognitive functioning and decision-making. It has a negative economic impact on work productivity. Furthermore, it exacerbates criminal behavior on a social level. Other research indicates that air pollution has a negative impact on people's life satisfaction and well-being.
- **Marginalized section more vulnerable:** Poor people are more vulnerable to air pollution because they are the one who spend more time on roads
- **Household air pollution:** It causes about 3.8 million premature deaths each year. The vast majority of them are in the developing world, and about 60% of these deaths are among women and children.
- **Environmental Effects:**
  - **Acid Rain:** Precipitation containing harmful amounts of nitric and sulfuric acids. If the concentration of ammonia in water is above 1 ppm it is toxic to fishes.
  - **Eutrophication**: Condition in a water body where high concentrations of nutrients (such as nitrogen) stimulate blooms of algae, which in turn can cause fish kills and loss of plant and animal diversity.
  - **Ozone Depletion: The "good" ozone** is gradually being destroyed by man-made chemicals referred to as ozone-depleting substances, including chlorofluorocarbons, hydrochlorofluorocarbons, and halons.
  - **Crop And Forest Damage:** Ground-level ozone can lead to reductions in agricultural crop and commercial forest yields, reduced growth and survivability of tree seedlings, and increased plant susceptibility to disease, pests and other environmental stresses (such as harsh weather).

INITIATIVES TO CONTROL AIR POLLUTION IN INDIA

- **National Clean Air Programme (NCAP):** The Central Government has launched the National Clean Air Programme (NCAP) under the Central Sector "Control of Pollution" Scheme as a long-term, time-bound, national-level strategy to address the country's air pollution problem.
- **BS6 Phase 2:** The BS6 phase 2 real driving emissions (RDE) norms come into effect in India from April 1, 2023.
- **Graded Response Action Plan (GRAP):** On **January 12, 2017,** the Graded Response Action Plan (GRAP) was notified for the prevention, control, and abatement of air pollution in Delhi and the National Capital Region. It identifies graded measures and implementing agencies for four AQI categories: Moderate to Poor, Very Poor, Severe, and Severe + or Emergency.
- **National Air Quality Index (AQI)**: It focuses on health effects one might experience within a few hours or days after breathing polluted air.
- **Pradhan Mantri Ujjwala Yojana (PMUY)**: It aims at providing clean-cooking fuel to poor households and bringing in qualitative charges in the living standards.

WAY FORWARD

- **Regulations and Standards:** Implementation of stringent air quality standards and regulations to limit emissions of pollutants from industrial facilities, power plants, vehicles, and other sources.
- **Transition to Clean Energy:** Promotion of renewable energy sources such as solar, wind, and hydropower to reduce reliance on fossil fuels and decrease emissions of greenhouse gases and air pollutants.
- **Vehicle Emission Controls:** Implementation of vehicle emission standards and regulations to reduce pollutants emitted from automobiles, including particulate matter, nitrogen oxides, sulfur dioxide, and volatile organic compounds.
- **Transportation Planning and Management:** Implementation of sustainable transportation strategies, such as promoting public transit, biking, walking, and ridesharing, to reduce vehicle congestion, emissions, and air pollution in urban areas.
- **Awareness and Education:** Public awareness campaigns, education programs, and community engagement initiatives to raise awareness about the causes, effects, and solutions to air pollution.

Bharat Stage Norm
• Bharat stage emission standards are emission standards instituted by the Government of India to regulate the output of air pollutants from compression ignition engines and Spark-ignition engines equipment, including motor vehicles. • India has adopted Bharat Stage (BS) Emission Standards since 2000, modelled on EU norms. • In April 2020, India leapfrogged from BS-IV to the implementation of BS-VI, with current standards similar to Euro-6/VI norms. • The BS standards regulate tailpipe emissions of air pollutants including particulate matter, SOx and NOx as well as carbon monoxide, hydrocarbons and methane. They have been developed for all vehicle categories and apply to vehicles manufactured since April 2020.

STUBBLE BURNING

The process of burning straw stubble that remains after the harvest of grains such as rice, wheat, etc. is known as **stubble burning.** To prepare fields for sowing wheat, which takes place between the end of September and the beginning of November, stubble (parali) is burned.

During the months of October and November, the practice is particularly common in Punjab, Haryana, and Uttar Pradesh.

RELATED FACTS

- **According to the Commission for Air Quality Management (CAQM),** the number of fires caused by Stubble Burning in Delhi and the NCR (National Capital Region) has decreased by 31.5% between 2021 and 2022.
- According to an estimate, 20 million tonnes of rice stubble is produced every year in Punjab alone, 80 per cent of which is burnt.
- In 2023, stubble burning incidents in Punjab decreased by an additional 25% compared to 2022, while Haryana saw a further 18% reduction. Uttar Pradesh reported a 15% decrease. The fire counts are based on data from NASA satellites.

IMPACT

- **Environmental damage:** It is caused by burning stubble, which releases poisonous gases such as carbon monoxide, methane, polycyclic aromatic hydrocarbons, and volatile organic compounds.
- **Impact on Soil Properties:** Heat from burning wastes raises soil temperature, which kills beneficial soil organisms.
- **Impacts on Human Health:** The resulting air pollution has had a number of negative health consequences on people, ranging from skin irritation to serious neurological, cardiovascular, and pulmonary issues.
- **Insufficient Infrastructure:** Farmers burned over 15.4 million metric tonnes (out of 19.7 MMT) of stubble in open fields because there was insufficient infrastructure for managing it.
- **Negative effects of agricultural subsidies:** Crop yields and agricultural production have significantly increased as a result of subsidies for power and fertilisers, as well as improved access to loans in the agricultural sector.

STUBBLE BURNING: CHHATTISGARH MODEL
• Gauthans are set up as part of the Chhattisgarh Innovative Model. • Each village owns a five-acre plot known as a Gauthan where residents can donate leftover stubble or parali to be gathered and converted into organic fertiliser by combining cow manure with natural enzymes.

INITIATIVES TO TACKLE STUBBLE BURNING

- **National Air Quality Management Commission:** Functions of the Commission include: (i) co-ordinating actions taken under the Ordinance by concerned state governments (Delhi, Haryana, Punjab, Rajasthan, and Uttar Pradesh), (ii) planning and executing plans to prevent and control air pollution in the NCR, (iii) providing a framework for identification of air pollutants, (iv) conducting research and development through networking with technical

institutions, (v) training and creating a special workforce to deal with issues related to air pollution, and (vi) preparing various action plans such as increasing plantation and addressing stubble burning.

- **PUSA Decomposers**: Recently, scientists have developed a **bio-decomposer technique** called 'PUSA Decomposers' for converting crop stubble into compost.
- **Combine Harvester**: Improvement should be made in the technology used in such machines so that minimal residue is left behind.
- **Centralized Control Room**: It must be set up to issue directions both for ensuring that appropriate technology to tackle this issue is within the reach of farmers and also ensure enforcement of non-compliance.
- **Encourage And Incentivise The Farmers**: To go for early paddy, so as to give them enough time to harvest and thereafter prepare their fields for the next Rabi crop.
- **Sow alternate crops**: Encourage farmers to sow alternate crops and shift them away in the long run from paddy to maize, fruits, vegetables and cotton.
- **Central Sector Scheme for Crop Residue Management:** The Central Sector Scheme on 'Promotion of Agricultural Mechanisation for In-Situ Management of Crop Residue' targets the states of Punjab, Haryana, Uttar Pradesh, and the NCT of Delhi. This scheme provides subsidies to farmers for in-situ crop residue management machinery and supports the establishment of Custom Hiring Centers (CHCs) to facilitate access to this equipment.

WAY FORWARD
- **Subsidizing Innovative Farm Technologies:** Recent innovations like happy seeder, rotavator, baler, paddy straw chopper, etc. are costly but they could help farmers to manage crop residues effectively.
- **New and Improved seed varieties:** Using improved varieties of rice and wheat crops, particularly short-duration crop varieties.
  o For example, **Pusa Basmati-1509 and PR-126** mature quickly and also improve the quality of the soil.
- **Using Bio-Waste Decomposers:** These decomposers contain agricultural micro-organisms which increase the Feed Conversion Ratio (FCR).
  o For instance, using Pusa-bio-decomposer, developed by the scientists at the Indian Agricultural Research Institute, which turns crop residue into manure in 15-20 days by accelerating the decomposition process.
- **Palletization:** After being dried and made into pellets, paddy straw can be combined with coal to be utilised as fuel in thermal power plants and other industrial facilities.
- **Alternative Uses:** As cow feed, compost manure, roofing in rural regions, packing material, paper-making, and the production of bioethanol.

NEW TARGETS FOR NATIONAL CLEAN AIR PROGRAMME (NCAP)

The National Clean Air Programme has been launched by the Ministry of Environment, Forest and Climate Change as a comprehensive initiative in partnership with various Ministries and States to improve air quality at city, regional and national level. It is a focused and time bound scheme to implement various sectoral policies, strengthen monitoring and enhance public participation in more than 100 cities for effective air quality management. Important points of NCAP are as following:

- **Goal to reduce emission:** The goal of the NAACP is to reduce PM2.5 and PM10 concentrations by 20%-30% by using 2017 as the baseline year for comparison.
- **Non-attainment cities:** Based on Air Quality data from 2014 to 2018, 132 non-attainment cities were identified across the country under NCAP.
- **City-specific action plan:** Preparation of city-specific action plans, which include measures to improve the monitoring network, reduce vehicular/industrial emissions, and raise public awareness.
- **Regular monitoring:** The implementation of city-specific action plans will be regularly monitored by Central and State Committees, specifically the Steering Committee, Monitoring Committee, and Implementation Committee.
- **Reliable data**: To supplement and develop effective and efficient ambient air quality monitoring networks across the country in order to ensure a comprehensive and reliable database.
- **Effective data dissemination:** To have an effective data dissemination and public outreach mechanism in place for timely measures to prevent and mitigate air pollution.
- **Workable management plan:** To have a workable management plan for the prevention, control, and reduction of air pollution.

PERFORMANCE ANALYSIS REPORT OF NCAP BY CREA
The Centre for Research on Energy and Clean Air (CREA) released a report analyzing the four-year performance of the National Clean Air Programme (NCAP) in India. Here's a summary of their findings:

Positive aspects

- **Air quality improvement:** 90 cities out of 131 cities have shown improvement in air quality in terms of annual PM10 concentrations in FY 2022-23 with respect to the baseline of FY 2017-18.
- Framework established: Committees and frameworks for implementing, monitoring, and reviewing NCAP actions have been formulated.

Areas for improvement

- **Target achievement:** Only 38 cities achieved their annual pollution reduction targets.
- **Slow progress:** Only 37 out of 131 cities have completed source apportionment studies, crucial for identifying pollution sources.
- **Limited transparency:** Information sharing on the functioning and effectiveness of NCAP measures at the state level remains opaque.
- **Incomplete monitoring network:** The rural air quality monitoring network is limited, and efforts to expand it haven't been fully realized.

Recommendations by CREA:

- **Enhanced coordination and monitoring:** Strengthen collaboration between various stakeholders and improve air quality monitoring, particularly in rural areas.
- **Effective utilization of funds:** Ensure allocated funds are used efficiently for implementing NCAP actions.
- **Reassessing non-attainment cities:** Reevaluate the list of non-attainment cities based on recent air quality data to ensure all polluted areas are included in the program.
- **Increased transparency:** Improve public access to information on NCAP implementation and progress.

Overall, the analysis suggests that while there has been some progress in improving air quality, the NCAP's implementation needs significant improvement to achieve its ambitious goals.

COMMISSION FOR AIR QUALITY MANAGEMENT (CAQM)

The Commission for Air Quality Management in the National Capital Region (NCR) and Adjoining Areas (CAQM) was formed through the CAQM Ordinance of 2020 and subsequently enshrined in the **CAQM Act of 2021.** This legislation aims to establish a commission for enhanced **coordination, research, identification, and resolution of issues** pertaining to air quality within the NCR and its surrounding regions.

- **Composition:**
  - **Chairperson:** A government official with the rank of Secretary or Chief Secretary will preside over the meeting.
  - **Governance Structure:** The chairperson will serve for three years or until reaching the age of 70. The committee will include representatives from various ministries and stakeholder states. Additionally, experts from the Central Pollution Control Board (CPCB), the Indian Space Research Organisation (ISRO), and civil society will be present.
- **Functions and abilities:**
  - It will have the authority to issue directives to these state governments on air pollution issues.
  - It will consider complaints as necessary to protect and improve the quality of the air in the NCR and surrounding areas.
  - It will also establish parameters for controlling air pollution.
  - It will also be in charge of identifying violators, monitoring factories and industries, as well as any other polluting unit in the region, and will have the authority to shut them down.
  - It will also have the authority to overturn directives issued by state governments in the region that may violate pollution standards.
- **CAQM's Ban on Coal Usage in Delhi-NCR:** Recently CAQM issued orders prohibiting the use of coal in industrial, domestic, and other non-essential applications throughout the Delhi-NCR region beginning January 1, 2023.
  - This step is being taken to reduce greenhouse gas emissions in the Delhi NCR. Delhi is one of the most polluted capital cities in the world.
  - It will save 1.7 million tonnes of coal per year.
  - It will also aid in the reduction of pollutants such as particulate matter (PM), nitrogen oxide (NOx), CO_2 and CO.

WHO GLOBAL AIR QUALITY GUIDELINES

Recently, the World Health Organization (WHO) released new Global Air Quality Guidelines (AQGs), further lowering the recommended safe levels of pollutants for human health. This marks the first update from WHO since 2005, aiming for all countries to achieve these recommended air quality levels.

New Guidelines

- The guidelines recommend new air quality levels to protect public health by reducing key air pollutants, some of which also contribute to climate change.
- By striving to meet these levels, countries will both safeguard health and mitigate global climate change.
- WHO's move paves the way for governments to adopt stricter air quality standards.
- The new guidelines specify levels for six pollutants with the most advanced evidence on health effects from exposure: particulate matter (PM2.5 and PM10), ozone (O3), nitrogen dioxide (NO2), sulfur dioxide (SO2), and carbon monoxide (CO).

REVISED AFTER 16 YEARS
WHO | Then & Now

Pollutant*	Average	2005*	2021*
PM2.5	Annual mean	10	5
	24-hour mean	25	15
PM10	Annual mean	20	15
	24-hour mean	50	45
O₃	Peak season	NS**	60
	8-hour mean	100	100
NO₂	Annual mean	40	10
	24-hour mean	NS**	25
SO₂	24-hour mean	20	40
CO	24-hour mean	NS**	4

India's National Ambient Air Quality Standards (NAAQS)
Average
● Annual mean
● 24-hour mean
PM2.5 — 40 | 60
PM10 — 60 | 100
NO₂ — 40 | 80
SO₂ — 50 | 80
Average (8 hour mean)
O₃ | 100; CO | 2

* micrograms per cubic meter (µg/m3); **NS - Not Set; PM2.5 & PM10 - Particulate Matters; O₂ - Ozone; NO₂ - Nitrogen Dioxide; SO₂ - Sulfur Dioxide; CO - Carbon Monoxide

IMPACT OF NEW GUIDELINES ON INDIA
- The new air quality guidelines classify nearly all of India as a polluted zone for most of the year. The new WHO norms should incentivize India to intensify efforts to improve air quality.
- Implementing the new guidelines may be challenging, particularly in South Asia, including India, due to difficult meteorological and climatic conditions, haze, heat islands, and high baseline pollution levels.
- Since WHO's guidelines are not legally binding, India is not immediately affected as its National Ambient Air Quality Standards (NAAQS) currently do not meet WHO's previous standards.
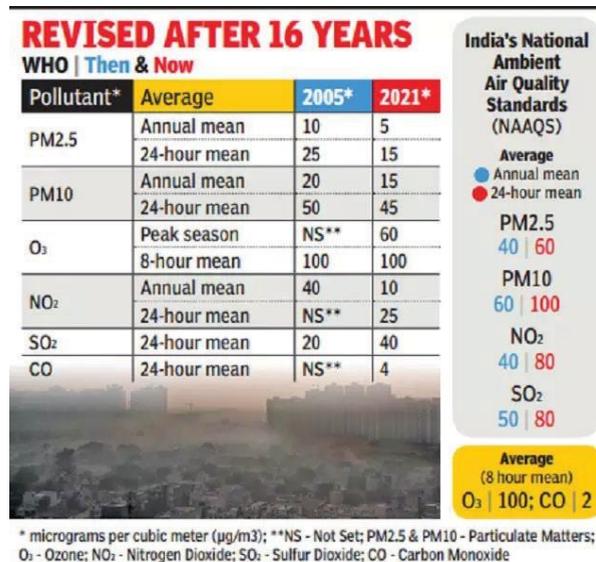
WATER POLLUTION

Water pollution is the contamination of water bodies, usually as a result of human activities, in such a manner that negatively affects its legitimate uses. Water pollution reduces the ability of the body of water to provide the ecosystem services that it would otherwise provide.
- **SDG 6 (Clean Water & Sanitation):** "Ensure universal access to and sustainable management of water and sanitation".
- **SDG 14:** The official wording is to "Conserve and sustainably use the oceans, seas and marine resources for sustainable development".

FACT WISE

- **Water-Stressed: According to WHO Over 2 billion people** live in water-stressed countries, which is expected to be exacerbated in some regions as a result of climate change and population growth.
- **Contamination: Globally, at least 2 billion people** use a drinking water source contaminated with faeces. Microbial contamination of drinking water as a result of contamination with faeces poses the greatest risk to drinking water safety.
- **Almost 60% of polluted river stretches exist in eight states:** Maharashtra, Assam, Madhya Pradesh, Kerala, Gujarat, Odisha, West Bengal and Karnataka.
- **Safely Managed Drinking-Water Service:** In 2022, 78% of the global population (approximately 6 billion people) used a safely managed drinking water service, which means the water was located on premises, available when needed, and free from contamination. This marks an improvement from previous years, reflecting ongoing efforts to provide clean and accessible drinking water worldwide.
- **As per NITI Aayog: Overall, 70 per cent** of the freshwater sources in the country were found to be contaminated and **India ranks 120 out of 122 countries** in terms of water quality.

CAUSES OF WATER POLLUTION
- **Sewage Water**: Includes discharges from residential and commercial areas containing human and animal waste, food remnants, cleaning agents, and contaminants.
  - Can harbor pathogenic microorganisms from household and hospital sewage.
- **Industrial Wastes:** Wastewater from industries like petroleum, paper manufacturing, metal extraction, and chemical manufacturing contains toxic substances such as heavy metals (mercury, cadmium, lead), and organic compounds.
  - Industrial discharges contribute significant pollution.

- **Agricultural Factors:** Runoff from agriculture introduces dissolved salts, nutrients (nitrates, phosphates), pesticides, and organic compounds.
  - Fertilizers and pesticides leach into groundwater or mix with surface water, posing threats to water quality.
- **Presence of organic and inorganic wastes** reduces **Dissolved Oxygen (DO)** content crucial for aquatic life. Low DO levels indicate high pollution, affecting aquatic organisms' survival.
- **Thermal and Radiation Pollution:** Thermal pollution from hot water discharge by industries and power plants elevates water temperature, reducing DO and threatening aquatic life.
  - Nuclear accidents near water bodies pose radiation risks, leading to DNA mutations in marine organisms and potential cancer risks.
- **Marine Pollution: Oceans receive pollutants** from sewage, garbage, and industrial discharges, affecting marine ecosystems and biodiversity.
  - Pollution sources include navigation activities, offshore oil mining, and oil spills, posing threats to aquatic life.

- **Point source pollution originates from specific locations,** such as industrial drain pipes or sewage treatment plants, where contaminants are discharged directly into water bodies. These sources are identifiable and easier to regulate compared to non-point sources.
- **In contrast, non-point source pollution involves pollutants** from diffuse origins or larger areas, making it challenging to identify and regulate. Runoff from agricultural fields, urban areas, and construction sites carries contaminants into water bodies, contributing to non-point source pollution.

BIOLOGICAL OXYGEN DEMAND (BOD)
- **Meaning**: In simpler words, the amount of oxygen needed by biological organisms such as bacteria in a given water sample for a breakdown of organic matter by oxidation process is called the Biochemical Oxygen Demand.
- I**ndicator of ohe Level Of Environmental Pollution:** Biological oxygen demand can be used as an indicator of the level of environmental pollution. For instance, the high levels of organic matter (in polluted water bodies or sewage), the greater the BOD.

CHEMICAL OXYGEN DEMAND (COD)
- **Meaning**: COD is a measure of the capacity of water to consume oxygen during the decomposition of organic matter and the oxidation of inorganic chemicals such as Ammonia and nitrite. COD measurements are commonly made on samples of wastewater from natural waters contaminated by domestic or industrial wastes.
- **Difference Between BOD And COD:** The main difference between BOD and COD is that BOD is the amount of oxygen that is consumed by bacteria while decomposing organic matter under aerobic conditions whereas COD is the oxygen required for the chemical oxidation of total organic matter in water.

EFFECTS OF WATER POLLUTION
- **Lower Dissolved Oxygen:** Higher biological and chemical oxygen demand reduces dissolved oxygen, threatening sensitive organisms like plankton, mollusks, and fish. **For example, in the Yamuna River**, industrial and domestic wastewater discharge reduces dissolved oxygen levels, endangering aquatic life.
- **Threats to Many Species:** Industries discharging hot water lower dissolved oxygen, jeopardizing various species. In Gujarat's industrial areas, thermal power plants release hot water into rivers, impacting aquatic ecosystems and fish populations.
- **Threats to Aquatic Species**: Biocides, PCBs, and heavy metals pose severe toxicity to aquatic species. **In the Ganges River,** industrial effluents containing heavy metals like lead and mercury endanger aquatic organisms, affecting the river's biodiversity.
- **Water-borne Diseases:** Water pollution leads to diseases like jaundice, cholera, and typhoid. **For example, In rural areas of Bihar,** contaminated water sources contribute to outbreaks of water-borne diseases, affecting public health.
- **Mercury Compounds:** Bacterial action converts mercury compounds in wastewater into toxic methyl-mercury, causing neurological disorders like Minamata disease. **In Kerala's Periyar River,** discharge from industries releases mercury, impacting local communities' health.
- **Cadmium Contamination**: Cadmium contamination in water can cause itai-itai disease and cancers.
- **Adverse Impact on Water Bodies**: Between 2019 and 2022, the Central Pollution Control Board (CPCB) identified 311 polluted stretches on 279 rivers. Despite efforts to reduce pollution, challenges persist, affecting the availability of clean water for rural and urban areas alike.

CONTROL MEASURES OF WATER POLLUTION

- **Sewage and Industrial Effluent Treatment**: Mandate proper treatment of sewage water and industrial effluents before discharge into water bodies to minimize contamination.
- **Cooling of Hot Water:** Ensure power plants cool hot water before release to prevent thermal pollution, preserving the ecological balance of receiving water bodies.
- **Prohibition of Domestic Cleaning in Water Sources:** Prohibit domestic cleaning activities in water sources supplying drinking water, safeguarding water quality.
- **Reduced Fertilizer and Pesticide Use:** Encourage judicious use of fertilizers and pesticides to minimize nutrient runoff and chemical pollution of water bodies.
- **Promotion of Organic Farming:** Advocate for organic farming practices and utilize animal waste as fertilizer to reduce chemical inputs, promoting eco-friendly agriculture.
- **Utilization of Water Hyacinth:** Harness water hyacinth to purify water by extracting toxins and heavy metals, contributing to water quality improvement efforts.

RIVER POLLUTION

Recent Context: Pollution levels in the tributaries of the Ganga River in Uttarakhand, especially in Udham Singh Nagar district, have surged significantly. Recent findings from the Uttarakhand Environment Protection and Pollution Control Board highlight alarming contamination levels, emphasizing a pressing environmental challenge in the region.

FACT WISE
Lack of access to safe drinking water: More than 163 million Indians – a population larger than Russia – lack access to safe drinking water.   **Water stress in rural areas**: Regardless of the source of water, availability of water decreases dramatically in most rural India during the summer months as water levels drop and surface sources may dry up.   **Water scarcity**: In 2025, India's per capita water availability is expected to be 1,341 cubic meters. This could fall to 1,140 cubic meters by 2050, bringing the country closer to water scarcity.   **NITI Aayog Composite Water Management Index**: According to the NITI Aayog Composite Water Management Index, **India ranks 120th out of 122 countries.**

SOURCES OF RIVER POLLUTION

- **Marine Dumping:** Numerous countries dispose of household waste in oceans, adding to marine pollution. These materials decompose slowly, harming marine ecosystems and water quality.
- **Sewage and Wastewater:** Despite treatment, sewage and wastewater still contain harmful chemicals, bacteria, and pathogens. Discharging them into water bodies introduces disease-causing agents, posing risks to human health and aquatic life. **For example**, in cities like Delhi, untreated sewage is discharged into the Yamuna River, leading to waterborne diseases and ecological degradation.
- **Excess fertilizers and pesticides**: They may reach the groundwater by leaching or may be mixed with surface water of rivers, lakes and ponds by runoff and drainage.
- **Chemicals & Effluents**: Industrialisation along the river belt is polluting the water with chemicals and other industrial effluents.
  - **For example,** the river Yamuna is now severely affected by Ammonia pollution and heavy froths are seen in Yamuna.
- **Garbage Dumping:** High population density around the river banks and the reckless dumping of non-biodegradable waste, especially plastics, is further adding to water pollution.
- **Sand Dredging:** High-quality sand from river beds is needed for India's booming construction industry. This has led to rising pollution in Indian rivers.
- **Formalin (Methanal) Contamination:** The Food Safety and Standards Authority of India (FSSAI) has banned formaldehyde in fresh fish, while the International Agency for Research on Cancer labelled the chemical a carcinogen.

POSSIBLE CONSEQUENCES OF RIVER WATER POLLUTION

- **Impact on Flora & Fauna:** Chemical, effluents and sewage that pollute Indian rivers is causing several species of aquatic life to go extinct or move away to safer havens.

- **Food Security**: Fish from polluted rivers is found to be high in mercury, lead and cadmium and hence, unfit for human consumption. Also, edible fish is contaminated with Salmonella, Shigella and other harmful microbes found in human faeces.
- **Drinking Water:** According to **NITI Aayog, a whopping 200,000 people** lose their lives every year due to various problems caused by consuming contaminated water.
- **Agriculture**: While agriculture is impacted adversely by the rising pollution of rivers, it is also one of the reasons for contaminating waters. Polluted water does not allow seeds to germinate and cause stunted growth, denying farmers of a bumper harvest.
- **Loss of Livelihood**: Fishermen and fish farms that once flourished on banks of various Indian rivers are finding it increasingly difficult to find sufficient catch of edible fish.
- **Loss of Export Revenue:** Freshwater fish varieties including the famous Hilsa, Rohu, Katla and prawns from Indian rivers once had a high demand in foreign countries, especially in the Middle East.

MEASURES TO CONTROL RIVER POLLUTION

- **Reducing the effluent concentration of the waste input by:** Wastewater treatment**;** Industrial in-plant process control**;** Eliminating effluent constituents by pre-treatment prior to discharge to sewer systems or by different product manufacturing for the industry.
- **Reducing the effluent volume by:**
  o Reduction of direct industrial discharge volumes into the municipal sewer system.
  o Reduction in infiltration into municipal sewer systems.
  o Reduction of waste volumes through process modifications in industries.
- **Increasing the upstream flow**: By low flow augmentation, i.e., releases from upstream reservoir storage or from diversion from nearby water bodies.
- **Water hyacinth (Eichhornia crassipes)**: Other aquatic weeds are used to upgrade wastewater treatment lagoons and treat chemical wastewater.
- **Rejuvenating the rivers**: **National Mission for Clean Ganga (NMCG)** takes measures for the prevention, control, and abatement of environmental pollution in River Ganga. It aims to ensure a continuous adequate flow of water so as to rejuvenate the river, Ganga.
  o **Namami Gange Project:** It integrates the efforts to clean and protect the Ganga River in a comprehensive manner.
  o National Mission for Clean Ganga launched the capacity building initiative on 'making water sensitive cities in Ganga basin.
- **Implementing national water policy**: **National Water Policy (2012)** aims to take cognizance of the existing situation, to propose a framework for the creation of a system of laws and institutions and for a plan of action with a unified national perspective. It suggests frameworks to conserve water resources through optimal, economical, sustainable and equitable means.

NAMAMI GANGE INITIATIVE

- **UN Recognized Namami Gange initiatives a**s one of top 10 World Restoration Flagships programmes aimed at reviving the natural world.
- **An Integrated Conservation Mission** aims to achieve the dual goals of **effectively reducing pollution and conserving and revitalizing the National River Ganga.**
  o Under this mission, all newly sanctioned projects receive full funding from the Central Government for the entire lifecycle cost of treatment assets.
  o This funding covers not only the creation of treatment facilities but also includes the 15-year Operation & Maintenance (O&M) costs.
- **Key Features**
  o **Implemented by the National Mission for Clean Ganga (NMCG)** since 2016, along with state counterparts through State Programme Management Groups.
  o **A Central Sector Scheme funded by the World Bank** under the Ministry of Jal Shakti.
  o **Organized into a 5-tiered structure,** including the National Ganga Council chaired by the Prime Minister, Empowered Task Force chaired by the Union Minister of Jal Shakti, National Mission for Clean Ganga (NMCG), State Ganga Committees, and District Ganga Committees.
  o **Namami Gange Mission-II (NGM-II)** was approved by the Cabinet in 2022 with an outlay of Rs. 22,500 Crore, extending until March 31, 2026.

- **Issues with implementation of Namami Gange program:**
  - o **Project delays due to challenges** in obtaining permissions from entities like the National Highways Authority of India (NHAI) and Railways.
  - o **Poor financial management**, with only about Rs. 13,000 Crore of funds released/ expended by NMCG to State Governments, State Missions for Clean Ganga (SMCG), and other agencies.
- **Way Forward**
  - o Implement pricing mechanisms to generate sufficient revenues for the operation and maintenance (O&M) of water and wastewater infrastructure.
  - o Utilize platforms like the River Cities Alliance (RCA) to facilitate the exchange of best practices among river cities.

MARINE POLLUTION

Marine pollution is a combination of chemicals and trash, the majority of which originates on land and is **washed or blown into the ocean.** This pollution harms the environment, the health of all organisms, and global economic structures.

The **oceans cover over 70% of the globe**. Its health, the well-being of humanity and the living environment that sustains us all are inextricably linked. **Yet neglect of ocean acidification, climate change, polluting activities and over-exploitation** of marine resources have made oceans, one of the earth's most threatened ecosystems.

FACT WISE (IUCN Report)

- **Livelihood Support**: Over three billion people depend on marine and coastal biodiversity for their livelihoods.
- **Large Economy**: Globally, the market value of marine and coastal resources and industries is estimated at $3 trillion per year or about 5 per cent of global GDP.
- **Huge Production**: Every year, over 300 million tonnes of plastic are produced for use in a wide range of applications.
- **Plastic Marine Debris**: Every year, at least 14 million tonnes of plastic end up in the ocean, and plastic accounts for 80% of all marine debris discovered from surface waters to deep-sea sediments

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CAUSES OF MARINE POLLUTION

- **Sewage: Sewage and pollutants flowing through** sewage systems, rivers, and drains directly contribute to ocean pollution. **For example, untreated sewage from cities like Mumbai and Kolkata** is discharged directly into the Arabian Sea and Bay of Bengal, respectively, impacting marine ecosystems.
- **Toxic Chemicals from Industries:** Direct discharge of industrial waste into oceans leads to pollution. **In regions like Gujarat's industrial belt,** chemical industries discharge toxic effluents into the Gulf of Khambhat, affecting marine life and coastal habitats.
- **Runoff from land-based sources,** including agricultural fields and urban areas, accounts for approximately 80% of marine pollution.
- **Large Scale Oil Spills:** Pollution from ships, particularly oil spills, poses a significant threat to ocean health. **For example, the 2020 oil spill off the coast of Chennai**, caused by a collision between two ships, resulted in extensive oil contamination along the Tamil Nadu coastline, impacting marine biodiversity.
- **Ocean Mining:** Mining operations in the ocean for minerals like silver, gold, and copper create sulfide deposits, affecting marine ecosystems. **In regions like the Andaman Sea**, ongoing mining activities pose risks to coral reefs and marine biodiversity.
- **Plastic Pollution**: Floating plastic debris, such as the Great Pacific Garbage Patch, is a major concern for ocean health.
- **Deoxygenation Causes**: Factors like eutrophication from nutrient runoff, nitrogen deposition from fossil fuel burning, and ocean warming contribute to deoxygenation.

Climate change impact on Ocean
1. **Marine Life Impact:** Warming oceans displace North Atlantic right whales, increasing deadly ship strikes and fishing entanglements, while lowering calving rates.
2. **Interference with Oceanic Circulation:** Climate warming slows the Atlantic Meridional Overturning Circulation, shifting the Gulf Stream northward, affecting the Gulf of Maine.
3. **Warming of the Gulf of Maine:** Decline in copepod populations reduces food supply for right whales, prompting migration to colder waters in the Gulf of St. Lawrence.

> 4. **Promoting Catastrophic Events:** Rising sea levels increase the risk of volcanic eruptions on Santorini by affecting crustal stability.

EFFECTS OF MARINE POLLUTION

- **Effect of Toxic Wastes on Marine Animals: Long-term exposure to toxic wastes** can lead to cancer, reproductive system failure, and behavioral changes in marine life.
- **Disruption to the Cycle of Coral Reefs: Oil spills** can float on the water's surface, blocking sunlight and hindering photosynthesis in marine plants, impacting coral reef health.
  - **Example**: Deepwater Horizon oil spill causing extensive damage to coral reefs in the Gulf of Mexico.
- **Depletion of Oxygen Content in Water**: Reduced oxygen levels in water decrease the survival chances of marine animals like whales, turtles, sharks, dolphins, and penguins.
- **Eutrophication**: Excessive nutrients lead to algal blooms, depleting oxygen levels and harming aquatic ecosystems.
- **Failure in the Reproductive System of Sea Animals:** Pesticide chemicals accumulating in the fatty tissue of animals can disrupt their reproductive systems.
  - **Example**: DDT contamination leading to thinning of bird eggshells and reproductive failure in seabird populations.
- **Effect on Food Chain:** Small animals ingest pollutants, passing them up the food chain to larger animals, leading to bioaccumulation and biomagnification.
  - **Example**: Mercury contamination in fish affecting predatory marine mammals like dolphins and orcas.

GLOBAL INITIATIVES

- **The Global Programme of Action (GPA) for the Protection of the Marine Environment from Land-based Activities:** The GPA is the only global intergovernmental mechanism directly addressing the connectivity between terrestrial, freshwater, coastal and marine ecosystems.
- **MARPOL Convention (1973):** It covers pollution of the marine environment by ships from operational or accidental causes. It lists various forms of marine pollution caused by oil, noxious liquid substances, harmful substances in packaged form, sewage and garbage from ships, etc.
- **The London Convention (1972)**: Its objective is to promote the effective control of all sources of marine pollution and to take all practicable steps to prevent pollution of the sea by the dumping of wastes and other matter.
- **Greenpeace**: It is an environmental NGO that is dedicated to conserving the oceans and marine life across the globe. Its grassroots efforts have resulted in the ban of destructive fishing practices, companies changing their fishing policies, and the creation of whale sanctuaries.

> **Measures to mitigate marine pollution as outlined in the London Convention 1972 include:**
> - Prohibition of specific substances such as oil, radioactive waste, and heavy metals from being dumped.
> - Regulation of the dumping of other substances through the establishment of limits, designated dumping zones, and strict criteria and guidelines.
> - Coordination among convention parties to ensure prior notification and consultation before undertaking dumping activities, enabling assessment of potential impacts.
> - Monitoring conducted by contracting parties and international organizations to track the type, quantity, location, and method of material dumped.
> - Implicit features of marine pollution mitigation include fostering international cooperation and promoting research and development efforts.

INDIAN INITIATIVES

- **Separate Collection & Storage:** The Rules also require local governments to provide separate collection, storage, and processing of plastic waste in their jurisdictions.
- **Phasing Out Single-Use Plastics:** The government initially set an ambitious goal of phasing out single-use plastics by 2022. Significant progress has been made, with a nationwide ban on items such as plastic plates, cups, straws, and carry bags under 120 microns effective from July 1, 2022. Recent amendments to the Plastic Waste Management Rules in 2024 aim to strengthen these measures by targeting microplastics and expanding the definition and regulations surrounding biodegradable plastics and recycling requirements.
- **Merchant Shipping Rules, 2009:** Furthermore, the Merchant Shipping Rules, 2009, enacted under the Merchant Shipping Act, of 1958, address the prevention of marine pollution.

WAY FORWARD

- **Implement Renewable Energy Sources**: Such as wind or solar power, to limit off-shore drilling.
- **Cut Down On The Industry And Manufacturing Waste**: And contain it in landfills to avoid spillage.
- **Use of Biotechnology**: Bioremediation **(use of specific microorganisms to metabolize and remove harmful substances) to treat oil spills.**
- **Minimizing Carbon Footprint**: At the individual level reduce carbon footprint by adopting a **"green" lifestyle.**
- **Global Treaty**: Have a global treaty on banning single-use plastics and collaborative efforts to clean up the ocean.
- **Nutrient Reduction Methods:** With legislative requirements, set specified targets, and used monitoring to discover problems and respond to management strategies. These can be adapted to the requirements and economy of the local area.
- **Assessments Of The Consequences:** On human economies and societies, particularly where fisheries, aquaculture, and livelihoods are threatened.

Over three billion people depend on marine and coastal biodiversity for their livelihoods. In this context, ocean health must be treated as a global issue and all nations should act in concert to implement **Sustainable Development Goal, 14** i.e. To conserve and sustainably use the oceans, seas and marine resources for sustainable development.

OTHER ISSUES RELATED TO MARINE POLLUTION

Dead Zone

- Dead zones are areas in oceans, seas, or freshwater bodies where **oxygen levels are severely depleted,** leading to **hypoxic** or **anoxic** conditions that cannot support most marine life.
- **Cause**: Dead zones often occur as a result of **nutrient pollution,** primarily from agricultural runoff containing excess nitrogen and phosphorus, which leads to excessive algal growth.
  - When these algae die and decompose, they consume oxygen, creating low-oxygen conditions that suffocate marine organisms such as fish, shrimp, and crabs.
- **Impact**: Dead zones can have significant ecological and economic impacts, including declines in fish populations, loss of biodiversity, and disruption of fisheries and coastal ecosystems.
- **Mitigation Measures:**
  - **Nutrient Management:** Implementing strict regulations on fertilizer and nutrient runoff from agricultural and industrial sources to reduce nutrient loading in water bodies, which is a primary cause of dead zones.
  - **Wetland Restoration:** Restoring wetlands and coastal habitats that act as natural filters, absorbing excess nutrients and improving water quality before it reaches sensitive marine ecosystems.
  - **Buffer Zones:** Establishing buffer zones along waterways to absorb runoff and filter pollutants before they enter rivers and oceans, helping to mitigate dead zone formation.
- **Examples:**
  - **Gulf of Mexico Dead Zone:** One of the largest dead zones globally, it forms annually in the Gulf of Mexico off the coast of Louisiana and Texas.
    - It is primarily caused by nutrient runoff from agricultural areas in the Mississippi River watershed.
  - **Chesapeake Bay Dead Zone:** The Chesapeake Bay, the largest estuary in the United States, experiences seasonal dead zones, particularly in the summer months.
    - Excess nutrients from agricultural runoff, urban areas, and wastewater treatment plants contribute to the formation of dead zones, which affect aquatic species and commercial fisheries in the region.

Ocean Acidification

- Ocean acidification refers to the **ongoing decrease in seawater pH and increase in acidity** due to the absorption of carbon dioxide (CO_2) from the atmosphere.
- **Cause**: When CO_2 dissolves in seawater, it reacts with water to form carbonic acid, leading to a decrease in pH and changes in seawater chemistry.
- **Impact**: Ocean acidification can have detrimental effects on marine organisms, particularly those with calcium carbonate shells or skeletons, such as corals, shellfish, and plankton.
  - It can impair their ability to build and maintain their calcium carbonate structures, leading to weakened shells, reduced growth rates, and increased vulnerability to predation and environmental stressors.
  - Ocean acidification also has broader ecosystem impacts, affecting food webs, biodiversity, and ecosystem functioning.
- **Mitigation Measures:**
  - **Reducing CO_2 Emissions:** Implementing policies and initiatives to reduce carbon dioxide (CO_2) emissions from human activities, such as transitioning to renewable energy sources and promoting energy efficiency measures.

- **Ocean Monitoring Programs:** Establishing monitoring programs to track ocean acidification trends and assess its impacts on marine ecosystems. These programs often involve the deployment of buoys, sensors, and research vessels to collect data on seawater chemistry.
- **Emission Reduction Agreements:** Participating in international agreements and treaties aimed at reducing greenhouse gas emissions, such as the Paris Agreement, to mitigate the drivers of ocean acidification on a global scale.

GROUNDWATER POLLUTION

Groundwater pollution occurs when contaminants enter the environment and migrate through aquifers alongside groundwater. These contaminants, influenced by various factors like their physical, chemical, and biological properties, flow from recharge areas to discharge areas following the landscape's direction.

Extent of Groundwater Contamination

- **Arsenic**: West Bengal, Bihar, Chhattisgarh, Assam and Uttar Pradesh.
- **Fluoride**: Andhra Pradesh, Bihar, Gujarat, Haryana, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal.
- **Iron**: Assam, West Bengal, Orissa, Chhattisgarh, and Karnataka. Localized pockets in Bihar, UP, Punjab, Rajasthan, Maharashtra, Madhya Pradesh, Jharkhand, Tamil Nadu, Kerala and North Eastern States
- **Uranium**: 16 states in northwestern, southern and south-eastern India. High prevalence in Rajasthan and Andhra Pradesh. In India, Uranium is not included in the list of contaminants monitored in drinking water specifications provided by the Bureau of Indian Standards.
- **Nitrate**: Andhra Pradesh, Bihar, Delhi, Haryana, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa. Punjab, Tamil Nadu, Rajasthan, West Bengal and Uttar Pradesh.

FACT WISE
• **Groundwater Recharge**: The total annual groundwater recharge is 437.60 billion cubic meters (BCM), according to a report by the Ministry of Jal Shakti (Dynamic Ground Water Resource Assessment Report 2022). • **Groundwater Extraction:** The amount of groundwater extracted was 239.16 BCM. The extraction has been at its lowest since 2004 when it was 231 BCM. • **Common Uses:** Irrigation (208.49 BCM) is the most common groundwater user, followed by domestic (27.05 BCM) and industrial (3.64 BCM).

CAUSES OF GROUNDWATER CONTAMINATION

- **Natural Sources**: Certain substances naturally occurring in rocks or soils, such as iron, manganese, arsenic, chlorides, fluorides, sulfates, or radionuclides, can dissolve into groundwater, causing undesirable odor, color, and health hazards. **For Example,** in the states of West Bengal and Bihar, high levels of arsenic in groundwater have led to widespread health issues among the population.
- **Agriculture**: Inefficient irrigation practices can lead to residual nitrogen from farms seeping into groundwater, causing elevated nitrate levels.
- **Industrial Waste:** Improper disposal of hazardous waste and spills from stored chemicals and petroleum products contribute to groundwater pollution from industrial sources.
- **Municipal Waste:** Pollution from landfills, septic tanks, uncontrolled human and animal waste disposal, inefficient onsite sanitation structures, and leaking sewage lines contaminate groundwater from municipal sources.
- **Uncontrolled Groundwater Extraction:** Excessive groundwater withdrawal for irrigation, particularly in regions like **Punjab and Haryana**, has led to inland saline problems and seawater intrusion in coastal aquifers.

IMPACT OF GROUNDWATER POLLUTION

- **Poor drinking water quality:** Causes a variety of ailments. Arsenic poisoning, for example, can cause skin ailments, gastrointestinal problems, and cancer. Fluoride pollution causes joint damage, bone abnormalities, and fluorosis.
- **Soil and Agriculture:** Groundwater contamination reduces soil quality and reduces productivity. Agricultural productivity has suffered as a result of high salinity.
- **Economic:** High clean-up expenses; High prices for alternate water suppliers; Increased illness burden - increased healthcare expenditures.
- **Environment:** Groundwater pollution can cause certain types of nutrients that are necessary for small amounts to become far too abundant to sustain normal life in a given ecosystem.

- **Chain of contamination:** When groundwater that supplies lakes, rivers, streams, ponds, and swamps becomes contaminated, this slowly leads to more and more contamination of the surface water.

WAY FORWARD

- **Replenishing the aquifers in overexploited areas is essential:** Financial and legal incentives should be given to individuals to recharge the common groundwater source. Example: In Chennai, rooftop rainwater harvesting has been made compulsory for buildings over three stories. The captured water is directed into the ground to recharge the aquifer.
- **Wastewater Treatment:** Treated wastewater can be a safe source for groundwater recharge
- **Salinity Ingress Prevention Scheme, Gujarat:** Regulates lifting underground water; Provisions for recharge dam/ recharge wells; Change in cropping patterns; Freshwater barriers; Rejuvenation of salinity land of oceanic area.
- **Demineralization**: Demineralization using the RO system can remove all hazardous impurities from drinking water
- **Implementation of pollution control laws**: For prevention of future contamination of aquifers.
  - **National Project on Aquifer Management:** Objective is to achieve equitable, safe and sustainable management of India's groundwater resources through improved systems of resource mapping, utilization and governance.

The effective answer to the freshwater crisis is to integrate conservation and development activities – from water extraction to water management – at the local level; making communities aware and involving them fully is, therefore, critical for success. All this will ultimately pave the way for combining the conservation of the environment with the basic needs of people.

PLASTIC POLLUTION

The plastic pollution crisis stems from the disparity between the vast quantities of plastic produced and consumed, and the world's capacity to manage this waste effectively. **According to the UN Environment Programme (UNEP),** out of the 9.2 billion tonnes of plastic manufactured from 1950 to 2017, approximately 7 billion tonnes ended up as waste in landfills or were dumped. If this trend continues unabated, projections indicate that **by 2050, there could be more plastic than fish in the ocean.**

According to the Organisation for Economic Co-operation and Development (OECD), only 15% of global plastic waste is collected for recycling. However, nearly half of this collected plastic is disposed of as residues, resulting in a mere 9% being effectively recycled. Additionally, 19% of plastic waste is incinerated, while 50% ends up in landfills, and 22% evades waste management systems altogether.

FACT-WISE
• **Plastic Demand**: India's plastic demand reached 20.89 million tonnes in 2021-22 and is projected to grow to 22 million tonnes by 2023.
• **Plastic Production**: India produces 3.5 million tonnes of plastic annually, with a per capita consumption of 25,490 grams.
• **Plastic Waste Generation**: India ranks 94th globally in per capita plastic waste generation.
○ According to a CPCB report from 2018-19, India's total annual plastic waste generation is 3.3 million metric tonnes.
• **Plastic Waste Recycling**: The Indian government claims that 60% of the country's plastic waste gets recycled.
• **Single-Use Plastic Ban**: The Indian government enacted a ban on single-use plastics on July 1, 2022, targeting 43% of plastic waste generated by single-use plastics.
• **NGT Order and Plastic Waste Management Rules**: The National Green Tribunal (NGT) ordered all states and UTs to submit action plans for implementing the Plastic Waste Management Rules, 2016.
○ India notified the Plastic Waste Management Rules in 2016, replacing the earlier rules from 2011.

CAUSES OF PLASTIC POLLUTION

Sources of plastic pollution can be categorized into land-based and ocean-based origins:

- **Land-Based Sources:**
  - **Sewer Overflows**: Inadequate sewage systems can lead to the discharge of plastic waste into rivers and oceans during overflow events.
  - **Inadequate Waste Disposal and Management**: Poor waste management practices, including littering and improper disposal, result in plastic debris entering waterways.
  - **Industrial Activities**: Industries generate plastic waste through manufacturing processes and may contribute to pollution through improper disposal practices.
- **Ocean-Based Sources:**

- o **Fishing Industry:** Discarded fishing gear, known as ghost nets, along with other plastic materials used in fishing operations, contribute to ocean plastic pollution.
  - o **Nautical Activities:** Boating, shipping, and recreational activities at sea can result in plastic debris being discharged directly into the ocean.
- **Additionally, natural processes** such as solar UV radiation, wind, currents, and wave action contribute to the fragmentation of larger plastic items into smaller particles known as microplastics (particles smaller than 5 mm) or nanoplastics (particles smaller than 100 nm).

CHALLENGES IMPOSED BY PLASTIC POLLUTION ARE:

- **Threat To Ecosystem:** It threatens the biodiversity and health of marine and terrestrial ecosystems. Plastic can harm or kill wildlife, damage habitats, and disrupt food webs.
- **Threat to Humans**: It poses risks to human health and well-being. Plastic can contaminate the food chain and expose humans to harmful chemicals, reduce the quality and enjoyment of natural environments, and increase the spread of diseases.
- **Threat to Climate:** It contributes to the climate crisis and resource depletion. Plastic emits greenhouse gases during its production, transportation, and degradation, and consumes large amounts of energy, water, and land.
- **Creates social and economic costs and inequalities**: Plastic can affect the livelihoods and incomes of people who depend on natural resources, such as fishers or farmers.
- **Climate Injustice:** Plastic can create environmental injustice and discrimination, as some communities or countries bear a disproportionate burden of plastic waste generation or disposal.

BRING PLASTIC WASTE RECYCLING MODEL UNDER PPP MODE: NITI AAYOG

- NITI Aayog suggests adopting the Material Recovery Facility (MRF) model for sustainable management of urban plastic waste.
- The MRF model should be implemented as a public-private partnership, initially funded by private players and supported by urban local bodies.
- The model ensures compliance with regulations, improves resource utilization, and focuses on social inclusion and protection of waste pickers.
- Segregation of waste at generation points and formalization of recycling units are critical for implementing the MRF model.
- Plastic waste management remains a challenge for urban local bodies in India, necessitating different models for sustainable plastic waste management.

WAY FORWARD

- **Raising Awareness:** Educate and raise public awareness about the harm of plastic pollution. "Beat Plastic Pollution" pledge by world leaders on World Environment Day 2018.
- **Promoting Alternatives:** Assess the availability of eco-friendly alternatives before imposing bans. Provide incentives, tax rebates, and support for adoption of alternatives.
- **Incentivizing the Alternative Industry**: Introduce tax rebates and conditions to support the transition from the plastic industry.
- **Expanding Biodegradable and Edible Plastics:** Promote the use of biodegradable and edible plastics from sustainable materials. G20 ministers adopt a framework to tackle global marine plastic waste.
- **Assessing Single-Use Plastics:** Identify and target problematic single-use plastics through assessments. Implement Plastic Waste Management Rules, 2016.
- **Assessing Impacts:** Evaluate social, economic, and environmental impacts of plastic waste management measures. Implement Extended Producer Responsibility (EPR) through Plastic Waste Management (Amendment) Rules 2018.

OECD released an interim report titled "Towards Eliminating Plastic Pollution by 2040: A Policy Scenario Analysis," outlining key findings on plastic pollution:
- **Microplastic Release Projection:** By 2040, it is anticipated that the release of microplastics into the environment will surge by 50% compared to the climate policies of 2021.
- **Impact of Global Policy Efforts:** Early, rigorous, and coordinated global policy actions, representing just 0.5% of global GDP, could potentially reduce plastic waste generation by a quarter compared to current forecasts for 2040.

- **Importance of Reducing Production and Demand:** To effectively tackle plastic waste issues, it is crucial to decrease production and demand through the implementation of taxes, regulations, and the promotion of sustainable alternatives.
- **Emphasis on Product Design and Recycling Techniques:** Improving the design of plastic products to enhance reusability and developing more efficient recycling methods are essential strategies for addressing plastic pollution effectively.

EXTENDED PRODUCER RESPONSIBILITY (EPR) ON PLASTIC PACKAGING

Extended Producer Responsibility (EPR) is a policy framework that mandates producers to take financial or physical responsibility for the environmentally sound treatment or disposal of their post-consumer products. In India, EPR was first introduced in 2012 to manage e-waste, and it was later expanded to include plastics through the Plastic Waste Management (PWM) Rules in 2016. **The guidelines for EPR were further strengthened with the Plastic Waste Management Amendment Rules in 2021.**

Guidelines for EPR in PWM Amendment rules, 2021

- **Plastics classified into categories** like rigid, flexible, multilayered packaging, and plastic sheets.
- **Producers, importers, and brand-owners (PIBO)** required to register on a centralized online portal by CPCB.
- **Progressive increase in EPR targets** for PIBOs, aiming for 100% compliance by 2023-24.
- **Implementation Guidelines:** Establishment of a centralized online portal for tracking and monitoring obligations. Compulsory registration of PIBOs and plastic waste processors. Introduction of EPR Certificates to incentivize compliance and promote circular economy.
- **Enforcement Mechanisms:** Environmental compensation levied on PIBOs failing to meet targets, following the polluter pays principle. State Pollution Control Boards (SPCBs) or Pollution Control Committees (PCCs) mandated to submit annual reports on EPR compliance.

RADIOACTIVE POLLUTION

Radioactive pollution refers to the presence of radioactive substances in the environment, which emit harmful radiation. These substances may come from various sources including nuclear power plants, mining and processing of radioactive materials, medical facilities, industrial processes, and nuclear accidents.

Radioactive pollution in India
- **Annual generation:** Estimates suggest India generates around **4 tonnes** of radioactive waste per Gigawatt (GW) of nuclear power capacity annually. - **Total volume:** With 22 operational nuclear power reactors and a combined capacity of around **6,780 MW**, the total annual radioactive waste generation in India is estimated to be around **27,120 tonnes.**

CAUSES OF RADIOACTIVE POLLUTION

- **Nuclear power plants:** Radioactive materials are used as fuel to generate electricity, and sometimes accidents or leaks can occur.
- **Nuclear weapons testing:** Detonating nuclear weapons releases radioactive fallout into the atmosphere.
- **Mining and processing of radioactive ores:** Activities such as uranium mining can release radioactive materials into the environment.
- **Medical facilities:** Radioactive materials are used in diagnostic and therapeutic procedures, and **improper disposal can lead to pollution.**
- **Industrial processes:** Some industrial activities involve the use of radioactive substances, leading to pollution if not properly managed.

HARMFUL EFFECTS OF RADIOACTIVE POLLUTION

- **Increased risk of cancer:** Exposure to radiation from radioactive pollutants can damage cells and increase the risk of various types of cancer.
- **Genetic mutations**: It can cause mutations in DNA, leading to hereditary disorders and birth defects.
- **Environmental damage:** It can contaminate soil, water, and air, harming ecosystems and wildlife.
- **Acute radiation sickness:** High levels of radiation exposure can cause symptoms such as nausea, vomiting, and organ failure.

MEASURES TO CONTROL RADIOACTIVE POLLUTION

- **Atomic Energy Regulatory Board (AERB):** India's Atomic Energy Regulatory Board (AERB) regulates and monitors nuclear and radiation-related activities to ensure safety and prevent radioactive pollution.
- **Nuclear Waste Management:** India has developed strategies for the safe management and disposal of radioactive waste. Facilities such as the Waste Immobilization Plant (WIP) at Tarapur and the Waste Management Division of the Bhabha Atomic Research Centre (BARC) are responsible for treating and storing radioactive waste.
- **Environmental Monitoring:** Environmental monitoring programs, conducted by organizations such as the Environmental Survey Laboratory (ESL) and the National Environmental Engineering Research Institute (NEERI), assess ambient radiation levels and monitor potential sources of radioactive pollution.

CHALLENGES IN MEASURES TAKEN TO CONTROL RADIOACTIVE POLLUTION

- **Complexity of Nuclear Waste Management:** Safe disposal of radioactive waste requires long-term containment solutions, posing technical and logistical challenges. **Example:** Construction of deep geological repositories faces technical hurdles like ensuring containment integrity and preventing groundwater contamination.
- **Regulatory Compliance and Enforcement:** Ensuring adherence to radiation safety standards across nuclear facilities is difficult due to inadequate oversigh**t.**
- **International Cooperation and Diplomacy:** Geopolitical tensions and regulatory differences impede international collaboration on radioactive pollution. **Example:** Disputes over nuclear proliferation strain diplomatic relations, hindering agreements on safe waste management.
- **Emerging Risks and Technological Advances:** Advancements in nuclear technology introduce new safety concerns and waste management challenges. **Example**: Increasing use of **radioactive isotopes** in medicine raises concerns about safe handling and disposal practices.

WAY FORWARD

- **Strict regulations and monitoring:** Governments should enforce strict regulations on the use, storage, and disposal of radioactive materials, along with regular monitoring of pollution levels.
- **Cleanup and remediation**: Efforts should be made to clean up contaminated sites and rehabilitate affected areas to minimize exposure to radioactive pollutants.
- **Development of alternative energy sources:** Investing in renewable energy sources such as solar and wind power can reduce reliance on nuclear energy, thereby decreasing the production of **radioactive waste.**
- **International cooperation:** Given the transboundary nature of radioactive pollution, international cooperation is crucial to address issues such as nuclear accidents and the illegal trafficking of radioactive materials.

KEYWORDS: Untreated Sewage; Organic Matter; Coliform Levels; Sewage Pollution; Waterborne Diseases; Economic And Human Cost Of Toxic Water-Bodies; ecological flow/ minimum flow of river

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	PREVIOUS YEAR QUESTIONS	
1.	What is oil pollution? What are its impacts on the marine ecosystem? In what way is oil pollution particularly harmful for a country like India?	2023
2.	Discuss in detail the photochemical smog emphasizing its formation, effects and mitigation. Explain the 1999 Gothenburg Protocol.	2022
3.	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 these revised standards?	2021
4.	What are the key features of the National Clean Air Programme (NCAP) initiated by the Government of India?	2020
5.	What are the impediments in disposing the huge quantities of discarded solid wastes which are continuously being generated? How do we remove safely the toxic waste that have been accumulating in our habitable environment?	2018
6.	Environmental impact assessment studies are increasingly undertaken before the project is cleared by the government. Discuss the environmental impacts of coal-fired thermal plants located at Pitheads.	2014
7.	Namami Gange and National mission for clean Ganga (NMCG) programmes and causes of mixed results from the previous schemes. What quantum leaps can help preserve the river Ganga better than incremental inputs?	2015

4   CLIMATE CHANGE AND GLOBAL WARMING

INTRODUCTION

Climate refers to characteristic atmosphere conditions of a place over long periods of time. It can be categorized based on geographical location, including tropical, subtropical, continental, and arctic, or by specific characteristics like Mediterranean, monsoon, or desert climates. Temperature and precipitation, alongside other variables, play pivotal roles in shaping climate patterns.

According to the United Nations Framework Convention on Climate Change (UNFCCC), climate change refers to alterations in climate directly or indirectly linked to human actions, resulting in modifications to the composition of the Earth's atmosphere. These changes go beyond natural climate fluctuations observed over similar timeframes.

FACT WISE
According to an NDMA report, India is particularly vulnerable to the effects of climate change, with around 68% of the country being prone to drought, and 60% to earthquakes.   **According to a study by Council on Energy, Environment and Water (CEEW),** over 75% of districts in India, home to more than half of India's population, are hotspots of extreme climate events such as cyclones, floods, droughts, heat and cold waves.   **According to the State of Global Climate Report, 2023 by WMO:**   **Global Mean Temperature:** In 2023, the global mean temperature was 1.45°C above the average of the period between 1850-1900, making it the warmest year on record. This surpasses previous records set in 2016 and 2020.   **Warmest Years:** Despite a cooling La Niña phase in previous years, the period from 2015 to 2023 remains the warmest eight-year span on record.   **Greenhouse Gas Concentrations:** The concentrations of greenhouse gases, including carbon dioxide and methane, reached new record highs in 2023. CO2 levels are now 50% higher than pre-industrial levels.   **Food Insecurity:** Approximately 333 million people, or 9.8% of the world's population, faced acute food insecurity in 2023. This marks a significant increase from previous years, exacerbated by climate-related extreme weather events.   - According to the Overseas Development Institute, by 2100, India could lose around 3-10% of its GDP annually due to climate change. Additionally, by 2040, the country's poverty rates might increase by 3.5%, driven by the adverse effects of climate change on agriculture, health, and infrastructure.   - As per the Department of Economic and Policy Research (RBI), India would spend about 1 trillion rupees by 2030 to comply industries to various climate change norms.

CAUSES OF CLIMATE CHANGE

NATURAL CAUSES

- **Continental Drift:** Over millions of years, the shifting of tectonic plates has altered weather patterns, contributing to gradual climate changes.
- **Plate Tectonics**: The movement of Earth's plates, driven by changes in the planet's core temperature, affects local temperatures and interconnected environmental factors, influencing climate over time.
- **Volcanic Activity**: While volcanic eruptions are brief events, their aftermath can persist for years. Emissions like carbon dioxide, dust particles, and aerosols released during eruptions impact the atmosphere, influencing climate dynamics.
- **Ocean Currents:** The interaction between wind movement and ocean currents disrupts temperature distributions, resulting in localized climate shifts.
- **Variation in Earth's Orbit:** Changes in the Earth's orbit affect the distribution of sunlight across seasons and geographic regions, contributing to climate variations.

ANTHROPOGENIC CAUSES

- **Greenhouse Gases:** Human activities release greenhouse gases, which trap heat from the sun, leading to elevated surface temperatures.

- **Land-use Patterns:** Large-scale industrial practices and alterations in agricultural methods, such as deforestation, release significant amounts of greenhouse gases.
- **Atmospheric Aerosols:** Minute liquid particles suspended in the atmosphere, known as aerosols, absorb and scatter solar and infrared radiation, causing fluctuations in atmospheric temperatures. For Example, black and brown carbon, warm the Earth's atmosphere, while sulphate droplets, cool it.

GREENHOUSE EFFECT

- **Greenhouse effect is a naturally occurring phenomenon** that covers the earth's lower atmosphere and make it warms, and it maintains suitable temperature for living things to survive.
- **Solar radiation warms Earth's surface and atmosphere**, with a portion reflected back into space, some absorbed by atmospheric gases, and the rest absorbed by the Earth's surface. The absorbed energy is re-emitted as infrared radiation, some of which is absorbed by greenhouse gases in the atmosphere, trapping heat and warming the atmosphere.
- **Greenhouse gases like carbon dioxide, methane, ozone, chlorofluorocarbons, and water vapor** contribute to the greenhouse effect, with water vapor being the most significant contributor.
- **Human activities, such as burning fossil fuels and deforestation**, have led to increased concentrations of greenhouse gases, intensifying the greenhouse effect.
- **This enhanced greenhouse effect results in global warming,** with studies showing a rise in global temperatures since the industrial revolution, particularly in the last few decades of the twentieth century.
- The increase in global temperatures poses significant challenges, including more frequent heatwaves, changes in precipitation patterns, and rising sea levels, with implications for ecosystems and human societies worldwide.

GLOBAL WARMING

- Global warming is **defined as an average rise in the temperature** of the atmosphere near the Earth's surface and in the troposphere, which can cause changes in climate patterns globally. **Climate change is the periodic alteration of the Earth's climate** caused by changes in the atmosphere as well as interactions between the atmosphere and several other biological, geologic, chemical, and geographic variables within the Earth system. **Main cause of Global Warming is Green House Effect.**
- Greenhouse gases (GHGs) act as a blanket around the Earth, trapping heat by absorbing energy and slowing its escape into space.
- Different GHGs vary in their ability to absorb energy and their lifespan in the atmosphere, which influences their warming potential.
- **Global Warming Potential (GWP) measures** how much heat a gas absorbs over a specified period compared to carbon dioxide (CO_2), with CO_2 serving as reference gas with a GWP of 1.
  - **Methane (CH_4) has a GWP of 28–36 over 100 years,** absorbing more energy than CO_2 but lasting a shorter time in the atmosphere.
  - **Nitrous Oxide (N_2O) has a GWP of 265–298 times that of CO_2** over 100 years, remaining in the atmosphere for more than a century.
  - **Certain gases like CFCs, HFCs, HCFCs, PFCs, and SF6, known as high-GWP gases,** trap significantly more heat per mass unit than CO_2, contributing to enhanced warming.

EVIDENCE OF GLOBAL WARMING

- **Warming Trends:** Each of the last three decades has been successively warmer at Earth's surface than any preceding decade since 1850.
  - **The period from 1983 to 2012** marked one of the warmest 30-year spans in the Northern Hemisphere over the past 800 years.
- **Ocean Warming:** Ocean warming accounts for over 90% of the energy accumulated in the climate system between 1971 and 2010.
  - The upper 75 meters of the ocean warmed by 0.11°C per decade from 1971 to 2010.
- **Cryosphere Changes:** Over the last two decades, the Greenland and Antarctic ice sheets have been losing mass, contributing to rising sea levels.
  - Glaciers worldwide have continued to shrink, with the rate of ice mass loss from the Greenland ice sheet substantially increasing between 1992 and 2011.

- **Arctic Sea Ice Decline:** Arctic sea ice extent decreased at a rate of 3.5 to 4.1% per decade from 1979 to 2012. The most rapid decrease in decadal mean extent occurred in summer, with declines observed in all seasons and successive decades since 1979.
- **Global Sea Level Rise:** Global mean sea level rose by 0.19 meters over the period 1901–2010.
  o Approximately 75% of the observed sea level rise since the early 1970s is attributed to glacier mass loss and ocean thermal expansion from warming.

GLOBAL WARMING: WHY INDIA IS HEATING UP SLOWER THAN THE WORLD AVERAGE

Annual mean temperature of the world has increased by 1.1 degree Celsius since preindustrial times, but this increase is not uniform. **The warming trends over the Indian region are different, with annual mean temperatures rising by 0.7 degrees Celsius from 1900, which is significantly lower than the 1.59 degree Celsius rise for land temperatures across the world.**

- **Influence Of Atmospheric Phenomenon:** This is due to a complex set of atmospheric phenomena, including heat transfers from the tropics to the poles through prevailing systems of air circulation.
- **Warmer Arctic:** The Arctic region has warmed at least twice as much as the world average, with its current annual mean temperatures being about 2 degrees Celsius higher than pre-industrial times. This is due to the albedo effect, changes in clouds, water vapor, and atmospheric temperatures.
- **Influence Of Aerosols:** Aerosols have the potential to affect the local temperature in multiple ways, scattering sunlight back and affecting cloud formation. Aerosol concentration over the Indian region is high due to natural and man-made reasons.
- **Location In The Tropics And Arid Climate:** This is due to its location in the tropics and arid climate, which is prone to faster and greater heating. Aerosols have the potential to avoid 0.1 to 0.2 degree Celsius of warming, but the extent of the impact is not clear.

CONSEQUENCES OF CLIMATIC CHANGE

ON ENVIRONMENT
- **Threat to biological diversity:** The source of enormous environmental, economic and cultural value will be threatened by rapid climate change.
- **Water stress and water insecurity:** Changed run-off patterns and glacial melt will add to ecological stress, compromising flows of water. An additional 1.8 billion people could be living in a water scarce environment by 2080.
- **Shifts in temperatures and precipitation patterns:** It may reshape the boundaries between grasslands, shrublands, forests and other ecosystems thus altering ecological balance.
- **The Glacial Melt:** The level of temperature rise in the mountains and glacial melt is very high in the last 2,000 years. The melting of glaciers is now attributed due to anthropogenic factors and human influence.

ON HYDROLOGICAL CYCLE
- **Changes in Hydrological Cycle:** Climate change induces alterations in the hydrological cycle, including glacier melts, variations in evapotranspiration, and impacts on catchment areas.
  o These changes interact with non-climatic factors such as population growth, economic development, urbanization, and land use, along with water management strategies.
- **Reduced Water Availability:** Approximately 80% of the global population faces significant threats to water security due to indicators like water availability, demand, and pollution.
  o Climate change can further disrupt water availability, exacerbating threats to water security worldwide.
- **Impact on Freshwater Ecosystems: Freshwater ecosystems**, more affected by human activities than marine and terrestrial ecosystems, have experienced a significant decline in species populations.
  o Between 1970 and 2000, populations of freshwater species declined by an average of 50%, highlighting the vulnerability of freshwater ecosystems to anthropogenic and climatic pressures.

ON OCEANS
- **Ocean Warming: Climate influences ocean temperatures,** circulation, and nutrient supply, impacting marine ecosystems.
  o Warming leads to stratification, where warmer, less dense surface waters restrict mixing with colder, nutrient-rich deeper layers.
  o Increased stratification can create oxygen minimum zones (OMZs) due to reduced oxygen mixing, affecting marine life.

- o Higher temperatures initially boost microbial growth but challenge thermal tolerance, leading to species replacement.
- **Ocean Acidification:**
  - o **Ocean absorbs over 25% of anthropogenic CO2 emissions**, decreasing pH and leading to ocean acidification. This occurs alongside other climate-related stressors like ocean warming and deoxygenation.
  - o Since the Industrial Revolution, ocean pH has fallen by 0.1 units, representing a 30% increase in acidity. Continued CO2 absorption is projected to increase ocean acidity by nearly 150% by the century's end.
  - o Acidification poses challenges for marine organisms dependent on calcium carbonate for shell and skeleton formation.
- **Ocean Deoxygenation:**
  - o Deoxygenation, the loss of oxygen from oceans, has intensified due to climate change.
  - o Warmer water holds less oxygen, reducing mixing with deeper oxygen-rich layers. Increased oxygen demand from warmer temperatures further depletes oxygen levels.
  - o Nutrient pollution exacerbates deoxygenation, particularly in coastal waters, leading to algal blooms and oxygen depletion.
- **Impact on Marine Ecosystems:**
  - o Changes in ocean conditions disrupt marine ecosystems, affecting organismal responses, food webs, and biodiversity.
  - o Acidification, warming, and deoxygenation collectively pose significant threats to marine life, necessitating urgent mitigation efforts.

ON FOOD SECURITY AND FOOD PRODUCTION SYSTEM

- **Impact on Food Access:** Climate change influences food prices and their volatility, affecting affordability and access.
  - o Vulnerability to reduced food access depends on households' food procurement methods.
- **Impact on Food Stability:** Increased climate extremes discourage investments in agriculture, leading to lower profits and reduced adoption of new technologies.
  - o Farmers may prioritize low-risk, low-return subsistence crops, diminishing future farm profits.
- **Impact on Food Production:** Increased atmospheric CO2 has enhanced water use efficiency and yields, benefiting crops like wheat and rice.
  - o However, rising CO2 levels may reduce the nutritional quality of staple crops, affecting global food security.
  - o Ozone (O3) emissions accompanying CO2 harm crop yields, with severe impacts in regions like India and China.
  - o Climate change negatively impacts production of major crops in tropical and temperate regions, particularly with temperature increases of 2°C or more.
- **Impact on Fisheries and Livestock:** Climate change is expected to negatively impact fisheries production, especially in tropical areas, while some developed countries may benefit.
  - o Livestock production will be affected by changes in forage and feed, direct impacts of temperature and water availability on animals, and indirect effects through livestock diseases.

ON HUMAN HEALTH

- **Mortality Impact: The WHO estimates** that climate change caused over 150,000 deaths in 2000 alone, with future increases likely.
- **Expansion of Disease Vectors:** Warming regions enable disease-carrying organisms to survive in areas previously inhospitable due to cold weather.
- **Health Risks: Studies suggest climate change** may significantly affect human health, especially among vulnerable groups like children and the elderly.
  - ▪ Elevated temperatures, extreme weather events, and increased climate variability can increase the risk of heat strokes, cardiovascular diseases, neurological disorders, and stress-related conditions.
- **Urban Heat Island Effect:** Urban areas experience compounded heat stress due to the heat island effect, where urban environments are significantly warmer than their rural surroundings.
  - o Warmer and moister conditions facilitate the spread of vector-borne diseases like malaria and dengue fever.

ON ECONOMY

- **Economic Impact of Inaction:** Failure to mitigate global carbon emissions could result in climate change costs amounting to 5 to 20 percent of the annual global gross domestic product. Conversely, investing just 1 percent of GDP could mitigate the most damaging effects.

- **Impact on Poverty in India:** A recent World Bank report suggests that climate change could push 45 million Indians into extreme poverty over the next 15 years, effectively negating economic progress.
- **Cost of Shoreline Alterations**: Climate change has the potential to significantly alter shoreline habitats, necessitating expensive relocation of ports and shore infrastructure. The value of global assets exposed to sea level rise is projected to be between $6 to $9 trillion, equivalent to 12 to 20 percent of the global GDP.
- **Damage from Extreme Weather Events:** More intense hurricanes and downpours, exacerbated by climate change, could cause billions of dollars in damage to property and infrastructure worldwide.

ON ENERGY INFRASTRUCTURE AND SUPPLY

- **Increased Energy Demand for Space Cooling:** Rising temperatures are expected to lead to higher demand for space cooling, exacerbating energy consumption. If this demand is met primarily by thermal power plants, it would contribute to global warming by increasing greenhouse gas emissions.
- **Competition for Water Resources:** Thermal power plants require significant amounts of water for cooling purposes during electricity generation. An increase in water withdrawal by these plants could intensify competition with agriculture and domestic consumption, especially in water-stressed regions.
- **Vulnerability of Coastal Power Plants:** Power plants situated along coastlines that utilize seawater for cooling are susceptible to various climate-related risks, including sea-level rise, cyclones, and storm surge. These hazards pose threats to the infrastructure and operational efficiency of coastal power facilities.

ON MOUNTAINOUS REGION

- **Rising temperatures:** They are causing accelerated warming in mountainous regions, leading to the rapid melting of glaciers and ice caps. These ice formations, crucial sources of freshwater for millions, are shrinking rapidly.
  - **High-mountain** areas have experienced a temperature increase **double the global** average, with the **Gangotri** Glacier in the Himalayas retreating over 14 kilometers since the 1930s.
- **Black Carbon and Glacial Melting:** Black carbon, emitted from fossil fuels and biomass burning, reduces snow and ice reflectivity, accelerating glacier melt.
  - **Positive Feedback Loop**: Deposited black carbon on glaciers exacerbates melting, releasing more black carbon, amplifying the process.
- **Impact on river system and Precipitation resources:** Mountain river systems are highly vulnerable to climate change and human activities like pollution, hydropower development, and water withdrawals.
  - For instance, heavy **precipitation** events in the **Himalayas** increased by **50**% since the 1950s, while **Andean droughts rose by 20%**.
- **Increased intensity and frequency of natural hazards and disasters:** The IPCC's Sixth Assessment Report highlighted increased heavy precipitation events and cryosphere-related changes in mountain regions, leading to floods, landslides, and water scarcity.
  - The United Nations Environment Programme **(UNEP)** estimates climate change could trigger 20 million additional displacements from mountainous regions by 2050
- **Impact on the mountainous ecosystem and biodiversity :** Climate change is significantly affecting biodiversity in mountainous regions, with species struggling to adapt to shifting temperatures and precipitation patterns.
  - The IPCC's 6th assessment report warns of a rapid decline in biodiversity, with up to 25% of species facing extinction by the century's end.

OZONE AND ITS DEPLETION

- **Ozone (O3) is a gas composed of three oxygen atoms,** found in both the troposphere and stratosphere. In the troposphere, it contributes to air pollution and smog, harmful to human health. Conversely, stratospheric ozone forms the ozone layer, which absorbs harmful ultraviolet (UV) radiation from the sun, protecting life on Earth.
- **Ozone Depletion occurs when substances introduced into the atmosphere disrupt the balance** between ozone formation and destruction, leading to significant reduction in ozone levels. This phenomenon is most pronounced over Antarctica, where the ozone layer has diminished by about 50% since it was first widely recognized in 1985. The formation of the "ozone hole" over Antarctica is a stark example of this depletion.
- **Mechanism of Ozone Depletion:**
  - CFCs break down under UV radiation, releasing chlorine atoms that react with ozone, forming chlorine monoxide (ClO) and oxygen.
  - Bromine atoms from halons and HBFCs react similarly, with each bromine atom capable of destroying more ozone than chlorine.

- **Environmental Effects:**
  - Increased UV-B radiation leads to higher risks of skin cancer, eye diseases, and immune system suppression in humans.
  - UV-B affects plant growth and development, aquatic ecosystems, and biogeochemical cycles.
  - It also degrades synthetic materials, reducing their lifespan.
- **Global Efforts to Protect Ozone:**
  - The **Vienna Convention (1985)** provided a framework for international cooperation on ozone protection.
  - The **Montreal Protocol (1987)** mandated the phase-out of ODS, with amendments accelerating this process. It is considered one of the most successful environmental treaties.
- **India's Role:**
  - India signed the Montreal Protocol in 1992 and has since phased out several ODS ahead of schedule.
  - The Ozone Depleting Substances (Regulation and Control) Amendment Rules, 2019 banned the import of HCFC-141b, a significant ozone-depleting chemical.
  - India's ongoing efforts include the phased reduction of HCFCs, aiming for a significant reduction in greenhouse gas emissions by 2030.
  - These comprehensive measures and international cooperation have led to significant reductions in ODS emissions, contributing to the gradual recovery of the ozone layer.
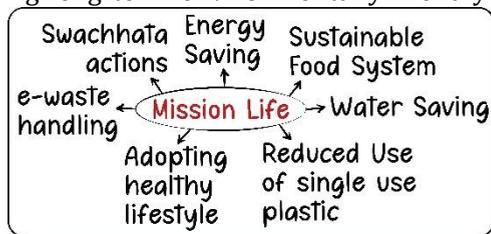
INTERNATIONAL EFFORTS TO COMBAT CLIMATE CHANGE

- **Carbon Border Adjustment Mechanism (CBAM):** An initiative by the European Union that would levy a carbon tax on products imported which are made from a non-environmental sustainable process.
- **Carbon Capture Utilisation And Storage (CCUS):** Methods and techniques to reduce, capture, and store carbon dioxide from flue gases and the atmosphere. CCUS becomes an important strategy to achieve India's goal of Net Zero by 2070.
- **Climate Tipping Points:** Points or threshold beyond which changes in climate perpetuate themselves due to global warming which is a great cause of concern.
- **Intergovernmental Panel on Climate Change (IPCC):** IPCC provides a mechanism to study the effects of global warming at a governmental level. IPCC assesses the science related to climate change.
- **United Nations Framework Convention on Climate Change (UNFCCC):** The ultimate objective of the Convention is to stabilize greenhouse gas concentrations "at a level that would prevent dangerous anthropogenic (human-induced) interference with the climate system".

NAPCC
→ National Solar Mission
→ National Mission on Enhanced Energy Efficiency
→ National Water Mission
→ National Mission on sustaining the Himalayan Ecosystem
→ National Mission for Green India
→ National Mission on Sustainable Agriculture
→ National Mission on Strategic Knowledge on Climate Change

- **Kyoto Protocol:** This protocol holds the developed countries accountable for the current high levels of GHG emissions into the atmosphere due to their role in the industrial revolution. Kyoto Mechanism includes Emission Trading, the Clean Development Mechanism and Joint Implementation.
- **Paris Agreement:** It is considered to be the world's first comprehensive climate agreement. It aims to keep the global temperature well below 2°C and preferably limit it to 1.5° Celsius, compared to pre-industrial levels.
- **REDD+:** It creates financial value for the carbon stored in forests to offer incentives for developing nations to reduce emissions from forested lands and invest in low-carbon paths.

NATIONAL EFFORTS TO TACKLE CLIMATE CHANGE

- **Uniform Carbon Trading Market:** Being the largest exporter of Carbon credit, India envisages having Uniform Carbon Trading Market. This would enable easy purchase and selling of carbon credits.
- **India Cooling Action Plan aims to provide sustainable cooling** while keeping in mind, the need to protect the ozone layer. It provides a 20-year perspective, with projections for cooling needs in 2037-38.
- **National Action Plan on Climate Change (NAPCC):** Comprising of 8 national missions to combat climate change was launched in 2008.
- **Mission LiFE:** Lifestyle for Environment, changing lifestyle by inculcating long-term environmentally friendly habits by taking one action at a time and making one change daily. Actions are listed under 7 categories.
- **India's Panchamrit pledge:** On climate change: India's pledged at COP 26 of UNFCCC to realise the motto of **'One Life One World'**.
  - Reduce emission by 1 billion tons of CO2.
  - Reduce Indian economy's emission intensity by 45%.
  - Increase non-fossil fuel energy capacity to 500GW by 2030.

Swachhata actions | Energy Saving | Sustainable Food System
e-waste handling ← Mission Life → Water Saving
Adopting healthy lifestyle | Reduced Use of single use plastic

- o Increase renewable energy share in the energy mix to 50% by 2030.
- o Net zero by 2070.

PRESENT CHALLENGES RELATED TO INDIA'S CLIMATE ACTION

- **Excessive Coal dependency**: Coal continues to be a driving force behind electrification in India and plays an important role in the energy security of the country.
- **High population**: It has led to increased energy demand which contributes to GHG emissions.
- **Environment vs Development**: India's commitment to net zero transition could potentially have implications on growth, on the economy and on energy availability for industrialisation and urbanization.
- **Delayed timeline**: Scientists have advised countries to go net zero latest by 2050 and move on to negative emissions to mitigate the worst effects of the climate crisis.
- **Emissions from the agricultural sector**: India's food and fertilizer subsidies have significantly contributed to climate change leading to high GHG emissions, especially in paddy cultivation.
- **Implementation bottlenecks**: institutional, systemic and process barriers, including financial constraints, inter-ministerial coordination, lack of technical expertise and project clearance delays.
- **Inadequate legal mechanism**: Existing laws are inadequate to deal with climate change and do not contain provisions specifically to reduce future climate impacts and tackle environmental/climate violations.

WAY FORWARD

- **Budgetary Allocation**: A vital step should be explicit including policies for climate mitigation in the government budget, along with energy, roads, health and education.
- **Collaborative Mitigation strategy**: National mitigation and preparedness strategy should have collaborated with international efforts for maximum impact.
- **Bottom-up Approach**: Bottom-up approach, by understanding the needs of the community at the local level, rather than providing directions from the leadership would make resilient efforts against climate change.
- **Robust Climate Change Adaptation**: Economies should move towards carbon-neutral measures of economic development. For instance, the spirit of the E-mobility scheme, Energy Conservation Building Code and other measures should be realised.
- **Setting up Early Warning Systems**: This would help to alert the downstream populations about an impending disaster.
- **Awareness generation:** Along the line of the Swachha Bharat Mission, awareness among the masses about climate change should be taken on mission mode.
- **Encouraging private participation**: Private entities should be promoted and incentivised for their active participation in India's transition towards the green economy.
- **Constitutional body**: Considering the requirement of strategic steps towards climate crisis, National Commission on Climate Change should be constituted for around the year deliberation on mitigation measures and strategies.

To conclude, sustainable growth depends on effective and efficient timely climate action. Thus, policymakers should connect the dots between carbon emissions, atmospheric warming, melting glaciers, extreme floods and storms. Preparedness and robust mitigation strategies would be one way to prevent unprecedented loss due to climate change.

Related Topics

IPCC'S SIXTH ASSESSMENT- SYNTHESIS REPORT

The Synthesis Report consolidates the primary discoveries of the AR6 cycle, drawing from inputs provided by the three Working Groups and the three Special Reports. Essential findings include:

- **Unprecedented Climate Warming:** Human-induced **global warming of 1.1 degrees Celsius** has instigated unparalleled alterations to Earth's climate in recent human history.
- **Impact:** Presently, with a global temperature increase of 1.1 degrees Celsius, the climate system is undergoing unparalleled changes across all global regions. These encompass rising sea levels, heightened extreme weather occurrences, and swiftly receding sea ice.
- **Broader Climate Influence:** The repercussions of climate change on both human populations and ecosystems surpass initial expectations in terms of scope and severity. Additionally, future risks are predicted to surge rapidly with each incremental temperature rise.
- **Adaptation Measures:** While adaptation measures can effectively enhance resilience, there is a need for increased financial support to scale up these solutions.

- While adaptation considerations are now integrated into climate policies in around 170 countries, numerous nations have not yet progressed from planning to execution.
- The resilience-building initiatives currently in place are mostly limited in scale, reactionary, and incremental, focusing primarily on immediate or short-term risks.
- The current allocation of global financial resources for adaptation is insufficient, posing constraints on the implementation of adaptation measures, especially in developing countries.

- **Global Temperature may Surpass 1.5 degrees Celsius:** According to various scenarios examined, there is a likelihood greater than 50% that global temperature will increase to or surpass 1.5 degrees Celsius between 2021 and 2040. In a high-emissions trajectory, the world might reach this threshold even earlier, possibly between 2018 and 2037.
- **Maladaptation**: Maladaptation refers to changes in natural or human systems that inadvertently heighten vulnerability to climate-related stimuli. It encompasses adaptation measures that fail to reduce vulnerability but instead exacerbate it.

28TH CONFERENCE OF PARTIES (COP 28)

COP-28 convened in Dubai, UAE, with representatives from 197 nations showcasing their initiatives to combat global warming and discussing future climate actions. The conference resulted in a mix of successes and setbacks, marking significant progress since the Paris Agreement. While some view it as a milestone towards ending the fossil fuel era, concerns persist regarding shortcomings in adaptation efforts and notable gaps in mitigation strategies.

The key highlights of the COP28 Climate Summit include:

- **Emissions Mitigation Targets**: Negotiations will aim to establish ambitious emissions reduction targets, aligning with the Paris Conference's goal of limiting global temperature rise.
- **Phase Down vs Phase-Out:** Developed nations may advocate for an accelerated phase-out, while developing countries, including India, grapple with balancing energy security needs and emission reduction objectives.
- **Climate Finance:** The contentious issue of financial support from developed to developing nations for climate mitigation and adaptation efforts will be addressed. Developing countries require significant funding, estimated at **$200 billion** annually by 2030, to adapt to worsening climate impacts.
- **Industry-led Solutions**: Discussions will center on leveraging industry-led innovations to drive sustainable development and reduce carbon footprints.
- **Low-carbon Innovation:** The conference will emphasize fostering low-carbon innovations and technologies to pave the way for a sustainable future.

A STATUS CHECK OF MAJOR PARAMETERS

CRITERIA	REQUIREMENT	CURRENT STATE
Emissions	Immediate peak and rapid reduction, 2030 emissions must be 43% below 2019	Emissions still rising. As of now, 2030 emissions likely to be just 2% below 2019
Adaptation	At least $215 billion/year needed to fund adaptation projects in developing countries	Barely $21 billion/year flowing now
Loss and Damage	An estimated $100 billion/year required to help countries hit by climate disasters	No money right now
Finance	An estimated tens of trillions of dollars per year needed to facilitate all climate actions	Even the modest promised flow of $100 bn per year has not materialised
Temperature	Hold rise within 1.5 °C from pre-industrial times	Breached for daily temp. Annual avgs likely to be breached in 4 years

- **Progress on Operationalizing the Paris Agreement Article:** Assessment of progress on operationalizing various aspects of the Paris Agreement, including reporting mechanisms and transparency, will be conducted.
- **Reforming the Role of Private Sector Investment:** The role of private sector investment in climate actions will be scrutinized, with a focus on effectively mobilizing private capital to address climate challenges.

INDIA'S ENGAGEMENTS AT COP28:

- **Green Credit Initiative:** Aims to motivate proactive environmental actions by issuing "Green Credits" for planting trees on barren or polluted land and near rivers, ultimately restoring natural ecosystems.

- **Leadership Group for Industry Transition (LeadIT 2.0):** Phase II prioritizes equitable and fair industrial transformation, joint development and sharing of low-carbon technologies, and financial aid for emerging economies transitioning to greener industries.
- **Global River Cities Alliance (GRCA)**: Launched at COP 28, this initiative led by India's National Mission for Clean Ganga underlines the country's commitment to sustainable river management and climate resilience. GRCA serves as a platform for knowledge exchange, pairing river cities, and sharing best practices.
- **Quad Climate Working Group (QCWG) on Localized Climate Action**: This event emphasized the crucial role of local communities and regional authorities in promoting sustainable lifestyles.

CHALLENGES FACED BY INDIA AT COP28

- **Cooling Pledge:** India is reportedly reluctant to endorse a global commitment to reduce emissions related to cooling at the COP28 climate summit, citing the necessity for affordable cooling in the world's most populous nation.
- **Luxury emissions:** India is urged to decrease "luxury emissions," covering sectors like oil and gas and waste, contributing to Methane Emissions. This request demands a nuanced approach considering its impact on various sectors and India's broader developmental objectives.
- **Loss and Damage Finance:** A recent CSE-Down to Earth assessment revealed that India experienced an extreme weather event almost every other day in the first nine months of this year. Hence, India's focus would be on securing "loss and damage finance."
- **Coal dependence and fossil fuel phase-out:** India's reliance on coal for power generation remains contentious. Immediate closure proposals for coal-fired power plants **conflict** with India's emphasis on **energy security.**
- **Agricultural Emission Cuts and Food Security:** The **agriculture** sector, along with animal husbandry, contributes nearly **15% of India's annual emissions.** Agreeing to emission cuts in agriculture could entail changes in cropping patterns with significant implications for India's food security.

The COP28 climate summit looms as a watershed moment for global climate action, presenting India with the critical task of balancing emissions reduction with equitable and sustainable development. COP28 stands as a pivotal point for international climate efforts, urging India to chart a course that reconciles emissions reduction with inclusive and sustainable development.

INDIA'S LONG-TERM LOW EMISSION DEVELOPMENT STRATEGY (LT-LEDS)

India has recently submitted its Long-Term Low Emission Development Strategy (LT-LEDS) to the United Nations Framework Convention on Climate Change (UNFCCC).

About India's LT-LEDS:

- **Goal:** Achieving net zero emissions by 2070.
- **Key Transitions:** The strategy outlines seven key transitions to low-carbon development pathways.
- **UNFCCC Commitment**: Formulated and communicated under **Article 4.19** of the Paris Agreement, in line with commitments made by parties to the UNFCCC.
- **Guiding Vision:** Inspired by the vision of LiFE, Lifestyle for the Environment.

Element	Initiatives	Current Policies and Targets
CO2 Reduction		Focused on low-carbon electricity and transport systems
	NDC Target	50% non-fossil power generation capacity by 2030
Electricity and Energy Systems	Renewable Purchase Obligations	For distribution companies, open access consumers, and captive power plants
	Green Energy Corridors	Strengthening transmission networks in 8 renewable energy-rich states
	Nuclear Capacity	Three-fold increase in nuclear power capacity by 2032
	Ethanol Blending	20% ethanol blending in petrol by 2025
Transport Systems	Indian Railways	Net-zero emissions by 2030
	Emission Standards	Bharat Stage VI emission standards
	PM Gati Shakti	National Master Plan for Multi-modal Connectivity
Building and Habitat Initiatives	National Building Code	Energy Conservation Building Code, Eco-Niwas Samhita
	National Mission on Sustainable Habitat	Promoting sustainable urban design
	Extended Producer Responsibility 2021	Plastic Waste Management (Amendment) Rules 2021
Energy Efficiency	National Missions for Enhanced Energy Efficiency	Standards and Labelling Scheme, Energy Efficiency Financing Platform
Industrial System Development	Economy-Wide Decoupling	Economic growth decoupled from emissions
	Fuel Switching	Promoting natural gas and bio-fuels
	Material Efficiency	Resource efficiency, plastic & e-waste management, steel recycling
	Green Hydrogen	Technology and infrastructure development
R&D and Capacity Building	Carbon Capture, Utilization and Storage (CCUS)	Develop relevant technologies
Environmental and Carbon Sinks	NDC Target	Increase carbon sink capacity by 2.5-3 billion tonnes CO2 equivalent by 2030
	Forest and Vegetation Cover	Enhance forest cover with socio-economic and ecological considerations
	Restoration	Restore 26 million hectares of degraded land by 2030
	National Biodiversity Targets	Align national targets with global Aichi Biodiversity goals
	Policies and Institutions	National Mission for a Green India, National Afforestation Programme, Nagar Van Yojana, National REDD+ Strategy 2018
Greening Efforts	Initiatives by NHAI and Indian Railways	Promote green infrastructure development
Economic and Financial Aspects	Business Responsibility and Sustainability Report (BRSR)	Mandated by SEBI for sustainability reporting by companies
	Renewable Energy Projects	Included under Priority Sector Lending (PSL)
	Sustainable Finance Group by RBI	Develop regulations for climate-conscious investments

INDIA'S UPDATED INDC'S

India recently submitted its Updated Nationally Determined Contributions (NDCs) to the United Nations Framework Convention on Climate Change (UNFCCC).

- **The submission of updated NDCs reflects the implementation of the Paris Agreement's** 'ratcheting mechanism,' which requires countries to enhance their climate action commitments every five years.
- This process **aims to progressively strengthen global efforts to combat climate change.** India's first NDC was submitted to the UNFCCC in 2015.

Components of India's 2015 NDC: The 2015 NDC outlined eight goals, three of which included quantitative targets extending up to 2030.

- **These targets focused on:**
  - Reducing emissions intensity.
  - Increasing the share of non-fossil fuels in installed electricity capacity.
  - Creating additional carbon sinks through the expansion of forest and tree cover.

A STEP TOWARDS 'NET ZERO' BY 2070

Commitments under updated NDC of 2022:
- Achieve about 50% cumulative electric power installed capacity from non-fossil fuel-based energy resources by 2030
- Reduce emissions intensity (emission per unit of GDP) by 45% by 2030 from 2005 levels
- Propagate a healthy and sustainable way of living based on traditions and values of conservation and moderation, including through a mass movement for 'LIFE'– 'Lifestyle for Environment' – as a key to combat climate change

(citizen-centric approach to combat climate change)

What does earlier (first) NDC of 2015 say:
It has three quantitative targets up to 2030
- Cumulative electric power installed capacity from non-fossil sources to reach 40%
- Reduce emissions intensity of GDP by 33-35% compared to 2005 levels
- Creation of additional carbon sink of 2.5 to 3 billion tonnes of CO2 equivalent through additional forest and tree cover
- It was submitted to the UNFCCC on October 2, 2015
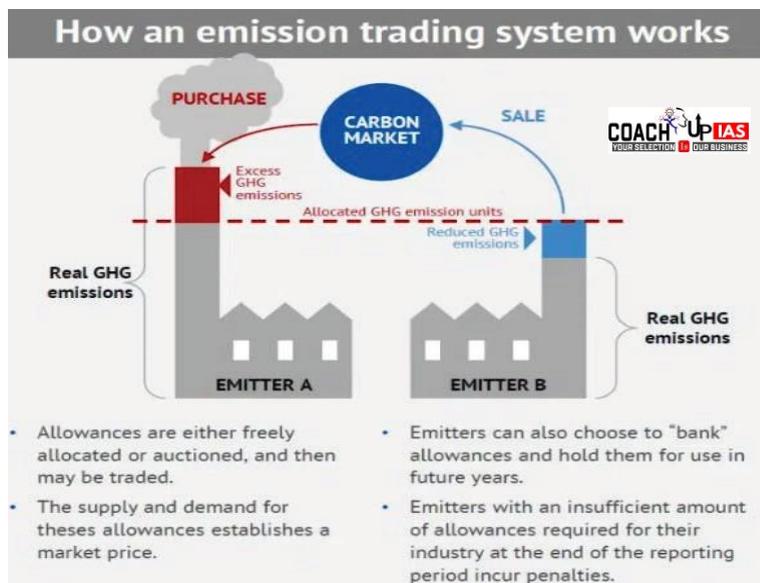
CARBON MARKETS

Carbon markets facilitate the buying and selling of carbon emissions to reduce global greenhouse gas emissions. They enable emissions reductions beyond individual country efforts.

Example: A factory in India can reduce emissions by receiving technology or financial aid from another country, or by investing in emission reduction measures and selling resulting reductions as Carbon Credits. Entities unable to meet their emission targets can purchase these credits to offset their own emissions.

- **Carbon Credit Market under the Paris Agreement:** The carbon market, which initially operated under the Kyoto Protocol, underwent a transition with the advent of the Paris Agreement in 2020.
  - **Article 6** outlines provisions for establishing a new carbon market.
  - **Article 6.2** permits bilateral arrangements for the transfer of emissions reductions.
  - **Article 6.4** introduces a broader carbon market where reductions can be traded by any party.
  - **Article 6.8** discusses non-market approaches available to countries for achieving their targets.

VARIOUS CARBON MARKETS

- **Compliance or mandatory markets:** They are regulated by national, regional, or international policies and operate based on the **"cap-and-trade"** principle. An example of this is the EU's emissions trading system (**ETS**)."
  - Established in 2005, the ETS sets emissions caps for sectors like power, manufacturing, and agriculture, allocating permits accordingly.
  - Entities exceeding their allowances must purchase additional permits, driving emissions trading and determining carbon prices through market dynamics.

How an emission trading system works

PURCHASE — CARBON MARKET — SALE

Excess GHG emissions

Allocated GHG emission units

Reduced GHG emissions

Real GHG emissions — EMITTER A

Real GHG emissions — EMITTER B

- Allowances are either freely allocated or auctioned, and then may be traded.
- The supply and demand for theses allowances establishes a market price.
- Emitters can also choose to "bank" allowances and hold them for use in future years.
- Emitters with an insufficient amount of allowances required for their industry at the end of the reporting period incur penalties.

- **Voluntary Markets:** In voluntary carbon markets, emitters purchase carbon credits to offset their emissions, typically originating from activities like afforestation. These credits are bought from projects that reduce, capture, remove, or avoid greenhouse gas emissions.

Global Carbon Markets Status:

- **Tradeable Carbon Allowances:** In 2023, the value of global tradeable carbon allowances reached a record €881 billion (approximately $949 billion), marking a 2% increase from the previous year. The EU's Emissions Trading System (ETS) contributed around 87% of this value, amounting to approximately €770 billion (around $824 billion).
- **Voluntary Carbon Markets:** Voluntary carbon markets are valued at around USD 2 billion globally, which is relatively small compared to compliance markets.
- **Cost Savings from Carbon Credits:** According to the World Bank, trading in carbon credits has the potential to halve the cost of implementing Nationally Determined Contributions (NDCs) by 2030, potentially saving up to USD 250 billion.

India Carbon Market Status

- India's carbon credit market boasts a value exceeding US $1.2 billion, making it the world's **second largest.**
- In India, carbon markets are primarily driven by the **clean development mechanism** under the **Kyoto Protocol**, with secondary schemes like the perform-achieve-trade and renewable energy certificates.

Key outcomes regarding Article 6 during COP27 included:

- The UNFCCC Secretariat was tasked with developing a trial version of the tracking system, known as the Centralized Accounting and Reporting Platform (CARP), to monitor carbon credits.
- Guidelines for the submission of Article 6-related data were endorsed.
- Certain matters, such as whether activities under Article 6.4 should encompass emission avoidance and conservation enhancement, were deferred to upcoming conferences.

Voluntary Carbon Market- Is the boom real?

The global voluntary carbon market (VCM) sector has witnessed significant growth in recent years, with India emerging as a key player. As of 2024, India ranks as the world's second-largest contributor to carbon offsets in this market. India has issued 278 million carbon credits between 2010 and 2022, accounting for 17% of the global supply. Over 1,400 projects are registered or under consideration in major crediting programs like Verra and Gold Standard.

- However, a new investigative report by the Centre for Science and Environment (CSE) and Down To Earth reveals issues of fraud within this booming sector. Titled '**Discredited: Does the Voluntary Carbon Market Benefit People and Climate in India?**', the report questions the effectiveness of VCM in reducing global greenhouse gas emissions and ensuring financial benefits for carbon-sequestering communities.
- The investigation, focused on the supply side of VCM, exposes a lack of transparency and accountability, with hundreds of projects operating without clear guidelines.
- The report calls for a reevaluation of the VCM's impact and proposes solutions for a more equitable and transparent market.

WAY FORWARD

- The UNDP underscores the importance of ensuring that emission reductions and removals are genuine and in line with the country's NDCs for carbon markets to succeed.
- Additionally, there must be transparency in the institutional and financial framework governing carbon market transactions.

CARBON CREDIT TRADING SCHEME, 2023

The Carbon Credit Trading Scheme, 2023, is introduced by the Ministry of Power to regulate and encourage the reduction of greenhouse gas emissions in India through the issuance and trading of carbon credits.

- **Carbon credit certificates** will be issued by the Bureau of Energy Efficiency (BEE) to entities that exceed their assigned emission reduction targets.
- **The Ministry of Power, with input from the Bureau of Energy Efficiency,** identifies entities obligated to participate in the trading scheme.
- The emission intensity targets for obligated entities are **set by the Ministry of Environment, Forest, and Climate Change,** following recommendations from the Ministry of Power.
- **Entities failing to meet their emission targets mus**t purchase carbon credit certificates as compensation.
- **Carbon credit certificates** will be traded on power exchanges approved by the Central Electricity Regulatory Commission (CERC).
- **The Grid Controller of India Limited (GCIL)** serves as the scheme's registry, responsible for entity registration and transaction record-keeping.

Challenges to Carbon Markets in India:

- **Lack of Standardization:** PAT and REC schemes do not specify their certificates' metric unit in terms of carbon dioxide equivalent, hindering their effectiveness as a price discovery mechanism for carbon.

- **Limited Experience:** India's industry stakeholders lack significant experience in cap-and-trade markets.
- **Fragmentation: Multiple sectoral market instruments** create fragmentation in the domestic energy market, impeding cross-linkages between schemes like PAT and REC.
- **Enforcement Issues: Weak enforceability on DISCOMs** undermines market effectiveness.
- **Greenwashing Risks:** Companies may opt for carbon credits to offset their emissions rather than implementing genuine emission reduction strategies or investing in clean technologies.

Way Forward:
- **Market Observation:** Examine current trading trends of environmental instruments to inform future strategies.
- **Demand-Supply Management:** Calibrate and manage the demand and supply of instruments effectively.
- **Fungibility Provision:** Introduce provisions for unit trading fungibility to attract voluntary buyers and encourage international market participation.

CARBON BORDER ADJUSTMENT MECHANISM (CBAM)

The European Union (EU) has formally notified the implementation of the Carbon Border Adjustment Mechanism (CBAM) to WTO members of the committee on trade and environment.

About CBAM:
- CBAM is a **plan to levy taxes** on carbon-intensive products like iron, steel, cement, fertilizer, aluminum, electricity, and hydrogen starting from 2026.
- It's also **known as a carbon border tax** or a carbon leakage instrument.
- CBAM is **part of the EU's Fit for 55 package,** aiming to reduce net greenhouse gas emissions by at least 55% by 2030 and achieve net zero emissions by 2050.
- Under CBAM, **EU importers must purchase carbon certificates equivalent to the carbon price** that would have been paid if the goods were produced under the EU's carbon pricing rules. They can claim deductions if the emission costs were already paid by the non-EU producer's country.

India's Opposition & Concerns:
- **India opposes CBAM as discriminatory, fearing increased prices** of Indian goods in Europe and a decline in demand, affecting Indian exports.
- **It contradicts the principle** of Common but Differentiated Responsibilities and Respective Capabilities (CBDR–RC).
- **CBAM may distort markets and worsen trust** issues among parties, along with challenges in measuring carbon prices of goods.
- **Concerns include potential violations of WTO rules,** economic risks to the Global South, and additional costs passed on to consumers.

Way Ahead:
- **India is developing standards to measure carbon embedded** in its products, led by the Bureau of Energy Efficiency (BEE) under the Power Ministry.
- **Financial support is needed for developing countries** to implement carbon pricing.
- There should be a **coordinated application** of carbon taxes and related climate change measures.
- **Bilateral resolution** with the EU is sought, alongside preparations to establish India's own carbon trading system.

CLIMATE FINANCE

Climate finance, as defined by the UNFCCC, encompasses funding from various sources to support climate change mitigation and adaptation efforts at local, national, and transnational levels. The scale of required finance for a global shift to a low-carbon economy is estimated at USD 4–6 trillion annually.

The UNFCCC, the Kyoto Protocol and the Paris Agreement call for financial assistance from Parties with more financial resources to those that are less endowed and more vulnerable. During COP26, India wanted a trillion dollars in climate money from industrialized countries over the next decade in order to adapt to and reduce the difficulties posed by global warming.

FINANCIAL MECHANISMS UNDER UNFCCC
- **Global Environment Facility (GEF):** Manages funds such as the Special Climate Change Fund (SCCF) and the Least Developed Countries Fund (LDCF).
- **Adaptation Fund:** Established to finance adaptation projects in developing countries. Receives a portion of proceeds from new market-based mechanisms under the Paris Agreement.
- **Green Climate Fund (GCF)**: Aims to mobilize USD 100 billion annually by 2020 to support developing countries in their low-emission and climate-resilient endeavors.

CLIMATE FINANCE IN INDIA

- **India's climate finance** needs cumulative investments of USD 6–8 trillion during 2015–2030 for energy system transformation and USD 10 trillion needed to achieve net-zero emissions by 2070.
- **Mobilization Efforts:**
  - Establishment of the National Adaptation Fund for Climate Change (NAFCC).
  - Issuance of green bonds and deposits, with the first green bond issued by Yes Bank in 2015.
  - Creation of the Sustainable Finance Group (SFG) under RBI.
  - RBI's participation in the Network for Greening of Financial System (NGFS).
  - Introduction of sovereign green bonds in the Union Budget 2022-23 for green infrastructure investments.

ISSUES AND CHALLENGES

- **Lack of Clarity:** There has been a lack of clarity on how to define and account for these climate finances, as serious concerns have been raised over self-reporting by the developed country parties.
- **Robust accounting framework:** For transparent reporting of climate finance, the modalities for the accounting of financial resources cannot be at the discretion of a particular country.
- **Threat to contributions:** For instance, the US pulled out of the Paris Agreement and refusal to continue US contributions to climate funds.
- **Bias towards mitigation:** Most climate funds have flown into mitigation, rather than adaptation.
- **Selective interest:** Climate finance has mostly concentrated on renewable energy, green buildings and urban transport, while other sectors like agriculture, degradation of land, water, etc. have seen a muted interest.

WAY FORWARD

- **Proper layout for climate finance:** Climate finance has to be predictable, assured and transparent to be part of the planning process and to make a difference.
- **Assessing the quantum required:** India must put in place a process to assess and monitor the total quantum of climate finance required with identified sources.
- **Financial accountability**: Climate finance must fall into the purview of accountability institutions like Comptroller and Auditor General, or judicial bodies such as the National Green Tribunal, with clear guidelines on its scrutiny.
- **Separate entity to deal:** Create a group or designate an individual within the executive branch that can oversee all of the climate change mechanisms supported by the government.

KEYWORDS: Climate apartheid, Think globally, act locally, Politicised climate negotiations, Carbon Offsetting, Carbon Sequestration, Flood management to Flood governance, Shift from subsistence to sustainability, From culture of indifference to culture of safety, Build back better, Pollution to solution, Closing the commitment gap

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	PREVIOUS YEAR QUESTIONS	
1.	The Intergovernmental Panel on Climate Change (IPCC) has predicted a global sea level rise of about one meter by AD 2100. What would be its impact in India and the other countries in the Indian Ocean region?	2023
2.	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
3.	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? (Answer in 250 words)	2021
4.	Explain the purpose of the Green Grid Initiative launched at the 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
5.	'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
6.	Should the pursuit of carbon credit and clean development mechanism set up under UNFCCC be maintained even though there has been a massive slide in the value of carbon credit? Discuss with respect to India's energy needs for economic growth.	2014

5	SUSTAINABLE DEVELOPMENT AND WASTE MANAGEMENT

"Faster, Sustainable and More Inclusive Growth" – **Twelfth Five Year Plan (2012-2017)**

INTRODUCTION

According to the UN, Sustainable development has been defined as development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

Sustainable development calls for concerted efforts towards building an inclusive, sustainable, and resilient future for people and the planet. As the post-2015 development agenda, the Sustainable Development Goals (SDGs) are an intergovernmental agreement that takes the role of the Millennium Development Goals.

SDG Report 2022
• On the 17 Sustainable Development Goals proposed as a part of the 2030 agenda, India is ranked 120th out of 192 UN nations.   • Because of better performance in delivering amenities like clean water and sanitation, and inexpensive and clean electricity, among other things, the nation's overall SDG score increased by 6 points, from 60 in 2019 to 66 in 2020–21.

CORE ELEMENTS OF SUSTAINABLE DEVELOPMENT

The essential components of sustainable development encompass **economic advancement, societal integration, and safeguarding the environment,** necessitating their alignment.

Environmental Sustainability:

- It aims to deter the exploitation of nature as an infinite resource while promoting its **preservation and responsible utilization**. Environmental sustainability is advanced through various measures including **conservation efforts, investment in renewable energy, water conservation, promotion of sustainable transportation, and innovative approaches** to construction and architecture.

Core Elements of Sustainable Development

Social Sustainability:

- It has the potential to promote gender parity and the advancement of individuals, communities, and cultures, thereby contributing to a just and equitably distributed standard of living, healthcare, and education worldwide.

Economic Sustainability:

- Emphasis is placed on achieving **balanced economic advancement** that fosters prosperity for everyone while preserving the environment. This involves **investing in and fairly allocating economic resources**, with the aim of eliminating poverty in its various manifestations.
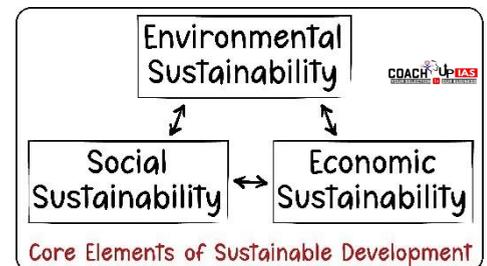
NEED FOR SUSTAINABLE DEVELOPMENT

The need for sustainable development is critical for guaranteeing the well-being of both present and future generations. Some key reasons are:

Environmental Challenges:

- **Resource Depletion:** Our current pace of resource consumption, like fossil fuels, water, and forests, is unsustainable. Sustainable development promotes responsible resource management, ensuring their availability for future generations.
- **Environmental Degradation:** Unsustainable practices lead to pollution, deforestation, and climate change. Sustainable development encourages practices that protect the environment and maintain ecological balance.

- **Biodiversity Loss:** The diversity of life on Earth is crucial for healthy ecosystems and human well-being. Sustainable development aims to conserve biodiversity and protect natural habitats.

Social and Economic Needs:
- **Poverty and Inequality:** Unequal access to resources and opportunities creates social and economic disparities. Sustainable development strives for equitable development and poverty reduction, ensuring all individuals have access to a good standard of living.
- **Health and Wellbeing:** Environmental degradation and poverty negatively impact human health. Sustainable development aims to foster healthy communities with access to clean air, water, and sanitation.
- **Economic Stability**: Unsustainable resource use and environmental degradation ultimately harm economic prosperity. Sustainable development promotes practices that ensure long-term economic growth and stability.

The Interconnectedness:
- The three pillars of sustainable development - economic, social, and environmental - are interconnected. Addressing one area positively impacts the others. For example, investing in renewable energy (environment) creates jobs (economy) and improves air quality (health).

Future Implications:
- **Human needs are met:** Everyone has access to basic necessities like food, water, and shelter.
- **The environment is protected:** Natural resources are used responsibly, and ecosystems are preserved.
- **Economic growth is sustainable:** Economic prosperity is achieved without compromising the environment or creating social inequalities.

Conclusion:
The need for sustainable development is undeniable. It is a collective responsibility to ensure a healthy planet, equitable societies, and a prosperous future for all. By working together, we can create a sustainable world that benefits current and future generations, addressing climate change, preserving biodiversity, and promoting social well-being.

BENEFITS OF SUSTAINABLE DEVELOPMENT

- **Poverty And Hunger Management**: End poverty and hunger in all its forms everywhere.
- **Inclusive Growth To Reduce Inequality In All Forms:** Ensure inclusive and equitable qualitative education and promote lifelong learning opportunities for all.
- **Gender Equality Management**: Achieve gender equality and empower all women and girls
- **Water And Energy Management**: Ensure availability and sustainable management of water and energy for all.
- **Economy And Industrial Management:** Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.
- **Consumption And Production Management**: Ensure sustainable consumption and production patterns.
- **Climate Change Action Management:** Take urgent actions to combat climate change and its impact.
- **Forest Management**: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably.
- **Global Partnership Management**: Strengthen the means of implementation and revitalise the global partnership for sustainable development.

SUSTAINABLE DEVELOPMENT GOALS

- **The Sustainable Development Goals (SDGs)** serve as comprehensive frameworks aimed at fostering a more sustainable and equitable future for all individuals. Essentially, the SDGs represent a set of **seventeen specific targets** endorsed by all UN member states in 2015 to enhance the prospects of future generations and are targeted to be achieved by 2030.
- The SDGs, constituting an intergovernmental agreement, **succeeded the Millennium Development Goals** as the overarching development agenda beyond 2015. **The Rio+20 summit held in Rio de Janeiro in 2012** was instrumental in shaping the SDGs, albeit as non-binding instruments.
- **Status of India:** According to the United Nations SDG Index and Dashboards Report 2023, which assesses countries' progress towards the Sustainable Development Goals (SDGs), the SDG Index Rank of India is 112 out of 166 countries, with an overall index score of 63.5 percent and spill-over score of 99.4 percent.

CHALLENGES IN REALIZATION OF SDGS

- **Global economic growth is sluggish:** In order to meet the Sustainable Development Goals (SDGs), the world must achieve an annual growth rate of 2.5 percentage points. However, up to 2021, global growth has only reached 0.36 percentage points, which is nearly seven times slower than that of the United States. The COVID-19 pandemic halted progress worldwide from 2019 to 2021.

- **Utilizing linear extrapolation:** To demonstrate the disparity between expectations and actual progress, linear extrapolation can be employed to forecast a future date for achieving perfection globally. However, this is a simplification, as countries nearing completion on certain goals may shift focus and resources to other objectives.
- **Unrealistic commitments:** Certain commitments, such as ending wars, poverty, climate change, hunger, and diseases, are impractical and difficult to achieve.
- **Financial Challenges:** Achieving SDG targets such as zero hunger and poverty necessitates substantial investments for their eradication. With one-third of the world's 1.2 billion extremely poor residing in India, the government alone lacks the resources to fund these ambitious SDG targets.
- **Monitoring and Implementation Ownership:** While NITI Aayog is anticipated to assume a pivotal role, concerns have been raised by its members regarding their limited manpower to effectively handle such an immense undertaking.

INITIATIVES TAKEN TO ACHIEVE SDG TARGETS
Global level
- **Paris Agreement on Climate Change: Aligned with SDG 13 (Climate Action)**, this landmark agreement, adopted by 196 countries, aims to limit global warming and address climate change.
- **Sendai Framework for Disaster Risk Reduction: Corresponding to SDG 11** (Sustainable Cities and Communities), this framework advocates proactive disaster preparedness, risk reduction, and early warning systems.
- **Global Goals Platform: Aligned with SDG 17** (Partnerships for the Goals), this online platform serves as a central hub for information, resources, and collaboration on SDG achievement. It facilitates knowledge sharing, partnerships, and engagement among governments, businesses, and civil society.

National Level
- **Pradhan Mantri Jan-Dhan Yojana (PMJDY):** Aligned with **SDG 1 (No Poverty) and SDG 10 (Reduced Inequalities),** PMJDY aims to provide financial inclusion by ensuring access to banking services, promoting economic empowerment, and reducing income disparities.
- **Ayushman Bharat - Pradhan Mantri Jan Arogya Yojana (AB-PMJAY): Supporting SDG 3** (Good Health and Well-being), this scheme provides health insurance coverage to vulnerable populations, promoting universal health coverage and reducing health inequalities.
- **Skill India Mission: Corresponding to SDG 8** (Decent Work and Economic Growth), this initiative aims to enhance employability and entrepreneurship skills, fostering inclusive and sustainable economic growth and promoting job creation.
- **Beti Bachao, Beti Padhao: Aligned with SDG 5** (Gender Equality) and SDG 4 (Quality Education), this campaign aims to address gender-based discrimination, promote girl child education, and empower women, contributing to gender equality and inclusive education.
- **Ujjwala Yojana: Aligned with SDG 7** (Affordable and Clean Energy), this initiative provides access to clean cooking fuel to households below the poverty line, reducing indoor air pollution and improving public health.
- **Start-Up India: Corresponding to SDG 9** (Industry, Innovation, and Infrastructure), this initiative aims to promote entrepreneurship and innovation, fostering sustainable economic growth and job creation through the development of a robust startup ecosystem.
- **Pradhan Mantri Awas Yojana (PMAY): Supporting SDG 11** (Sustainable Cities and Communities), PMAY aims to provide affordable housing to all urban households, addressing housing shortages, slum proliferation, and inadequate living conditions.

SUSTAINABLE DEVELOPMENT GOALS PROGRESS REPORT 2023

Recently, the UN Department of Economic and Social Affairs (UNDESA) released the Sustainable Development Goals (SDG) Progress Report 2023. This report monitors global progress on the 17 SDGs outlined by the United Nations.

Here are some key highlights from the report:
- **Progress Assessment:** The report indicates that progress on over 50% of the SDG targets is inadequate, with nearly 30% showing no improvement or regression.
- **Impact of Global Challenges:** The COVID-19 pandemic, coupled with issues such as climate change, biodiversity loss, and escalating pollution, is exacerbating existing challenges and hindering progress towards sustainable development goals.
- **Education Concerns:** By 2030, the report predicts that approximately 84 million children will be out of school, and nearly 300 million enrolled children will lack basic literacy skills.

- **Persistent Poverty:** If current trends persist, an alarming 575 million people are projected to live in extreme poverty by 2030, underscoring the urgency of addressing socioeconomic disparities.

In light of these findings, the report offers several recommendations:

- **Renewed Commitment:** Heads of state and governments are urged to reaffirm their commitment to advancing the SDGs and prioritize collective action to address pressing global challenges.
- **Fulfilling Commitments:** The international community is called upon to honor the commitments outlined in the Addis Ababa Action Agenda, which provides a comprehensive framework for financing sustainable development initiatives.
- **Targeted Interventions:** More targeted policies and actions are essential to eradicate poverty, reduce inequality, and promote the rights of women and girls, emphasizing the importance of inclusive and gender-responsive approaches.
- **Strengthening Multilateralism**: To effectively address current challenges, there is a critical need to enhance the capacity of the multilateral system, fostering collaboration and coordination among nations and stakeholders.

Overall, the report underscores the urgency of collective action and **underscores the need for sustained commitment and concerted efforts to achieve the SDGs by 2030.**

WAY FORWARD

- **SDG Revolution:** The SDGs are reshaping development, demanding new strategies and partnerships.
- **Precision Monitoring - SDG India Index:** The recalculated index closely tracks State/UT progress annually, addressing gaps for a dynamic evaluation framework.
- **Whole-of-Society VNR:** India's VNR adopts a "whole-of-society" approach, engaging extensively to address Agenda 2030 issues.
- **Capacity Building for SDGs:** UN collaboration brings a comprehensive program for training in SDG monitoring, localization, and more.
- **Collaborative SDG Financing:** NITI Aayog partners with the IMF to estimate and refine SDG financing, with future state-specific exercises planned.
- **Focus on Backward States:** NITI Aayog collaborates closely with historically underdeveloped States, aiding in SDG adoption, monitoring, and institutional development.

Mission LiFE

Mission LiFE is an India-led global mass movement aimed at encouraging individual and collective actions to protect and preserve the environment. The concept was introduced by the Prime Minister at the United Nations Framework Convention on Climate Change (UNFCCC) **COP-26 in Glasgow.**
- Mobilize at least 1 billion Indians and global citizens to take individual and collective action for environmental protection from 2022 to 2027.
- Aim for at least 80% of all Indian villages and urban local bodies to become environment-friendly by 2028.

LOCALIZATION OF SDGS

Localization of the SDGs refers to the process of **adapting the Sustainable Development Goals (SDGs) to the specific context of sub-national regions**, such as states, provinces, or cities. The Ministry of Panchayati Raj has been actively pursuing the localisation of Sustainable Development Goals (SDGs) through Gram Panchayat Development Plan (GPDP), which involves **participatory planning by converging various schemes to achieve specific SDGs.** The objective of GPDP is to fulfill the Constitutional mandate of Gram Panchayats, aiming for economic development and social justice at the grassroots level.

BENEFITS OF LOCALISATION OF SDGS

- **Tailored Solutions:** Localisation allows for the development of tailored solutions that address specific local needs and challenges.
- **Community Empowerment:** Involving local communities in the planning and implementation of SDGs enhances their sense of ownership and empowerment.
- **Efficient Resource Allocation**: Localisation ensures that resources are allocated efficiently, targeting areas and populations most in need.
- **Faster Implementation:** By decentralizing decision-making and action, localisation enables faster implementation of SDG initiatives.

- **Enhanced Accountability**: Local governments are more accountable to their constituents, leading to greater transparency and responsiveness in SDG implementation efforts.

CHALLENGES IN SDG LOCALISATION

- **Limited availability** of finance, data, and capacities for subnational monitoring.
- **Lack of policy coherence** and coordination between national and local efforts.
- **Enhanced responsibilities** with limited funds transfer and local resource mobilization.
- **Limited awareness** of the SDGs at the sub-national level.
- **Necessity for local translation and adaptation** in a diverse country like India.

EFFORTS TAKEN FOR LOCALIZATION OF SDGS

- In India, the National Institution for Transforming India (NITI Aayog) oversees the adoption and monitoring of SDGs in the country while promoting competitive and cooperative federalism among States and Union Territories (UTs).
- The annual **'SDG India Index,'** launched by NITI Aayog in 2018, monitors progress at the state and UT levels.

Examples of Successful Localisation from States
- **Andhra Pradesh: Implemented 'Navaratnalu,'** a cluster of nine flagship programs targeting vulnerable communities across sectors such as agriculture, health, education, and housing.
- **Bihar: Implemented 'Viksit Bihar ke 7 Nischay,'** a package of programs focusing on inclusion, entrepreneurship, women's reservation in jobs, provision of essential amenities, and higher education.

WAY FORWARD

- Emphasize people-centric, gender-responsive, and community-responsive localisation of SDGs.
- Establish robust monitoring and evaluation mechanisms through effective partnership among all SDG stakeholders.
- Foster learning from shared experiences to overcome functional silos and address global challenges through local actions.
- Raise awareness about SDGs in Panchayati Raj Institutions (PRIs) and empower rural local bodies through proper devolution of Funds, Functions, and Functionaries.

ENVIRONMENT, SOCIAL AND GOVERNANCE (ESG)

- It refers to a **set of standards used to evaluate** a company's performance in maintaining the environment and maintaining good relations with its stakeholders.
- It serves as a **strategic framework for actions** spanning the organization's environmental impact and sustainability commitments, workplace culture and dedication to diversity and inclusion, and overall ethos addressing corporate risks and practises.
- **Indian Legal Framework for ESG:**
  o The Companies Act of 2013 mandated **Corporate Social Responsibility (CSR)** reporting and spending, the first global programme of its kind.
  o The top 1,000 listed businesses by market capitalization are required by SEBI to submit the **Business Responsibility and Sustainability Report (BRSR).**
  o The Reserve Bank of India (RBI) recognised the significance of green finance in India by holding a **Select Focus Group (SFG).**
  o **'Environmental, Social and Governance Rating Providers for Securities Markets'**: SEBI publishes a consultation document.

SUSTAINABLE AGRICULTURE

Sustainable agriculture involves cultivating methods that optimise natural resource use, minimise environmental harm, and enhance resilience to climate change, ensuring the needs of future generations are not compromised. Recognising the importance of ecological services is fundamental to sustainable agriculture, a concept that has gained significant momentum since the **Brundtland Report's publication in 1987**.

SUSTAINABLE AGRICULTURE CONCEPT

- Sustainable agriculture balances current food production with the needs of future generations, avoiding soil degradation and environmental harm.
- It integrates environmental health, economic profitability, and social equity, prioritizing natural resource conservation and ecosystem preservation.

- Sustainable agriculture includes practices like crop rotation, minimal tillage, and organic manure use, minimizing reliance on artificial inputs like fertilizers and pesticides.
- It manages renewable resources holistically, maintaining productivity and ecosystem services for current and future generations.

SUSTAINABLE AGRICULTURE PRINCIPLES

- **Environmental Sustainability:** Sustainable environmental practices encompass the protection, recycling, substitution, and preservation of the natural resource foundation, comprising land (soil), water, and wildlife.
- **Economic Sustainability:** Economic sustainability is attained by improving crop rotation and soil conservation practices, leading to enhanced yields.
- **Social Sustainability:** Upholding social justice and cultural cohesion is vital for attaining social sustainability.
- **Reduction of Non-renewable and Unsustainable Inputs:** It's imperative to minimize the use of non-renewable and environmentally harmful inputs, thereby lessening the ecological footprint of agricultural activities.

- **Leveraging Farmer Expertise for Sustainability:**
  Farmers' expertise is invaluable not only in maximizing agricultural productivity but also in promoting self-reliance and self-sufficiency within farming communities. Their insights and knowledge play a crucial role in shaping sustainable farming practices.
- **Promotion of Biodiversity:** Encouraging biodiversity within agricultural systems enhances resilience to pests, diseases, and climate change while also providing ecosystem services such as pollination and natural pest control.
- **Water Conservation and Management:** Implementing practices that optimize water use efficiency, such as drip irrigation and rainwater harvesting, helps conserve water resources and reduce agricultural water consumption.

ZERO BUDGET NATURAL FARMING (ZBNF)

Zero Budget Natural Farming (ZBNF) is an inventive agricultural approach that breaks away from conventional methods by eliminating the need for external inputs like chemical fertilizers and pesticides. It was introduced by agriculturist **Subhash Palekar** in the mid-1990s, ZBNF has become a sustainable and cost-effective substitute for Green Revolution-driven practices.

ZBNF promotes several natural farming practices:

- **Jivamrita/Jeevamrutha:** A fermented microbial culture that enriches the soil with nutrients, stimulates microbial activity, and enhances earthworm activity, while also providing protection against fungal and bacterial diseases in plants.
- **Bijamrita**: This mixture safeguards young roots from soil-borne and seed-borne diseases effectively. Prepared from a blend of desi cow dung, urine, jaggery, among other ingredients, it contributes to plant health and vitality.
- **Acchadana/Mulching**: Involves laying a protective layer of biomass on the soil surface, which helps in retaining moisture, suppressing weed growth, and improving soil structure and fertility.
- **Whapasa/Moisture Management:** Whapasa ensures the presence of both air and water molecules in the soil, promoting optimal soil moisture conditions. ZBNF advocates reducing irrigation and watering only at noon in alternate furrows to conserve moisture effectively.

SIGNIFICANCE

- **Improved Crop Productivity and Soil Fertility:** ZBNF enhances crop yields and soil fertility through atmospheric nitrogen fixation, without relying on synthetic fertilizers. **For example, farmers practicing ZBNF in Andhra Pradesh,** India, have reported significant increases in yields of crops like paddy, millets, and pulses.
- **Cost Reduction for Farmers**: By utilizing cow dung, urine-based formulations, and botanical extracts, ZBNF reduces input costs, making farming more economically sustainable. **Farmers in Karnataka, India**, practicing ZBNF have reported up to 30% reduction in input costs compared to conventional farming methods.
- **Healthier Food Production: ZBNF** eliminates the use of chemical fertilizers, resulting in crops free from harmful residues, thus promoting healthier food production and reducing health risks.

- **Empowerment and Employment Generation:** Adoption of ZBNF can create employment opportunities in agriculture and allied sectors, particularly empowering women and contributing to rural livelihoods. **In Telangana, India, the implementation of ZBNF** has led to the formation of women-led Self Help Groups (SHGs) engaged in seed conservation and organic farming activities.
- **Environmental Sustainability**: ZBNF prevents soil degradation, salination, and water contamination, ensuring sustainable land and water resources and minimizing the environmental footprint of agriculture.

CHALLENGES
- **Experts question** the effectiveness of ZBNF in addressing agrarian challenges in India, citing limited testing on diverse soil types.
- **Agrarian distress persists** due to escalating input expenses, inadequate MSPs, and stagnant prices.
- **Challenges from conventional farming methods**, such as knowledge gaps, seed bank availability, cold chain facilities, MSPs, and marketing issues, remain unresolved.

WAY FORWARD
- **Establishment of local markets** is essential to ensure farmers receive fair prices for their harvest.
- **Providing cash incentives** to farmers adopting practices like "yogik" farming and "gou mata kheti" can encourage the adoption of zero budget natural farming.
- Initiatives such as **Rashtriya Krishi Vikas Yojana and Parampargat Krishi Vikas Yojana** can be tailored to support the implementation of zero budget farming.

> **National Mission on Natural Farming (NMNF)**, also known as Bharatiya Prakritik Krishi Paddhati Programme (BPKP), operates as a sub-mission under the Paramparagat Krishi Vikas Yojana (PKVY) within the framework of the National Mission on Sustainable Agriculture (NMSA).

ORGANIC FARMING

Organic farming entails **cultivating land and nurturing crops using natural methods.** Its goal is to maintain soil vitality and wellness by incorporating organic materials like crop residues, animal manure, and beneficial microorganisms, fostering nutrient release for sustainable and eco-friendly crop production, devoid of pollution.

CONCEPTS OF ORGANIC FARMING
- **Traditional Practice:** Organic farming has been a way of life and a tradition in our Indian farming system for centuries; it is not a new concept.
- **Pest and Disease Management:** Organic farming has its own system for controlling pests and diseases in crop and livestock production, which avoids the use of various synthetic chemicals or gene manipulation.
- **Foundation in Natural Laws:** Organic farming is based on an intimate understanding of nature's laws and rules.
- **Sustainable Nutrient Management:** They release nutrients to increase crop yield and sustainability. "Organic agriculture is a production system that promotes the health of soils, ecosystems, and people."

COMPARISON WITH ZERO BUDGET NATURAL FARMING
Similarities:
- **Both organic and natural farming** practices are considered **sustainable** agriculture methods.
- They aim to produce **chemical-free foods** by avoiding synthetic fertilizers and chemical pesticides.
- Both emphasize the use of **local seed varieties** and homemade pest control methods.

Differences:

Aspect	Organic Farming	Natural Farming (ZBNF)
Intervention Approach	Holistic system optimizing productivity (e.g., ploughing, tilling)	Minimal intervention to preserve natural agroecosystem
Handling of Agroecosystem	Incorporates diverse communities (plants, livestock)	Emphasizes preservation of natural agroecosystem
Practices	Supports conventional practices like ploughing, tilling, etc.	Avoids practices such as ploughing, tilling, and manuring
Cost	Can be capital-intensive due to bulk organic manures	Extremely low-cost, often zero, utilizing locally made preparations

SIGNIFICANCE
- **Expanding Market Opportunities:** High demand for organic products in India and globally leads to increased export revenue.
- **Health and Nutritional Benefits:** Organic products are more nutrient-dense, palatable, and healthier compared to those produced with chemicals and fertilizers.
- **Environmental Advantages**:
  - Organic farming, free of fertilizers and chemicals, has no negative environmental impact.
  - Supports increased wildlife presence, particularly in lowlands with ample grazing opportunities.

> **Case Study: The Sri Lankan Crisis and Organic Farming**
> In 2021, Sri Lanka experienced a severe economic crisis, leading to food shortages, inflation, and social unrest. While the crisis had multiple contributing factors, the government's sudden and poorly implemented shift towards organic farming played a significant role in exacerbating the situation.

CHALLENGES
- **Limited Availability:** Organic manure is not widely accessible, and if purchased, organic inputs may be more expensive than chemical fertilizers in terms of plant nutrients.
- **Complexity of Guidelines:** Guidelines for organic production, processing, transportation, and certification are complex and challenging for the average Indian farmer to comprehend.
- **Certification Hurdles:** Many farms in India, either never chemically managed or returning to organic farming, are not formally recognized as organic.
  - The costs and extensive documentation required for certification deter many farmers from seeking certification.

INITIATIVES TAKEN
- **Mission Organic Value Chain Development in the NorthEast Region (MOVCD-NER):** The **primary objective** is to foster certified organic production through a value chain approach, facilitating the connection between growers and consumers while bolstering the entire value chain's development.
- **Paramparagat Krishi Vikas Yojana (PKVY):** It promotes organic farming via a cluster-based approach in organic villages and the adoption of the Participatory Guarantee System (PGS) certification.
- **Certification Schemes**: The **Food Safety and Standards Authority of India (FSSAI)** regulates food in the nation, including organic food both domestically and for imports.
  - The **Participatory Guarantee System (PGS**) certifies organic products, ensuring compliance with quality standards.

WAY FORWARD
- **Scaling up:** Expanding organic land area and production to meet growing demand requires infrastructure development, efficient supply chains, and financial support for farmers transitioning to organic practices.
- **Market access and fair prices:** Facilitating access to organic markets, ensuring fair prices for producers, and raising consumer awareness of the value proposition of organic food are crucial.
- **Research and development:** Continuous research on organic farming methods, pest management, and seed variety development are essential for enhancing productivity and resilience.

CLIMATE SMART AGRICULTURE

The Food and Agriculture Organization of the United Nations (FAO) defines Climate-Smart Agriculture (CSA) as agricultural practices that aim to boost productivity sustainably, improve resilience (adaptation), decrease or eliminate greenhouse gas emissions (mitigation) where feasible, and contribute to achieving national food security and development objectives.

THREE PILLARS
- **Production Focus:** CSA aims to enhance agricultural productivity and income derived from crops, livestock, and seafood while minimizing adverse environmental impacts. This will lead to improved food and nutritional security.
- **Adaptation Strategy:** CSA endeavors to reduce farmers' vulnerability to short-term risks and enhance their resilience to adapt and thrive amid both immediate shocks and long-term challenges.
- **Mitigation Efforts:** CSA aims to reduce or eliminate greenhouse gas (GHG) emissions wherever possible, striving for emission reductions for every unit of food, fiber, and fuel produced. Preventing agricultural deforestation and optimizing the capacity of soils and trees to act as carbon sinks are key mitigation strategies.

SIGNIFICANCE

- **Integration of Climate Change:** Unlike conventional agricultural development, CSA deliberately incorporates climate change considerations into the design and development of sustainable agricultural systems.
- **Protection of Ecological Services:** CSA recognizes the importance of ecosystems in providing essential services such as clean air, water, food, and materials, thereby safeguarding ecological services vital for agricultural sustainability.
- **Multiple Access Points:** CSA provides various entry points, including technological advancements, climate change modeling, information technology, insurance schemes, value chains, and institutional and political frameworks enhancement, rather than being limited to specific activities or technologies.
- **Context-Dependent Approach:** CSA acknowledges that what may be considered climate-smart in one area may not be applicable in another, emphasizing that no single action is universally climate-smart at all times.
- **Inclusion of Marginalized Groups:** CSA initiatives prioritize the inclusion of the poorest and most vulnerable populations, particularly women and marginalized groups, to achieve food security goals and enhance resilience, as they are often disproportionately affected by climatic events such as droughts and floods.

CHALLENGES

- **Knowledge and Skill Gaps:** Small-scale and resource-poor farmers often lack access to current information and technical skills needed for climate-smart practices, hindering adoption.
- **Financial Constraints:** Limited financial resources pose a barrier to implementing climate-smart agriculture, as upfront investments in new technologies and infrastructure are often required.
- **Uncertain Climate Projections:** Uncertainty in climate change projections and regional climatic variability make it challenging for farmers to make informed decisions and adapt their practices.
- **Limited Access to Resources:** Farmers face difficulties accessing essential resources like land, water, seeds, and fertilizers, with climate change exacerbating resource scarcity.

GOVERNMENT INITIATIVES

- **National Innovations on Climate Resilient Agriculture (NICRA):** Project aims to bolster the resilience of Indian agriculture, encompassing crops, livestock, and fisheries, against climatic variability and climate change by developing and implementing advanced production and risk management technologies.
- **Climate-Smart Villages (CSV):** Strategy to implement and promote climate-smart agriculture at the local level, enhancing farmers' adaptation to climate change.
- **Pradhan Mantri Fasal Bima Yojana (PMFBY):** Government-sponsored agriculture insurance program offering financial assistance to farmers in case of crop loss or damage.
- **National Water Mission (NWM):** Launched to ensure Integrated Water Resource Management (IWRM) and increase Water Use Efficiency (WUE), including in agriculture.

WAY FORWARD

- **Policy Support and Integration:** Governments should formulate and implement policies that promote climate-smart agriculture and integrate it into national agricultural strategies and plans.
- **Knowledge and Capacity Building:** Foster knowledge sharing and capacity building among farmers, extension workers, researchers, and policymakers. Utilize training programs, farmer field schools, demonstration plots, and digital technology to disseminate information and best practices.
- **Research and Development:** Invest in research to deepen understanding of the impact of climate change on agriculture and develop innovative solutions. This includes creating climate-resilient crop varieties, innovative cropping systems, and climate information services to support informed decision-making by farmers.

WASTE MANAGEMENT

Waste refers to any material, substance, or byproduct that is discarded, unwanted, or no longer useful. It can be generated from various sources, including households, industries, commercial establishments, institutions, and construction activities.

Waste management encompasses the collection, transportation, treatment, recycling, and disposal of waste materials to minimize environmental impacts, public health risks, and resource depletion. Effective waste management strategies aim to reduce waste generation, promote recycling and reuse, and ensure proper treatment and disposal of waste to protect human health and the environment.

GENERAL CATEGORIZATION OF WASTE

- **Non-Hazardous Waste:** Waste that does not pose a significant risk to human health or the environment, including most municipal solid waste and non-toxic industrial waste.
- **Hazardous Waste:** Waste that exhibits hazardous properties such as toxicity, flammability, reactivity, or corrosivity, requiring special handling, treatment, and disposal.
- **Types of Hazardous waste** can be explained in following manner:
  - o **Toxic Waste:** Waste containing toxic substances that can cause harm to humans, animals, or ecosystems through exposure or contamination.
  - o **Flammable Waste:** Waste that can catch fire easily and pose a risk of combustion or explosion, such as solvents, fuels, and certain chemicals.
  - o **Corrosive Waste:** Waste that can corrode or damage materials upon contact, including strong acids, alkalis, and corrosive cleaning agents.
  - o **Reactive Waste:** Waste that is unstable, reactive, or prone to violent reactions under certain conditions, such as explosives, oxidizers, and reactive metals.
- **Biodegradable Waste:** Organic waste that can be broken down by microorganisms through natural processes of decomposition, including food waste, yard waste, and agricultural residues.
- **Non-Biodegradable Waste:** Waste that does not readily decompose or degrade in the environment, such as plastics, metals, glass, and certain synthetic materials.

Related Facts
Solid Waste • The total waste generated in India was **152,245 Metric Tons Per Day(MT/D).** • Out of this **114,183 MT/D (75%)** of waste is processed. • **Central Pollution Control Board (CPCB)** recently projected that annual waste generation in India will increase to **165 MT by 2030.** **Plastic Waste** • India generates around 3.4 million tonnes (MT) of plastic waste, a report said on Wednesday noting that only 30 per cent of it is recycled. **Hazardous Waste** • As per the Central Pollution Control Board (CPCB), there are about 41,523 industries in the country generating about 7.90 million tonnes of hazardous waste annually, out of which landfillable waste is about 3.32 million tonnes (42.02%), incinerable waste is about 0.60 million tonnes (7.60%) and recyclable hazardous waste is about 3.98 million tonnes (50.38%). **E-Waste** • According to the **"E-waste Management market in India 2022-2027"** report India stands as the **third-largest** contributor to global e-waste production, trailing only China and the US. **Biomedical Waste** • **CPCB Report:** India generates around **101 Metric Tonnes per day (MT/day)** of COVID-19-related bio-medical waste in addition to the regular bio-medical waste generation of about **609 MT per day.**

SOLID WASTE MANAGEMENT

"Solid waste management" encompasses the complete process of collecting, treating, and disposing of solid waste. Waste is sourced from diverse origins and undergoes disposal within the waste management framework. The process involves collecting, transporting, treating, analyzing, and disposing of waste.

CHALLENGES IN SOLID WASTE MANAGEMENT

- **Waste Generation:** Rapid urbanization, population growth, and changing consumption patterns contribute to increasing volumes of solid waste.
- **Waste Composition:** Diverse waste streams with varying compositions pose challenges for sorting, recycling, and disposal.
- **Infrastructure Deficiencies:** Inadequate waste collection, transportation, and disposal infrastructure in many areas lead to improper waste management practices.

- **Environmental Pollution:** Improper disposal of solid waste results in environmental pollution, including air and water pollution, soil contamination, and habitat degradation.
- **Health Risks:** Improperly managed solid waste can pose health risks to communities, including the spread of diseases and exposure to hazardous materials.
- **Social and Economic Impacts:** Inequities in waste management services, informal waste picking, and marginalized communities bearing the brunt of waste-related impacts contribute to social and economic challenges.

SOLID WASTE MANAGEMENT CYCLE

- The solid waste management cycle encompasses the various stages involved in the handling, treatment, and disposal of solid waste to minimize environmental impacts and promote sustainability.

NATIONAL INITIATIVES FOR SWM

- **Solid Waste Management Rules:** The Ministry of Environment, Forest and Climate Change (MoEFCC) has issued **Solid Waste Management Rules in 2016,** which lay down guidelines and regulations for the management of solid waste. The rules emphasize waste segregation, collection, transportation, processing, and disposal in an environmentally sound manner.
- **Waste-to-Energy Projects:** Several waste-to-energy projects have been initiated in India to convert municipal solid waste into energy through incineration or anaerobic digestion.
  - **Example: Delhi's Timarpur-Okhla Waste to Energy plant** is one of the largest waste-to-energy projects in India. The plant converts municipal solid waste into electricity, providing a sustainable solution for waste management while also contributing to renewable energy generation.
- **Project REPLAN** explores innovative solutions, such as creating plastic carry bags by incorporating cotton fibre rags. This initiative addresses both **waste reduction** and **resource utilization**.
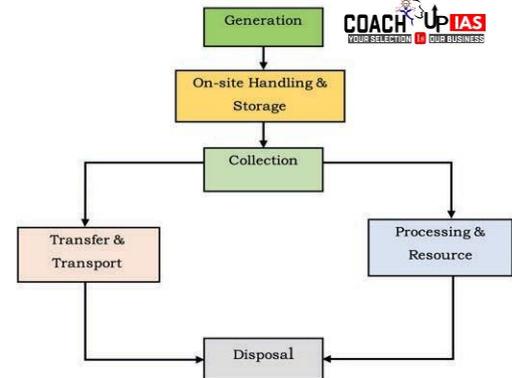
Solid Waste Management Rules 2016:
- The **Solid Waste Management Rules 2016** outline guidelines for waste separation into three categories by generators:
- **Wet (Biodegradable)**
- **Dry (Plastic, Paper, Metal, Wood, etc.)**
- **Domestic hazardous wastes** (e.g., **diapers, napkins, empty containers of cleaning agents, mosquito repellents, etc.**)
- Waste generators are mandated to hand over segregated wastes to authorized rag-pickers, waste collectors, or local bodies.
- Waste generators are required to pay:
  - **'User Fee'** to waste collectors.
  - **'Spot Fine'** for littering and non-segregation.
- Used sanitary waste like **diapers** and **sanitary pads** should be securely wrapped in pouches provided by manufacturers or brand owners, or in suitable wrapping material. These should be placed in bins designated for **dry waste/non-biodegradable waste**.

4R Principle: Waste Reduction Strategy:
- **Reduce**: The strategy emphasizes minimizing plastic usage to alleviate environmental impact.
- **Reuse:** Opting for rechargeable items over disposables is promoted to reduce unnecessary waste.
- **Recycle**: Encouraging the segregation of waste for proper disposal and supporting the use of recycled or green products.
- **Recovery or Reclaim**: The strategy advocates for the utilization of various systems and technologies to convert waste into new materials or energy, fostering sustainability and resourcefulness.

WAY FORWARD

- **Waste Reduction:** Promoting waste reduction at the source through awareness campaigns, incentives, and regulations to minimize waste generation.
- **Source Segregation:** Encouraging households and businesses to segregate waste at the source to facilitate recycling and composting.

- **Community Engagement:** Engaging communities in waste management initiatives through participatory approaches, community-based organizations, and citizen participation.
- **Circular Economy:** Adopting circular economy principles to promote resource efficiency, material recovery, and product reuse and recycling.
- **Innovative Financing:** Exploring innovative financing mechanisms, such as green bonds, carbon credits, and public-private partnerships, to fund sustainable waste management projects.

Effective solid waste management is crucial for environmental sustainability and public health. By tackling waste generation, improving infrastructure, raising awareness, and fostering collaboration, we can mitigate pollution and promote sustainable development.

PLASTIC WASTE MANAGEMENT

Plastic waste management involves the systematic handling, treatment, and disposal of plastic waste to minimize environmental pollution, conserve resources, and promote sustainability.

The plastic waste management cycle encompasses the various stages involved in the handling, treatment, and disposal of plastic waste to mitigate environmental impacts and promote sustainability. **Key stages in the plastic waste management cycle**

Fig: Plastic Waste Management

- **Generation:** The cycle begins with the generation of plastic waste, which includes various types of plastic materials used in packaging, consumer products, construction, and other industries.
- **Collection:** After plastic waste is generated, it needs to be collected from its source. Collection methods may include curbside collection, drop-off points, recycling centers, and informal waste pickers.
- **Sorting and Segregation:** Once collected, plastic waste undergoes sorting and segregation to separate different types of plastics based on their composition, color, and recyclability.
- **Energy Recovery:** Plastic waste that cannot be recycled economically or feasibly may be used for energy recovery through processes such as waste-to-energy incineration or pyrolysis.
- **Landfilling:** Plastic waste that cannot be recycled or recovered for energy may be disposed of in landfills. Proper landfilling practices are essential to prevent environmental pollution, groundwater contamination, and public health risks associated with plastic waste.
- **Recycling:** Recycling is a key component of plastic waste management, where plastic materials are processed and converted into new products or raw materials. Recycling processes may involve shredding, washing, melting, and extruding plastics to produce pellets, fibers, or other recyclable materials.
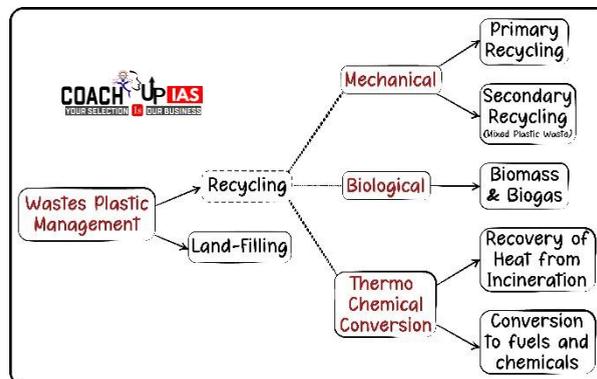
CHALLENGES IN PLASTIC WASTE MANAGEMENT

- **Collection and Segregation:** Inadequate infrastructure and resources hinder efficient waste collection and segregation, particularly in rural areas. Mixed waste collection practices result in contamination of recyclable plastics, reducing their usability.
- **Recycling and Processing:** Limited recycling capacity and outdated technology impede effective handling of diverse plastic types. Also Inefficient sorting and processing lead to the production of low-quality recycled plastics with limited applications.
- **Policy and Regulations:** Weak enforcement of plastic waste management regulations undermines their effectiveness.
- **Public Awareness and Behavior Change:** Preference for single-use plastics persists despite awareness campaigns, driven by convenience and affordability.
- **Technological and Economic Challenges:** High costs associated with advanced recycling technologies deter investment and adoption.
- **Single-Use Plastics:** Single-use plastics, such as disposable packaging, bottles, and utensils, contribute significantly to plastic waste generation. Reducing the consumption and production of single-use plastics is essential to mitigate plastic pollution and promote sustainable alternatives.

NATIONAL INITIATIVES FOR PWM IN INDIA

Plastic Waste Management Rules 2016

- The **Plastic Waste Management Rules (PWMR), 2016**, provides the statutory framework for plastic waste management in an environmentally sound manner throughout the country.
- The **Ministry of Environment, Forest and Climate Change** has notified the **Plastic Waste Management Amendment Rules, 2021,** on August 12, 2021, prohibiting identified single use plastic items from July 1, 2022.
- The Ministry also notified the Guidelines on the **Extended Producer Responsibility** for plastic packaging vide Plastic Waste Management Amendment Rules, 2022, on February 16, 2022.

Ban on Single Use Plastic

- **Single-use plastics, or disposable plastics,** are used only once before they are thrown away or recycled.
- These items are things like **plastic bags, straws, coffee stirrers, soda and water bottles and most food packaging. Up to 50%** of plastics that we use are single-use.
- **India has banned manufacture, import, stocking, distribution, sale and use of identified single use plastic items,** which have low utility and high littering potential, all across the country from **July 1, 2022.**

India Plastics Pact

- Launched in 2021, the India Plastics Pact is an ambitious, collaborative initiative that brings together businesses, governments, and NGOs to tackle plastic waste challenges in India.
- It aims to transform the current linear plastic system into a circular economy by focusing on the "3 Rs": Reduce, Reuse, Recycle.

PLASTIC WASTE MANAGEMENT (AMENDMENT) RULES 2022:

- **Introduction of Extended Producer's Responsibility (EPR):** Holds producers accountable for environmentally sound management of plastic products throughout their life cycle.
- **Phase-out of Single-Use Plastics:** Aims to eliminate single-use plastics from the economy.
  - Focuses on sustainable alternatives and responsible waste management practices.
- **New Provisions and Categories of Plastics:**
  - **Category 1:** Rigid plastic packaging.
  - **Category 2:** Flexible plastic packaging, plastic sheets, carry bags, sachets, or pouches.
  - **Category 3:** Multi-layered plastic packaging.
  - **Category 4:** Compostable plastic sheets and carry bags.
- **Plastic Packaging Regulations:**
  - **Mandatory Reuse:** Rigid plastic packaging material must be reused.
  - **Prescribed Recycling:** Minimum recycling levels enforced under EPR, promoting the use of recycled plastic content.
- **Extended Producer Responsibility (EPR):** It is the responsibility of a producer for the environmentally sound management of the product until the end of its life. EPR is a policy approach that holds producers, manufacturers, and importers accountable for the entire life cycle of their products, including post-consumer waste management. These rules introduce a Market-Based Mechanism & sale and purchase of surplus EPR certificates.
- **CPCB-Controlled Portal:** Registration, return filing, and data repository. Single-point access for **EPR implementation orders and guidelines.**
- **Annual Report on EPR Portal:** Reporting by **State Pollution Control Boards** and **Pollution Control Committees.**

WAY FORWARD

- **Innovation:** Support research and development of innovative solutions to address plastic waste, such as biodegradable plastics, compostable packaging, and alternatives made from renewable resources. Encourage the adoption of sustainable materials and packaging designs that minimize environmental impact.
- **Policy Interventions:** Implement policies and regulations to hold businesses accountable for their plastic usage and waste management practices. This may include extended producer responsibility schemes, taxes or fees on single-use plastics, and incentives for eco-friendly alternatives.
- **International Cooperation:** Foster collaboration between governments, businesses, NGOs, and international organizations to develop coordinated strategies for addressing plastic waste on a global scale. Share best practices, knowledge, and resources to maximize impact and drive meaningful change.

"Waste to Wealth"

The **"Waste to Wealth"(WtW)** concept promotes viewing waste not as a burden, but as a valuable resource. It aims to transform waste materials into valuable products or resources, minimizing waste disposal and creating economic and environmental benefits.

Approaches in WtW

- **Recycling**: Converting used materials into new products (e.g., plastic bottles into clothing).
  - Example: 'Oceanness' is a purpose driven apparel brand which makes eco-friendly clothes, made from **100% recycled plastic bottles**, without being mixed with other materials.
- **Composting**: Transforming organic waste into nutrient-rich fertilizer.
  - Example: The decentralized composting system in **Pune**, where households compost organic waste helps in reducing landfill burden, creating nutrient-rich fertilizers and is aligned to its goal of becoming a **'zero landfill city'.**
- **Waste-to-Energy (WtE):** Generating electricity or heat from waste through combustion or other processes.
  - Example: **Indore** has a WtE plant that processes municipal solid waste to generate electricity, reducing reliance on fossil fuels and managing waste effectively.
- **Upcycling**: Reusing discarded materials for new purposes with added value.
  - Example: The **Hasiru Dala Foundation** in **Bengaluru** upcycles discarded materials like wood and plastic into unique and functional furniture, promoting sustainability and creating jobs.
- **Biogas production:** Anaerobic digestion of organic waste to produce methane for energy.
  - Example: As envisioned in the **Union Budget 2023-24, 500 new 'waste to wealth' plants** under **GOBARdhan scheme** will be established for promoting **circular economy.**
    - These will include **200 compressed biogas (CBG) plants, including 75 plants in urban areas, and 300 community or cluster-based plants.**

Benefits	**Challenges**
Reduces reliance on virgin resources: Conserves natural resources like trees and metals. **Minimizes waste disposal:** Reduces reliance on landfills and incineration. **Creates new economic opportunities:** Generates jobs in waste collection, processing, and product development. **Lowers environmental impact:** Reduces greenhouse gas emissions and pollution.	**Investment and infrastructure:** Requires investment in new technologies and processing facilities. **Market development:** May require developing markets for recycled products or WtE energy. **Public awareness and behavior change:** Requires promoting waste reduction and proper waste segregation.

Overall, the **Waste to Wealth** concept represents a shift towards more **sustainable and resource-efficient waste management practices,** emphasizing the potential for turning waste into valuable resources, fostering innovation, and contributing to the transition towards a **circular economy.**

E-WASTE MANAGEMENT

- Electronic waste, or e-waste, refers to discarded electronic devices such as computers, smartphones, TVs, and household appliances. E-waste contains hazardous materials like lead, mercury, and cadmium, which can pose serious environmental and health risks if not managed properly.
- E-waste management involves the proper handling, recycling, and disposal of electronic devices to minimize their environmental impact and ensure the responsible use of resources.

KEY STAGES IN E-WASTE MANAGEMENT CYCLE

- **Collection:** Discarded electronic devices are gathered from households, businesses, and institutions to extract valuable materials for recycling.
- **Sorting and Segregation:** E-waste is sorted to separate recyclable materials (metals, plastics, glass) from non-recyclable components.
- **Processing and Recycling:** E-waste is dismantled and shredded to recover valuable materials using mechanical, magnetic, and chemical methods.

- **Refurbishment and Reuse:** Functional components and devices are refurbished and reused, extending their lifespan and reducing the demand for new resources.
- **Disposal of Hazardous Materials**: Hazardous components (batteries, circuit boards, mercury) are safely removed and disposed of to prevent environmental contamination.

CHALLENGES IN E-WASTE MANAGEMENT

- **Informal Recycling:** Much of the world's e-waste is recycled informally in developing countries, often under unsafe and unregulated conditions, leading to environmental pollution and health hazards for workers.
  - As per the **ICEA report,** the management of e-waste in India is largely informal, with around **90% of e-waste collection and 70% of recycling** handled by the informal sector.
- **Resource Recovery:** Recovering valuable materials from e-waste, such as metals and rare earth elements, requires specialized techniques and technologies that are not widely available.
- **Data Security:** E-waste disposal must address data security concerns to prevent the unauthorized access or misuse of personal or sensitive information stored on electronic devices.
- **Legislation and Enforcement:** Inadequate legislation, weak enforcement mechanisms, and lack of awareness contribute to poor e-waste management practices and illegal dumping of e-waste in many regions.

NATIONAL INITIATIVES FOR EWM IN INDIA

E-waste (Management) Rules 2023:

- Seeks to amend the E-waste (Management) Rules of 2022.
- Adds two substances to the exemptions outlined in Schedule II of the E-waste (Management) Rules of 2022: Cadmium and lead in Solar panels/cells, solar Photovoltaic panels/cells/modules, and lead in Medical Devices (excluding all implanted and infected products).
- Requires every producer to furnish detailed information regarding the constituents of the equipment and their components, consumables, parts, or spares.

Establishment of E-Waste Collection Centers

- Several states and municipalities in India have set up e-waste collection centers to facilitate the proper disposal of electronic waste.

Capacity Building and Training

- Organizations and institutions in India are actively involved in capacity-building initiatives to enhance skills and knowledge in e-waste management.
- **Example: The Electronics Sector Skills Council of India (ESSCI)** offers training programs and certification courses for professionals working in the electronics and recycling sectors.

WAY FORWARD

- **Extended Producer Responsibility (EPR):** Implementing EPR schemes to hold manufacturers responsible for the collection, recycling, and disposal of their products at the end of their life cycle.
- **Formal Recycling Infrastructure:** Developing formal e-waste recycling facilities with proper equipment and safety measures to ensure environmentally sound recycling and disposal practices.
- **Circular Economy Approaches:** Promoting circular economy models that emphasize product reuse, repair, remanufacturing, and recycling to minimize e-waste generation and resource consumption.

BIO-MEDICAL WASTE MANAGEMENT

Biomedical waste management involves the safe handling, collection, treatment, and disposal of waste generated from healthcare facilities, laboratories, research institutions, and other biomedical facilities.

This waste includes potentially infectious materials, sharps, pathological waste, pharmaceuticals, and other hazardous substances. Effective biomedical waste management is essential to protect public health, prevent the spread of infections, and minimize environmental pollution.

BIOMEDICAL WASTE MANAGEMENT CYCLE

Key stages of Biomedical waste management cycle

- **Segregation**: Segregating bio-medical waste at the point of generation into different categories based on its type, such as infectious waste, sharps, and pharmaceutical waste.
- **Collection**: Using leak-proof containers, color-coded bins, and puncture-resistant containers for safe collection and storage of bio-medical waste.

- **Transportation**: Transporting bio-medical waste in dedicated vehicles equipped with appropriate safety measures to prevent spills, leaks, and exposure during transit.
- **Treatment and Disposal:** Treating bio-medical waste through methods such as autoclaving, incineration, microwaving, or chemical disinfection to inactivate pathogens and reduce its volume before final disposal.
- **Monitoring and Compliance:** Implementing monitoring mechanisms, regular inspections, and quality control measures to ensure compliance with bio-medical waste management regulations and standards.

CHALLENGES IN BIOMEDICAL WASTE MANAGEMENT

- **Health Risks:** Improper handling and disposal of biomedical waste pose significant health risks to healthcare workers, waste handlers, patients, and the general public. Exposure to infectious agents and hazardous chemicals can lead to infections, injuries, and long-term health effects.
- **Regulatory Compliance:** Compliance with stringent regulations and guidelines for biomedical waste management can be challenging for healthcare facilities. Lack of awareness, inadequate infrastructure, and limited resources may hinder compliance with waste segregation, storage, transportation, and disposal requirements.
- **Inadequate Infrastructure:** Many healthcare facilities, especially in resource-limited settings, lack proper infrastructure and facilities for biomedical waste management. This includes insufficient storage space, inadequate waste segregation systems, and limited access to safe disposal methods such as incineration or autoclaving.
- **Training and Awareness:** Proper training and awareness among healthcare workers and waste handlers are essential for safe and effective biomedical waste management. However, inadequate training programs and limited awareness about the risks associated with biomedical waste may lead to improper handling and disposal practices.
- **Cost Constraints:** Effective biomedical waste management often requires investment in specialized equipment, infrastructure, and personnel. Healthcare facilities, particularly in low-resource settings, may face financial constraints that limit their ability to implement proper waste management practices.

GLOBAL INITIATIVES IN BIOMEDICAL WASTE MANAGEMENT

Basel Convention

- The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal is a global treaty aimed at regulating the transboundary movement of hazardous wastes and ensuring their environmentally sound management.
- **India is a party to the Basel Convention** and has committed to regulating the transboundary movement of hazardous wastes and ensuring their environmentally sound management.

NATIONAL INITIATIVES

Biomedical Waste Management Rules, 2016:

- The **Biomedical Waste Management Rules, 2016 replace the Biomedical Waste (Management and Handling) Rules, 1998**, and aim to streamline biomedical waste management practices, minimize environmental pollution, and protect public health.
- **Segregation and Classification:** The rules specify **guidelines** for the segregation of biomedical waste at the point of generation into different categories, such as **sharps, infectious waste, pathological waste, chemical waste, and general biomedical waste.** Each category has designated **color-coded bins** or containers for segregation.
- **Storage and Transportation:** Biomedical waste must be stored in **leak-proof, puncture-resistant containers** that are properly labeled with the biohazard symbol and waste category. Healthcare facilities are required to maintain separate storage areas for different types of biomedical waste.
- **Treatment and Disposal:** Biomedical waste must undergo treatment to render it non-infectious and safe for disposal. Treatment methods include **autoclaving, incineration, microwave treatment, chemical disinfection, and other approved technologies**. Disposal of treated biomedical waste must be carried out in accordance with prescribed procedures to prevent environmental contamination and public health risks.

- Guidelines for Treatment and Disposal of Waste Generated During Healthcare Activities During COVID-19 Pandemic
- These guidelines aimed to address the increased generation of infectious waste, including personal protective equipment (PPE), contaminated materials, and biomedical waste, due to the healthcare response to the pandemic

WAY FORWARD

- **Investment in Infrastructure and Technology**: Invest in infrastructure, equipment, and technology for safe biomedical waste management, including centralized treatment facilities, waste segregation systems, and non-incineration disposal methods.
- **Training and Capacity Building**: Provide comprehensive training programs for healthcare workers, waste handlers, and other stakeholders on waste segregation, handling, transportation, disposal protocols, infection control, and occupational safety.
- **Public Awareness and Education**: Promote public awareness and education campaigns to inform about the risks associated with biomedical waste and encourage responsible waste management practices.
- **Collaboration and Partnerships:** Foster collaboration among government agencies, healthcare institutions, waste management companies, and civil society organizations for knowledge sharing, resource mobilization, and coordinated efforts to enhance waste management systems.

CIRCULAR ECONOMY

The circular economy is an **economic model** that aims to **minimize waste and resource depletion** by keeping products, materials, and resources in use for as long as possible through strategies such as recycling, reuse, and remanufacturing.

In a circular economy, the traditional **"take-make-dispose" linear model** is replaced with a **closed-loop system** where resources are regenerated and continuously circulated within the economy. This approach promotes **sustainable production and consumption practices, reduces environmental impacts, and fosters economic resilience and innovation.**

PRINCIPLES OF CIRCULAR ECONOMY

The principles of a circular economy emphasize **sustainable resource management and waste reduction** by promoting the following strategies:

- **Reduce:** The principle of reduction involves minimizing the consumption of resources and the generation of waste at the source. This includes designing products and processes to be more resource-efficient, optimizing material use, and reducing unnecessary packaging or components.

  - o **Example**: Designing products with **minimal packaging**, such as eliminating unnecessary plastic wrap on fruits and vegetables, reduces the amount of waste generated at the consumer level.
- **Reuse:** Reuse involves extending the lifespan of products, components, or materials by using them multiple times for the same or different purposes. This can involve refurbishing or repairing products to restore their functionality or repurposing materials for alternative applications.
  - o **Example**: The concept of "**upcycling**" has gained popularity, where discarded materials or products are transformed into new items of higher value. For instance, **discarded shipping containers** are **repurposed** into **modular homes or office spaces**, reducing the need for new construction materials.
- **Recycle:** Recycling entails recovering materials from products or waste streams and converting them into new products or raw materials. This helps to close the loop in the production cycle, reduce the extraction of virgin resources, and minimize waste sent to landfills or incineration.
  - o **Example**: **Recycling paper waste** to produce new paper products conserves trees and reduces deforestation.
- **Repair:** Repair involves fixing products or components that are damaged or malfunctioning instead of discarding them. Repairing items extends their useful life, reduces the need for replacement, and conserves resources by avoiding the production of new goods.
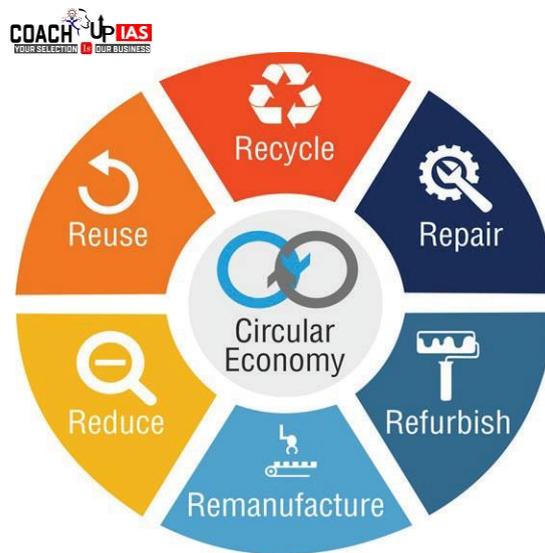
- o **Example**: Repairing electronic devices such as smartphones and laptops extends their lifespan and reduces electronic waste. Repair shops and DIY repair tutorials help users fix issues such as broken screens or malfunctioning components.
- **Refurbish:** Refurbishing involves restoring or renovating products to a like-new condition, often through cleaning, maintenance, or upgrading. Refurbished items can be resold or reintroduced into the market, providing cost-effective alternatives to new products while reducing waste.
  - o **Example**: Refurbishing used appliances such as refrigerators or washing machines restores their functionality and appearance, making them suitable for resale at a lower cost than new appliances.
- **Remanufacture:** Remanufacturing involves disassembling products, refurbishing individual components, and reassembling them to create products that are equivalent or superior in performance to new ones. This process maintains the value and functionality of existing materials and reduces the environmental impact of manufacturing.
  - o **Example**: Remanufactured engines are widely used in the automotive industry, offering a sustainable alternative to new engines. Companies like **Caterpillar** and **Cummins** remanufacture engines by **disassembling, cleaning, and replacing worn parts,** reducing material consumption and energy use.

CIRCULAR ECONOMY IN INDIA

- The circular economy is an economic model aimed at reducing waste and maximizing resource efficiency by promoting the reuse, recycling, and regeneration of materials and products.
- In India, initiatives to transition towards a circular economy include waste management programs, recycling initiatives, and sustainable production and consumption practices.
- The government and various stakeholders are working to promote circularity in sectors such as manufacturing, construction, textiles, and electronics through policy interventions, incentives, and awareness campaigns.

NEED FOR CIRCULAR ECONOMY IN INDIA

- **Resource Scarcity:** With a population of more than **1.4 billion** people, India accounts for **18%** of the global population, living on only **2.4 %** of the world's surface. Consequently, India faces **resource scarcity** due to its rapidly growing population and industrialization.
- **Environmental Degradation:** Traditional linear economic models, characterized by **"take-make-dispose"** patterns, contribute to **environmental degradation** through resource depletion, pollution, and waste generation.
- **Waste Management Crisis:** According to the **State of India's Environment 2023 report**, Municipal Solid Waste (MSW) generation in India is estimated to be around **150,000 tonnes per day (TPD).** This is expected to increase to **165 million tonnes by 2030 (CPCB).**
- **Economic Growth and Competitiveness:** Embracing circular economy principles can drive economic growth and enhance competitiveness.
- **Climate Change Mitigation:** Circular economy strategies contribute to climate change mitigation by reducing greenhouse gas emissions associated with resource extraction, manufacturing, and waste management.
- **Social Equity and Inclusive Development:** Circular economy initiatives can create opportunities for social inclusion and sustainable development

MEASURES TO PROMOTE CIRCULAR ECONOMY IN INDIA

- **Circular Economy Cell: Circular Economy Cell (CE Cell)** was constituted in **NITI Aayog** in September, 2022 as a dedicated unit to work in the area of Circular Economy.
  - o 10 sectoral Circular Economy action plans were finalized in NITI Aayog for implementation by stakeholder Ministries/Departments.
- **G-20 outcomes:** During its G-20 presidency, India has prioritized **four key areas** for advancing the circular economy:
  - o Enhancing circularity in the steel sector
  - o Promoting Extended Producer Responsibility (EPR)
  - o Fostering a circular bioeconomy
  - o Establishing an industry-led coalition to drive resource efficiency and circular economy initiatives.
- **Policy measures:** Guidelines outlined in policies like Plastic Waste Management Rules, e-Waste Management Rules, Construction and Demolition Waste Management Rules and Metals Recycling Policy are aligned to circular economy principles.
- **Industrial recycling:** NITI Aayog promoted the usage of fly ash and slag produced in the steel industry in other sectors like road construction, agriculture, cement, etc.

- **Eleven focus areas:** To expedite the transition of the country from a linear to a circular economy, 11 focus areas have been identified. The focus areas include 11 end-of-life products/recyclable materials/wastes that either continue to pose considerable challenges or are emerging as new challenge areas that must be addressed in a holistic manner.

CHALLENGES TO CIRCULAR ECONOMY IN INDIA

While India has embraced the circular economy (CE) concept, several challenges hinder its full potential:

- **Lack of awareness and understanding:** CE is still a relatively new concept in India, requiring broader awareness among businesses, consumers, and policymakers.
- **Insufficient policy and regulations:** Supportive policies exist, but a more robust framework with clear incentives and regulations is needed to drive widespread CE adoption.
- **Limited access to finance and investment:** Attracting investment for CE projects and infrastructure development requires innovative financing solutions and risk-sharing mechanisms.
- **Gaps in infrastructure and technology:** Upgrading waste collection, sorting, and processing infrastructure is crucial, alongside investment in technologies for resource recovery and reuse.
- **Consumer behavior change:** Shifting mindsets towards repair, reuse, and responsible consumption requires sustained awareness campaigns and incentives.
- **Informal waste sector:** Integrating the informal sector into the formal waste management system is crucial for effective resource recovery and CE implementation.
- **Skill development:** Building a skilled workforce equipped for CE jobs in areas like repair, refurbishment, and resource management is vital.

WAY FORWARD

- **Prioritization and Actionable Steps:** Identify key sectors and develop targeted strategies like green building codes, take-back schemes for electronics, and extended producer responsibility for textiles.
  - **Example**: The India Construction Materials Environmental Resource Centre (ICEMERC) promotes resource efficiency in construction, offering guidelines and tools for recycled content and circular design.
- **Localized Strategies:** Implement pilot projects in diverse regions like urban slums and rural areas, adapting solutions to local contexts.
  - **Example**: **The SELCO Foundation's "Waste to Wealth" program** in rural India uses locally available waste materials like **bioplastics** and **upcycled textiles** to create livelihood opportunities.
- **Leveraging Existing Initiatives:** Integrate circular economy principles into existing government programs.
  - **Example:** Align and integrate the Swachh Bharat Mission (Clean India Mission) for waste collection and the Skill India Mission for workforce development.
- **Performance Measurement and Monitoring:** Establish clear metrics like resource efficiency, waste reduction, and job creation in the circular economy to track progress.

Example: The **NITI Aayog's "Circular Economy Framework"** outlines key indicators for measuring progress towards circularity in various sectors

KEYWORDS: Circular Economy, Sustainable Consumption, Clean Energy Transition, Social Equity, Waste Minimization, Landfill Management, Extended Producer Responsibility.

PREVIOUS YEAR QUESTIONS		
1.	What are the impediments in disposing the huge quantities of discarded solid wastes which are continuously being generated? How do we remove safely the toxic wastes that have been accumulating in our habitable environment?	2018
2.	Sikkim is the first 'Organic State' in India. What are the ecological and economical benefits of Organic State?	2018

INTRODUCTION

Environmental conservation is a practice that sets the way for environmental and natural resource protection on an individual, organizational, and governmental level.

There are a number of environmental problems ranging from hydrological issues, ozone depletion, global warming to deforestation, desertification and pollution, all these issues pose a severe threat not only to the human existence but also to the entire ecosystem. Environmental conservation is one of the key issues that need to be addressed in order to combat climate change and global warming.
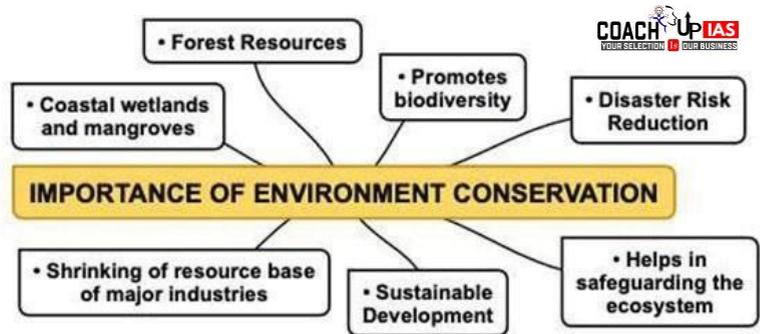
POLLUTION RELATED ACTS

WATER (PREVENTION AND CONTROL OF POLLUTION) ACT OF 1974 AND AMENDMENT, 1988

The Act aims to prevent and control water pollution and maintain or restore the wholesomeness.

Features:

- **Regulatory Authority:** The Act vests regulatory authority in the State Pollution Control Boards (SPCBs) to establish and enforce effluent standards for factories that discharge pollutants into water bodies.
- **Central Pollution Control Board (CPCB):** The CPCB performs similar functions as the SPCBs but for Union Territories. It formulates policies and coordinates the activities of different State Boards.
- **Control of Sewage and Industrial Effluents:** The SPCBs control the discharge of sewage and industrial effluents by granting consent to discharge. They have the power to approve, reject, or impose conditions on the discharge.
- **Testing and Sample Analysis:** The Act grants power to both SPCBs and CPCB to test equipment and take samples for analysis to monitor and assess water pollution levels.
- **Enforcement:** Before the amendment in 1988, enforcement under the Act relied on criminal prosecutions initiated by the Boards.
- **1988 Amendment Act:** The 1988 amendment to the Act empowered both SPCBs and CPCB to close down industrial plants that were found to be defaulting or violating pollution control regulations.

Water (Prevention and Control of Pollution) Amendment Act, 2024

Key Highlights of the Act:

- **Empowers Central Government to:**
  - Exempt certain categories of industrial plants from provisions relating to restriction on new outlets and new discharges.
  - Prescribe manner of nomination of chairman of State Pollution Control Board.
  - Issue guidelines for grant, refusal, or cancellation of consent by any State Board for establishment of any industry, operation, treatment, etc.
  - Appoint an Adjudicating officer who is an officer not below Joint Secretary to the Centre or a Secretary to the State to hold an inquiry and to impose the penalty.
- **Penalty for Contravention:** Contraventions of provisions for which no penalty has been provided in the Act shall attract a penalty of Rs. 10,000 to Rs. 15 lakhs.
  - Persistence of contravention shall attract a penalty which may extend to Rs. 10,000 per day.
- **Crediting Penalty Amount:** To be credited to the Environmental Protection Fund established under the Environment (Protection) Act, 1986.
- **Appeal:** Appeal against the order of the adjudicating officer may be made to the National Green Tribunal.

AIR (PREVENTION AND CONTROL OF POLLUTION) ACT OF 1981 AND AMENDMENT, 1987

The Air (Prevention and Control of Pollution) Act, 1981 was enacted by the Parliament of India to implement the decisions taken at the United Nations Conference on the Human Environment held in Stockholm in June 1972.

Features:

- **Expansion of Authority:** The Air Act expanded the authority of the Central Pollution Control Board (CPCB) and State Pollution Control Boards (SPCBs) established under the Water Act to include air pollution control.
- **Consent Requirement:** Industries operating within designated air pollution control areas are required to obtain "consent" (permit) from the State Pollution Control Boards.
- **Emission Standards:** The states are mandated to prescribe emission standards for industries and automobiles after consulting the central board and considering its ambient air quality standards.
- **Power to Test and Analyze:** The Act grants power to the SPCBs to test equipment and take samples for analysis from sources such as chimneys, fly ash, dust, and others.
- **Enforcement:** Prior to its amendment in 1988, enforcement under the Air Act relied on criminal prosecutions initiated by the Boards.
- **Closure of Defaulting Plants:** The 1988 amendment empowered the SPCBs and CPCB to close down industrial plants that were found to be defaulting or violating pollution control regulations.

ENVIRONMENT-RELATED ACTS & POLICIES

WILDLIFE PROTECTION ACT, 1972, AND AMENDMENTS

The Wildlife (Protection) Act, 1972 is important legislation in India that provides legal provisions for the protection and conservation of wildlife and their habitats. The primary objectives of the Act are to protect the remaining population of endangered species by banning hunting, providing legal protection to their habitats and finally, restricting wildlife trade.

Features and Provisions:

- **Legal Framework:** The Act establishes a legal framework for the protection, preservation, and management of wildlife in India. It aims to control and regulate the trade in wildlife and wildlife products.
- **Schedules:** The Act included various schedules that classify species of plants and animals into different categories based on their level of protection. These schedules determine the degree of legal protection and penalties for offences related to hunting, trade, and possession of wildlife species.
- **Constitutional Provisions:** The Wildlife (Protection) Act is supported by constitutional provisions that emphasize the importance of protecting and improving the natural environment, including forests and wildlife.
- **Bodies Constituted:** The Act establishes various bodies responsible for the implementation and management of wildlife conservation efforts, such as NBWL, SBWL, Central Zoo Authority, NTCA, and WCCB.
- **Protected Areas:** The Act recognizes different types of protected areas, including Sanctuaries, National Parks, Conservation Reserves, Community Reserves, and Tiger Reserves. These areas are designated to safeguard wildlife habitats and promote their conservation.

Amendments:

- **Wildlife (Protection) Amendment Act of 1991:** This amendment focused on strengthening penalties and fines for wildlife-related offences.
  - It also introduced provisions for the protection of endangered species, emphasizing their conservation and the need for stricter enforcement.
- **Wildlife (Protection) Amendment Act of 2002:** This amendment introduced the concept of community reserves and conservation reserves as protected areas.
  - It aimed to involve local communities in wildlife conservation efforts and promote sustainable use of natural resources.
- **Wildlife (Protection) Amendment Act of 2006:** This amendment addressed the issue of human-wildlife conflict and established the National Tiger Conservation Authority (NTCA).
  - The NTCA was tasked with managing and protecting tiger reserves in the country. Additionally, the amendment created the Tiger and Other Endangered Species Crime Control Bureau to combat wildlife-related crimes.

Key Highlights of Wildlife (Protection) Amendment Act, 2022:
- This recent amendment aims to increase the number of species protected under the law and implement the provisions of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).
  - The amendment reduces the number of schedules from six to four.

- **Schedule I** provides the highest level of protection for animal species,
- **Schedule II** offers a lesser degree of protection,
- **Schedule III** protects plant species,
- **Schedule IV** includes specimens scheduled under CITES.
  - o **Increase in Penalties**
    - General violation increases to 1 lakh from Rs25,000.
    - For specially protected animals increases to Rs. 25,000 from Rs10,000.
  - o **Relaxation of certain restrictions**
    - Filmmaking (without causing any adverse impact to the habitat for wildlife) as one of the purposes for which permits may be granted to enter or reside in a sanctuary.
    - Certain activities such as, grazing or movement of livestock, bona fide use of drinking and household water by local communities etc. allowed without a permit in a sanctuary.
  - o The amendment also allows for the use of elephants for religious or other purposes but imposes increased penalties for violations related to both general and specially protected animals.
- **Significance:**
  - o Expands the species protected under the law by implementing the CITES.
  - o Participation of forest **dwellers.**
  - o Rationalizing Schedules for the purpose of clarity.
- **Issues with new Act**
  - o Potential allowance for open sale and purchase of elephants, previously restricted to inheritance of captive elephants.
  - o Continued authority of the Centre over 'vermin' declaration.
  - o **Federal structure concerns:** Wildlife protection falls under the Concurrent List.
  - o Amendment renders the State Boards for Wildlife chaired by Chief Ministers defunct and provides for establishing Standing Committee of Board for Wildlife to be headed by the Forest Minister with maximum 10 nominated members.

ENVIRONMENT PROTECTION ACT, 1986

- The Environmental Protection Act (EPA) was formulated in response to India's participation in the **Stockholm Conference**, a United Nations Conference on the Human Environment held in June 1972.
- The EPA serves as a means to implement the decisions and agreements reached during the Stockholm Conference.

Features:

- **Constitutional Basis:** The genesis of the Act lies in Article 48A (Directive Principles of State Policy) and Article 51A (g) (Fundamental Duties) of the Indian Constitution, which emphasizes the duty of citizens and the state to protect and improve the environment.
- **Central Government's Powers:** The Act empowers the Central Government to take all appropriate measures to prevent and control pollution, establish effective mechanisms for environmental protection, and abate environmental pollution.
- **Sampling and Evidence Collection:** The Act grants powers to the Central Government or authorized individuals to collect samples of air, water, soil, or other substances as evidence in cases related to offences under the Act
- **Handling of Hazardous Substances:** The Act prescribes a special procedure for the handling of hazardous substances, which must be followed by the concerned person or entity.
- **Locus Standi and Citizen Complaints:** The Act relaxes the rule of "Locus Standi," allowing even common citizens to approach the court if they provide a notice of sixty days regarding the alleged offence and their intention to file a complaint with the Central Government or competent authority.
- **Government's Power to Issue Directions:** The Act empowers the Central Government to issue directions for the operation, process, prohibition, closure, or regulation of any industry.
  - o It also grants the power to stop or regulate the supply of electricity, water, or other services without obtaining a court order.
- **Stringent Penal Provisions:** The Act includes stringent penal provisions, with a minimum penalty of imprisonment for up to five years or a fine of up to one lakh rupees, or both.
  - o Further penalties can be imposed if the violation continues after conviction, with imprisonment of up to seven years for persistent failure or contravention.

BIOLOGICAL DIVERSITY ACT, 2002

The Biological Diversity Act, of 2002 was enacted in India with the aim of fulfilling the objectives outlined in the United Nations Convention on Biological Diversity (CBD) of 1992. The Act recognizes the sovereign rights of states to utilize their biological resources while promoting the conservation, sustainable use, and fair sharing of benefits derived from genetic resources.

Objectives:
- Conservation of biological diversity
- Sustainable use of its components
- Fair and equitable sharing of benefits arising from the utilization of genetic resources

Features:
- **Three-Tier Structure:** The Act establishes a three-tier structure to regulate access to biological resources:
  - **National Biodiversity Authority (NBA):** The NBA is the apex body responsible for formulating policies, granting approvals for access to genetic resources, and ensuring compliance with the Act at the national level.
  - **State Biodiversity Boards (SBB):** Each state in India has a State Biodiversity Board responsible for implementing the Act within the state's jurisdiction. They work in coordination with the NBA.
  - **Biodiversity Management Committees (BMC):** At the local level, Biodiversity Management Committees are formed to promote conservation, sustainable use, and equitable sharing of benefits. They play a crucial role in biodiversity management and decision-making processes.
- **Local Community:** It emphasizes the involvement of local communities in biodiversity conservation and the sustainable use of resources.
- **Legal Framework:** It provides a legal framework for the protection, conservation, and sustainable utilization of India's biological resources while ensuring fair and equitable sharing of benefits among stakeholders.
- **Global Objectives:** It aligns with the global objectives of the CBD and aims to safeguard India's rich biodiversity for present and future generations.
- **Other Provisions:** The Act also includes provisions for the regulation of access to biological resources, protection of traditional knowledge associated with biodiversity, and establishment of biodiversity heritage sites.

Note: Biological Diversity (Amendment) Act, 2023 is covered in detail in Chapter 6. Conservation of Biodiversity

INDIAN FOREST ACT, 1927

This act had a significant impact on forest-dependent communities. It aimed to extend state control over forests, reducing people's rights to forest use. Amendments were made to restrain local use by forest-dependent communities and make forest laws more effective.

Objectives of the Indian Forest Act, 1927:
- **Consolidation Of Previous Laws:** The act aimed to consolidate existing forest laws into a single comprehensive legislation.
- **Establishment Of Different Forest Classes:** It provided the government with the power to create various classes of forests to ensure effective usage, primarily for colonial purposes.
- **Regulation Of Forest Produce Movement:** The act aimed to regulate the movement and transit of forest produce and impose duties on timber and other forest products.
- **Declaration Of Forest Areas:** It defined the procedures for declaring an area as Reserved Forest, Protected Forest, or Village Forest.
- **Prohibition Of Forest Offences:** The act outlined forest offences and prohibited acts within Reserved Forests, along with penalties for violating the provisions.
- **Enhancement of Conservation And Accountability:** The act sought to make forest and wildlife conservation more accountable through its provisions.

FOREST CONSERVATION ACT, 1980

The Forest Conservation Act of 1980, introduced to replace the Forest (Conservation) Ordinance, aims to regulate and limit the utilization of forests for non-forest purposes in India.

Key features of the Forest Conservation Act of 1980:
- **Advisory Committee:** The act allows for the establishment of an advisory committee to provide guidance and advice to the Central Government on matters related to forest conservation.
- **Central Government Authority:** The Central Government holds the ultimate authority in implementing and enforcing laws formulated under the act.

- **Penalties For Violations:** Any individual or entity found in violation of the provisions of the act is liable to pay penalties as prescribed.

Note: The Forest Conservation (Amendment) Act, 2023 is covered in detail Chapter 6. Conservation of Biodiversity

NATIONAL FOREST POLICY, 1988

The National Forest Policy of 1988 is a significant policy document in India that focuses on the preservation, conservation, and development of forests. It outlines the following key themes:

- **Preservation Of Ecological Equilibrium:** The policy emphasizes the importance of maintaining environmental stability and ecological balance, particularly atmospheric equilibrium, which is crucial for the survival of all forms of life.
- **Protection Of Forests As National Heritage:** Forests are recognized as national heritages due to their rich biodiversity and the presence of diverse flora and fauna. The policy aims to preserve and restore forests as valuable natural assets.
- **Legislation For Environmental Quality:** The policy highlights the enactment of various legislations in India to improve environmental quality. These include the Wildlife Protection Act of 1972, the Water Act of 1974, the Air Act of 1981, the Forest Conservation Act of 1980, and the Environment Protection Act of 1986.
- **Forest Management Principles:** The policy promotes essential principles of forest management, such as controlling soil erosion and denudation, managing sand dunes, increasing forest/tree cover through afforestation and social forestry programs, and ensuring sustainable forest production to meet national demands.
- **People's Participation:** The policy emphasizes the involvement of local communities and stakeholders in forest management through initiatives like Joint Forest Management, aiming to raise awareness and achieve forest conservation goals while minimizing the impact on existing forests.

The **National Forest Policy of 1988** recognizes the need for effective forest management practices that protect and improve forests while considering the dependence of forest fringe regions and forest-dwelling communities on forest resources. It encourages a balanced approach to forest conservation and development, ensuring the sustainable use of forest products and maximizing wood substitution.

THE SCHEDULED TRIBES AND OTHER TRADITIONAL FOREST DWELLERS (RECOGNITION OF FOREST RIGHTS) ACT, 2006

The Forest Rights Act (FRA) of 2006 is an important legislation in India that aims to restore and recognize the rights of deprived forest-dwelling communities. Here are some key points about the Forest Rights Act:

Features:

- **Recognized Rights:** The Act recognizes and secures various rights, including community rights, the right to protect and conserve community forest resources, the right to intellectual property and traditional knowledge related to biodiversity and cultural diversity, and the rights of displaced communities and over developmental activities.
- **Inclusion of Protected Areas:** National Parks, Sanctuaries, Reserve Forests, and Protected Forests are included for the recognition of rights under the Act.
- **Forest Land Diversion:** The Act provides for forest rights even in cases of forest land diversion for essential public amenities like schools, hospitals, water supply, roads, and other infrastructure.
- **Heritability of Rights:** The rights conferred under the Act are heritable but not alienable or transferable. In the case of married persons, the rights are registered jointly in the names of both spouses and in the case of single-headed households, it is registered in the name of the household head. In the absence of a direct heir, the heritable right passes on to the next of kin.
- **Protection from Eviction:** No member of a forest-dwelling Scheduled Tribe or other traditional forest dwellers can be evicted or removed from forest land under their

Rights for the dwellers

What the Forest Rights Act, 2006, entails

- Tenurial security over the forestland under occupation prior to December 13, 2005
- Recognition of community right over forest and forest products
- Protection and conservation of community forest resources
- Conversion of all forest villages and habitation located inside the forestland into revenue villages
- In situ rehabilitation of displaced persons evicted without compensation prior to December 13, 2005
- Recognition of ancestral domain (habitat) right to

Particularly Vulnerable Tribal Groups

- Seasonal access to nomadic, pastoral and semi-nomadic communities over forestland

- Conversion of all leases granted by erstwhile governments, zamindars and king into permanent land records

Residents of Gunduribadi village in Odisha's Nayagarh district get ready for mapping their land boundaries for the Forest Rights Act implementation. ■ SPECIAL ARRANGEMENT

occupation until the recognition and verification process is completed.
- **Role of Gram Sabha:** The Gram Sabha, the village-level local self-government institution, is designated as the competent authority for initiating the process of determining the nature and extent of individual or community forest rights for forest-dwelling Scheduled Tribes and other traditional forest dwellers.

Minor Forest Produce (MFP) and Tribal Rights in India

Minor Forest Produce (MFP) is a subset of forest produce and got a definition only in 2007, when the Forest Rights Act, 2006 was enacted. The Act defines a Minor Forest Produce (MFP) as all non-timber forest produce of plant origin. This includes: Bamboo, Leaves (Tendu, Sal, etc.), Fruits, Seeds, Flowers (Mahua), Honey, Lac, Medicinal Plants, Resins & Gums, etc.

- **Significance for Tribal Communities**
  - **Source of Livelihood:** MFPs often form the backbone of the tribal economy, providing both sustenance and income through the collection and sale of these products.
  - **Food Security:** Many MFPs are directly consumed by tribal communities, ensuring food security and nutrition.
  - **Traditional Medicine:** Tribal communities have extensive knowledge about the medicinal properties of various MFPs, using them for traditional healing practices.
  - **Cultural Importance:** Certain MFPs hold deep spiritual and cultural significance within tribal societies.
- **The Forest Rights Act (2006) and MFP:** The Forest Rights Act recognizes the following rights of forest-dwelling communities over MFPs:
  - **Ownership Rights:** The right to own, use, and sell MFPs traditionally collected within or outside village boundaries.
  - **Access Rights:** The right to access, collect, and use MFPs for self-consumption or sale.
  - **Protection Rights:** The right to protect, regenerate, and manage community forest resources, which include areas where MFPs are found.

Challenges:
- **Balancing Individual Rights and Community Rights:** Some states prioritize individual rights over community rights, neglecting the importance of community involvement in sustainable forest management.
- **Insufficient Recognition of Individual Forest Rights (IFRs):** Acknowledging Individual Forest Rights has been inadequate, often hindered by opposition from the Forest Department, apathy from other government bodies, and the misuse of technology.
- **Challenges of Digital Processes in Areas with Limited Connectivity:** The introduction of digital processes, as seen with the VanMitra software in Madhya Pradesh, poses challenges in regions with poor connectivity and low literacy rates.
- **Incomplete Acknowledgment of Community Forest Rights (CFRs):** The slow and incomplete recognition of community rights to access and manage forests (CFRs) along with resistance from the forest bureaucracy hinder the empowerment of local communities in forest management.
- **Limited Recognition of CFRs in Most States:** While Maharashtra, Odisha, and Chhattisgarh have made progress in recognizing CFRs, this advancement is not reflected in most states.

Way Forward
- **Strengthening Gram Sabha:** Actively involve the local self-government, Gram Sabha, in decision-making processes regarding forest management to enhance their empowerment.
- **Fostering Inclusive Decision-Making:** Ensure the participation of rights holders in decision-making processes, incorporating their perspectives to effectively address their needs.
- **Educational Outreach and Training:** Organize awareness programs and training sessions for forest dwellers, enlightening them about their rights outlined in the Forest Rights Act (FRA).
- **Capacity Building:** Enhance the capabilities of civil society organizations to advocate for and support the rights of forest dwellers.

The **Forest Rights Act,** with its comprehensive rights framework and focus on community involvement, represents a significant step toward more inclusive and sustainable forest governance in India. Its successful implementation can lead to a more equitable distribution of forest resources, empowerment of marginalized communities, and the preservation of traditional ways of life.

COASTAL REGULATION ZONE (CRZ) NOTIFICATION 1991, 2011 AND 2018

- The Coastal Regulation Zone (CRZ) notification was first issued in 1991 by the Ministry of Environment, Forest and Climate Change (MoEF&CC) in India under the Environment (Protection) Act of 1986.
- **Objective:** The objectives of the CRZ notification are to conserve and protect coastal stretches, ensure livelihood security for fishing communities and locals living in coastal areas, and promote sustainable development based on scientific principles, considering natural hazards and sea-level rise.

Coastal Regulation Zone Notification, 2018

Index
CRZ I A: Eco-sensitive areas
CRZ I B: Inter-tidal areas
CRZ II: Areas which have been developed up to or close to the shore
CRZ III A: CRZ-III areas, where the population density is more than 2,161 sq km as per 2011 Census
CRZ III B: Areas with population density of less than 2,161 per sq km, as per 2011 Census
CRZ IV A: 12 nautical miles from the Low Tide Line towards the sea
CRZ IV B: Tidal influenced waterbodies
NDZ: 50 metres from High Tide Line in CRZ III A areas, 200 m from HTL in CRZ-III B areas

Features:

- **Definition of CRZ:** The coastal regulation zone (CRZ) includes coastal areas of seas, bays, creeks, rivers, and backwaters influenced by tides up to 500 meters from the high tide line (HTL), as well as the land between the low tide line (LTL) and the high tide line.
- **CRZ 1991 to CRZ 2011:** Several amendments were made to the CRZ 1991 notification, which was consolidated and issued in the CRZ 2011 notification. The CRZ 2011 took into account the issues and concerns from the earlier notification.
- **CRZ 2011 notification** categorizes coastal zones into four types: CRZ-I for ecologically sensitive areas, CRZ-II for developed areas within municipal limits, CRZ-III for relatively undisturbed areas with restricted construction, and CRZ-IV for aquatic zones with provisions for traditional fishing and waste disposal regulations.

New Rules under CRZ Regulations 2018:
- Two separate categories for CRZ-III (Rural) areas have been introduced.
- In densely populated rural areas (CRZ-IIIA), the **no-development zone is reduced to 50 meters from the high-tide level.**
- Rural areas with lower population density (CRZ-IIIB) maintain a **no-development zone of up to 200 meters from the high-tide line**.
- Islands close to the mainland coast and backwater islands in the mainland now have a **no-development zone of 20 meters**.

Coastal Zone Management Plans (CZMPs):
States are required to prepare Coastal Zone Management Plans (CZMPs) to guide development activities in their coastal areas. This requirement comes from the Coastal Regulation Zone (CRZ) Notification, 2019, issued by the Ministry of Environment, Forests and Climate Change (MoEFCC).

Purpose of CZMPs:
- To ensure sustainable development in coastal areas by balancing conservation, livelihood, and economic activities.
- To implement the provisions of the CRZ Notification, 2019, within each state's specific coastal context.
- To identify and protect Ecologically Sensitive Areas (ESAs) within the coastal zone.
- To delineate different CRZ categories (CRZ-I, II, III, and IV) and specify permissible activities in each.
- To facilitate stakeholder participation in coastal management decision-making.

Benefits of CZMPs:
- Promote balanced and sustainable development in coastal areas.
- Protect ecologically sensitive areas and biodiversity.
- Help mitigate the impacts of climate change and natural disasters.
- Improve resource management and reduce pollution.
- Enhance livelihoods and well-being of coastal communities.

WETLAND CONSERVATION AND MANAGEMENT RULES 2017

Wetlands (Conservation and Management) Rules, 2017 have been made official by the Ministry of Environment, Forests, and Climate Change (MoEF&CC) in accordance with the provisions of the Environment (Protection) Act, 1986.

Features:
- **Composition of SWA:** Every state and Union Territory is required to set up a State Wetland Authority. The State Wetland Authority defines strategies for the better use of wetlands and recommends measures for wetland conservation.
- **Determining Wise Use Principle:** The State Wetland Authority determines the **"wise use principle"** that governs the management of wetlands. The concept of "wise use" refers to sustainable use practices that are compatible with conservation goals.
- **Regulating Activities:** The authority develops a comprehensive list of activities that are regulated and permitted within notified wetlands and their zone of influence. It also has the power to recommend additional prohibited activities for specific wetlands.
- **National Wetland Committee:** The Central Wetlands Regulatory Authority is replaced by the National Wetland Committee (NWC), which is headed by the Secretary to the Ministry of Environment, Forest and Climate Change (MoEF&CC).
  - The NWC advises on the designation of Wetlands of International Importance under the Ramsar Convention and collaborates with international agencies on wetland-related issues.
- **Digital Inventory:** All state authorities are required to prepare a list of all the wetlands in their jurisdiction. Based on this information, a digital inventory for wetlands will be created and updated every 10 years.
- **Prohibited Activities:** The rules prohibit the discharge of unwanted waste into wetlands, including waste from villages, towns, cities, and industries. Solid waste dumping into wetlands is also prohibited.
  - The conversion of wetland areas for non-wetland purposes and the construction of permanent structures on notified wetlands are banned.

NATIONAL GREEN TRIBUNAL ACT (NGT ACT), 2010

The National Green Tribunal (NGT) is a specialized body established under the NGT Act to address cases related to environmental protection, conservation of forests, and other natural resources.

Features:
- **International Recognition:** With the establishment of the NGT, India became the third country in the world, after Australia and New Zealand, to have a specialized environmental tribunal. It was the first developing country to do so, highlighting India's commitment to environmental governance.
- **Purpose and Jurisdiction:** The NGT is tasked with the effective and expeditious disposal of cases related to environmental protection. It has jurisdiction over civil cases under seven specific laws related to the environment, including acts such as the Water (Prevention and Control of Pollution) Act, 1974, the Forest (Conservation) Act, 1980, the Air (Prevention and Control of Pollution) Act, 1981, and others listed in your previous message.
- **Penalties for Non-Compliance:** The NGT Act provides for penalties in case of non-compliance. These penalties may include imprisonment for a term that can extend up to three years, a fine that can go up to ten crore rupees, or both imprisonment and fine, depending on the severity of the violation.
- **Appeal to the Supreme Court:** An appeal against the orders, decisions, or awards of the NGT can be made to the Supreme Court of India. Generally, such appeals must be filed within ninety days from the date of communication of the NGT's order/decision/award.
- **Scope of Challenges:** The NGT provides a platform for challenging violations of the laws mentioned earlier or any decisions are taken by the government under these laws. It serves as a forum for addressing environmental issues and ensuring compliance with environmental regulations.

INTERNATIONAL EFFORTS FOR ENVIRONMENTAL CONSERVATION

UNITED NATIONS CONFERENCE ON THE HUMAN ENVIRONMENT (1972)

Also known as the **Stockholm Conference,** the first global conference on the environment convened under the United Nations and held in Stockholm, Sweden.
- Considered the first United Nations (UN) conference to focus on international environmental issues.
- The Stockholm conference started the contemporary "environmental era".

Key Agreements under Stockholm conference:
- Created the UN Environment Programme (UNEP), the first UN programme focused solely on environmental issues.

- Safeguard natural resources like air, water, land, flora, and fauna for present and future generations.
- Limit toxic substance release and heat emissions within environmental capacity.
- Support poorer nations in their fight against pollution.
- Align environmental policies with the development needs of developing countries.

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50 YEARS OF STOCKHOLM CONFERENCE
- Recently, the Stockholm+50 meeting was held at Stockholm, Sweden to commemorate the 50 years since the 1972 Stockholm Conference.

Stockholm+50 Recommendations for actionable agenda:
- Placing human well-being at the center of a healthy planet and prosperity for all.
- Recognizing and implementing the right to a clean, healthy, and sustainable environment.
- Adopting system-wide changes in our current economic system.
- Accelerating transformations of high-impact sectors.
- Assisting developing countries in tackling environmental challenges by providing access and support for digital and technological solutions.

EARTH SUMMIT (1992)
Also known as The United Nations Conference on Environment and Development (UNCED). It succeeded in raising public awareness of the need to integrate the environment and development. 190 countries pledged to achieve by 2010, a significant reduction in the current rate of biodiversity loss at global, regional and local levels.

Outcomes Of the Summit:
- Agenda 21
- UN Framework Convention on Climate Change (UNFCCC)
- UN Convention on Biological Diversity
- Management, Conservation and Sustainable Development of all types of forest
- The Earth Charter

Landmark Agreements: An important achievement of the summit was an agreement on the Climate Change Convention which in turn led to the Kyoto Protocol and the Paris Agreement.

Important legally binding agreements (Rio Convention) were opened for signature:
- Convention on Biological Diversity.
- United Nations Convention to Combat Desertification.

Agenda 21	Sustainable development commitment from Rio Earth Summit 1992. UN action plan for sustainability. • **Objectives**: Blueprint for 21st-century sustainability, combating environmental deterioration, conserving habitats.
Rio+5 (1997)	UN session in Rio to review Agenda 21 progress. Focus on urgent environmental and socio-economic issues. • **Objective**: Thorough review of 1992 Rio agreement's status, addressing environmental and socio-economic concerns.
Rio+10 (2002)	Affirmed UN commitment to Agenda 21 and MDGs. Johannesburg Declaration set targets for sustainable development.
Rio+20 (2012)	UN Conference on Sustainable Development, Rio+20. Aimed to develop post-2015 SDGs building on MDGs. • **Objective:** Develop SDGs converging with post-2015 development agenda.

UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE (UNFCCC)
An international environmental treaty seeking to reduce greenhouse gases to prevent global warming.
- **Genesis:** Initially signed in 1992 at the United Nations Conference on Environment and Development, famously known as the Earth Summit. It is headquartered in Bonn, Germany.
- **Members:** It boasts 197 parties, including India.

Key Agreements:
- **Paris Agreement:**
  o **Legally Binding Since 2015:** Adopted in 2015, it is a legally binding agreement.

- o **Objective:** To limit the global average temperature increase to well below 2°C above pre-industrial levels, with concerted efforts to constrain the rise to 1.5°C.
- **Kyoto Protocol:**
  - o Adopted in 1997 and came into force in 2005.
  - o Obligated industrialized nations and transitioning economies to curtail and diminish greenhouse gas emissions as per mutually agreed individual targets.
  - o Commitments under this protocol concluded in 2020.

REDD+
- REDD+ is a framework created by the UNFCCC Conference of the Parties to encourage activities in the forest sector that reduce emissions from deforestation and forest degradation.
- It also guides towards sustainable management of forests and the conservation and enhancement of forest carbon stocks in developing countries.

UN CONVENTION ON BIOLOGICAL DIVERSITY OR BIODIVERSITY CONVENTION (1992)

It is a **legally binding treaty** on the signatories. It has been ratified by 196 nations including India. (USA and the Vatican have not signed).

Objectives:
- Conserve biological diversity.
- Sustainable use of the components of biodiversity.
- Fair and equitable sharing of the benefits arising out of the utilization of genetic resources.

Cartagena Protocol on Biosafety (2000)	• Supplementary agreement to the UN CBD. Focuses on the movement of LMOs produced with modern technology. • Objective: Protect biodiversity from risks of LMOs, implement biosafety regime
Nagoya Protocol (2010)	• Another UN CBD supplementary agreement. Concerned with access to genetic resources and fair benefit sharing. • Objectives: Conserve biodiversity, ensure sustainable use, fair benefit sharing

Note: COP15 - Kunming -Montreal Global Goals for 2050 and GBFF is covered in detail in Chapter 6. Conservation of Biodiversity

UNITED NATIONS CONVENTION TO COMBAT DESERTIFICATION (UNCCD)

United Nations Convention to Combat Desertification (UNCCD) is the only legally binding framework set up to address desertification and effects of drought.
- Established in 1994, this is the only legally binding international agreement that connects environment and development to sustainable land management.
- It focuses particularly on arid, semi-arid, and dry sub-humid areas, known as the drylands, where some of the most vulnerable ecosystems and communities are located.
- UNCCD has released a 2018–2030 Strategic Framework focusing on:
  - o **Mitigate, adapt and manage** land degradation.
  - o **Mobilize** financial and non-financial resources.
  - o **Improve** the condition of land degradation through participation.

ENVIRONMENTAL SUSTAINABILITY

Environmental sustainability can be defined as the ability to meet the needs of the present without compromising the ability of future generations to meet their own needs.

INTERNATIONAL TREATY ON PLANT GENETIC RESOURCES FOR FOOD AND AGRICULTURE (PGRFA) (2001)

It is a legally binding agreement that was adopted by the Thirty-First Session of the Conference of the Food and Agriculture Organization (FAO) of the United Nations in 2001.
- Commonly known as the Seed treaty, it serves as a significant international agreement for the conservation, utilization, and management of Plant Genetic Resources for Food and Agriculture (PGRFA) worldwide, aimed at benefiting people globally.
- India is a party to this treaty.

- It provides the necessary international legal framework for the establishment of the Svalbard Global Seed Vault in Norway.
- Funding for the treaty is sourced from its Contracting Parties and the FAO.

Objectives
- Recognizing the enormous contribution of farmers to the diversity of crops that feed the world.
- Establishing a global system to provide farmers, plant breeders and scientists with access to plant genetic materials.
- Ensuring that recipients share the benefits they derive from the use of these genetic materials with the countries where they have originated.

GB9 of International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA)
India hosted the Ninth Session of the Governing Body (GB9) of the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA). Here are the major decisions made during GB9:
- In a historic move, the Federation of Seed Industry of India (FSII) contributed Rs 20 lakhs to the Benefit-Sharing Fund (BSF).
- India was appointed as the Co-Chair of the Working Group on Enhancement of Multilateral System of Access and Benefit-sharing (MLS).
- Consensus was reached on the implementation of Farmers' Rights after extensive negotiations at GB9. Various options for encouraging, guiding, and promoting the realization of Farmers' Rights were considered.
- Contracting Parties acknowledged India's intervention, supported by several African nations, regarding the impact of institutional reforms within the CGAIR system (a global research partnership for a food-secure future) on the funding of gene banks globally.

	PREVIOUS YEAR QUESTIONS	
1.	How does the draft Environment Impact Assessment (EIA) Notification, 2020 differ from the existing EIA Notification, 2006?	2020
2.	What are the key features of the National Clean Air Programme (NCAP) initiated by the Government of India?	2020
3.	What are the salient features of the Jal Shakti Abhiyan launched by the Government of India for water conservation and water security?	2020
4.	How does biodiversity vary in India? How is the Biological Diversity Act, 2002 helpful in conservation of flora and fauna?	2018
5.	The Namami Gange and National mission for clean Ganga (NMCG) programmes and causes of mixed results from the previous schemes. What quantum leaps can help preserve the river Ganga better than incremental inputs?	2015
6.	Environmental impact assessment studies are increasingly undertaken before project is cleared by the government. Discuss the environmental impacts of coal-fired thermal plants located at Pitheads.	2014
7.	Discuss global warming and mention its effects on the global climate. Explain the control measures to bring down the level of greenhouse gases that cause global warming, in the light of the Kyoto Protocol, 1997.	2022
8.	Explain the purpose of the Green Grid Initiative launched at the 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
9.	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
10.	Give an account of the current status and the targets to be achieved pertaining to renewable energy sources in the country. Discuss in brief the importance of the National Programme on Light Emitting Diodes (LEDs).	2016
11.	Should the pursuit of carbon credit and clean development mechanisms set up under UNFCCC be maintained even though there has been a massive slide in the value of carbon credit? Discuss with respect to India's energy needs for economic growth.	2014
12.	Explain the concepts of "Environmental Sustainability" and "Sustainable Development of People"?	2012

7 CONSERVATION OF BIODIVERSITY

"The State is a Trustee of Natural Resources" - **Supreme Court of India**

INTRODUCTION

UNCBD defined Biodiversity as the variability among living organisms from all sources, including diversity within species, between species, and of ecosystems. Biodiversity includes diverse species, genetic variations within species, and a range of ecosystems (terrestrial and marine) crucial for human societies, encompassing coastal areas, forests, wetlands, grasslands, mountains, and deserts.

- **Definition:** Biodiversity conservation is the protection and management of biodiversity to obtain resources for sustainable development. Biodiversity is the biological variety and variability of life on Earth. Biodiversity is a measure of variation at the genetic, species, and ecosystem level.
- **Main Objectives:** To preserve the diversity of species; Sustainable utilization of species; Sustainable utilization of the ecosystem
- **Interdependence:** All forms of life have so closely interlinked that disturbance in one gives rise to an imbalance in the others.
- **Environmental Degradation:** If species of plants and animals become endangered, they cause degradation in the environment, which may threaten human beings' own existence.

APPROACHES IN BIODIVERSITY CONSERVATION

- **In situ Conservation**: It is the approach of protecting an endangered plant or animal species in its natural habitat, either by protecting or cleaning up the habitat itself or by defending the species from predators. Main zone under the In Situ Conservation - Biosphere Reserves, National Parks, Wildlife Sanctuaries.
- **Ex-situ Conservation**: In this approach, threatened animals and plants are taken out of their natural habitat and placed in special settings where they can be protected and given special care.

INDIA AND BIODIVERSITY

- **Biodiversity Hotspots:** India has 4 biodiversity hotspots out of 36 in the world which include the Eastern Himalaya, the Indo-Burma region, the Western Ghats, and the Sundarbans.
- **Mega Biodiversity Nations:** With 2.4% of the world's land area, India accounts for about 7-8% of recorded species of the world. India is one of the 17 Mega Biodiversity Nations in the world.
- **High Endemic Diversity:** The Pride of India lies in its nearly 6,500 native plants which are still used in the indigenous healthcare systems. It is a country with rich biodiversity.
- **Tropical Forests:** The highest levels of terrestrial biodiversity are found in tropical forests, which host over 80 per cent of species of terrestrial animals, plants and fungi.
- **Floral Diversity:** Approximately 45,000 plant species (7% of the world's total) exist in India, with 33% being endemic, while 15,000 are flowering plants (6% of the world's total) and around 1,500 plant species are endangered.
- **Animal Diversity:** India boasts high animal biodiversity, with 91,000 species (6.5% of global fauna), including 60,000 insects, 2,456 fish, 1,230 birds, 372 mammals, over 440 reptiles, 200 amphibians, and 500 molluscs, as well as diverse livestock breeds such as 400 sheep, 27 cattle, and 22 goats.
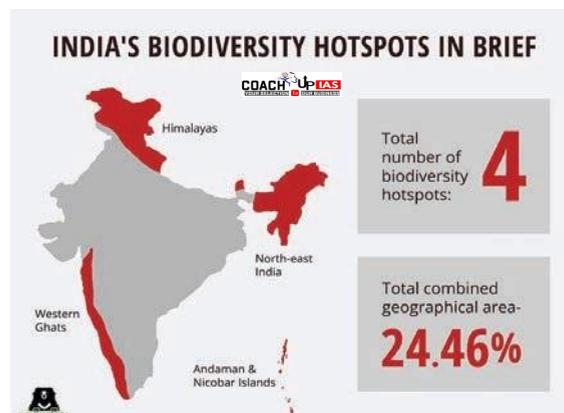

FACT-WISE

- **Global Assessment Report**: According to a 2019 Global Assessment Report on Biodiversity and Ecosystem Services by IPBES 25% of plant and animal species are threatened with extinction as the result of human activity.
  - Over 680 vertebrate species have gone extinct since the 16th century, and around 9% of domesticated mammal breeds used for food and agriculture were lost by 2016.
- **Living Planet Report by WWF**: Wildlife populations including mammals, birds, amphibians, reptiles, and fish, have experienced a significant 69% drop between 1970 and 2018.
  - In India, the report highlights declines in populations of honeybees and 17 species of freshwater turtles.

- The warm water corals with approximately 50% already lost and projections indicate a potential loss of 70 - 90% at a 1.5°C warming.
- Only 37% of rivers over 1,000 km long remain free-flowing, posing threats to fish migration.
- Oceanic sharks witnessed a 71% reduction in global abundance over the last 50 years.
- **IUCN**: More than 41,000 animals worldwide are threatened with extinction.

BIODIVERSITY HOTSPOTS

- Biodiversity hotspots are the regions that are rich with life and at high risk for destruction.
- Across the world, **36 areas declared as Biodiversity hotspots**. They **account for just 2.4% of Earth's land surface**, but they hold up more than half of the world's plant species as endemics (i.e., species found no place else) and nearly 43% of bird, mammal, reptile and amphibian species as endemics.
- Biodiversity hotspot concept was put forth by **Norman Myers in 1988.**
- **India is one of the 17 megadiverse countries** in the world, and there are **four biodiversity hotspots found in India.** These are **Himalayas, Indo-Burma, Sundaland and Western Ghats-Sri Lanka.**

INDIA'S BIODIVERSITY HOTSPOTS IN BRIEF

Total number of biodiversity hotspots: 4

Total combined geographical area- 24.46%

Importance of Biodiversity Hotspots	Threats To Biodiversity Hotspots
- Preservation of endemic species. - Developing a healthy ecosystem. - Conservation of natural resources. - Helps in controlling pollution. - They are the habitat of many species. - They provide food sources. - They are the good sources of medicines and pharmaceutical drugs.	- Unplanned and poorly managed tourism. - Resource exploitation and habitat loss. - Deforestation - Urbanisation and population explosion. - Overgrazing and unsustainable agriculture. - Mining and industrial expansion.

BIODIVERSITY COOL SPOTS

- Cool-spots are defined as the world's last refuges where high numbers of threatened species still persist.
- They could be the result of protection or because of intact habitat that has not been cleared yet.
- Some of the "cool spots" identified include parts of the Amazon rainforest, Andes Mountains, and tundra and boreal forests of Russia and North America.

SIGNIFICANCE OF BIODIVERSITY CONSERVATION

- **Ecological Balance:** Every organism in an ecosystem contributes to its function and survival, performing various functions and providing resources for others.
- **Maintaining Cycles:** Species play vital roles in energy capture, decomposition, nutrient cycling, and climate regulation, ensuring the balance and sustainability of ecosystems.
- **Hotspot Ecosystems:** Ecosystems serve crucial functions like soil formation, pollution reduction, and resource protection, essential for both ecosystem health and human well-being.
- **Agro-biodiversity:** Crop diversity, a vital component of biodiversity, is crucial for agricultural resilience and sustainable food production.
- **Reservoir of Resources:** Biodiversity serves as a rich source of materials for food, pharmaceuticals, cosmetics, and other products, supporting various industries and human needs.
- **Social Cohesive Role:** Diverse environments provide resources for communities and cultures, fostering social cohesion and cultural identity, while also increasing resilience to climate change and natural disasters.

CAUSES OF BIODIVERSITY LOSSES AND THREATS TO BIODIVERSITY

- **Natural Causes**:
  - **Geological and Ecological Changes:** Historical events like ice ages, continental drift, tectonic shifts, uplifts, and subsidence have shaped ecosystems and influenced wildlife distribution and survival. **Example:** The formation of the Himalayas created new habitats for unique species.
  - **Natural Disasters:** Events like wildfires, hurricanes, floods, and volcanic eruptions can devastate habitats and wildlife populations. **Example:** 2018 California wildfires destroyed large areas of forest habitat and wildlife species.
  - **Climate Change and Variability:** Natural climate changes, including historical shifts and cycles like El Niño and La Niña, affect ecosystems and wildlife. Example: **Example:** The 1997-1998 El Niño caused droughts in Australia, affecting koalas.
  - **Disease Outbreaks:** Natural diseases can lead to declines in biodiversity and local extinctions. **Example:** The chytrid fungus has decimated amphibian populations worldwide.

- **Anthropogenic Causes:**
  - **Habitat Loss and Fragmentation:** Deforestation, urbanization, and land conversion for agriculture reduce available habitat and isolate wildlife populations. **Example:** Amazon rainforest is being cleared for agriculture, fragmenting habitats and threatening species

THE FIVE THREATS TO BIODIVERSITY

Land and Sea use Change (Including habitat loss and degradation)	Pollution	Species overexploitation	Climate Change	Invasive species and disease
Example: Agricultural land use which is responsible for **80%** of the global deforestation	Make the environment unsuitable for survival directly and indirectly	Example: Overfishing which may decimate global fish populations by 2050	Forcing the animal to shift range or confounding the signals that trigger seasonal events and more	Compete with native species for space, food and other resources; sometimes spread disease that native species have no immunity of

  - **Pollution:** Air, water, and soil pollution from human activities harm wildlife directly or indirectly. **Example:** 2010 Deepwater Horizon oil spill impacted marine life in the Gulf of Mexico.
  - **Invasive Species:** Non-native species outcompete native species, prey on them, or introduce diseases, causing declines in native wildlife and biodiversity. **Example:** Lantana camara, outcompetes native flora, disrupting local ecosystems in India.
  - **Hunting and Poaching:** Unregulated hunting and poaching, exacerbated by mismanagement of forest resources, pose a major threat to wildlife.
  - **Illegal Wildlife Trade:** High demand for wildlife products like pangolin scales fuels illegal hunting and trafficking, endangering species.

CONSEQUENCES OF LOSS OF BIODIVERSITY

- **Food Security:** Loss of pollinators and decline in fish stocks threaten agricultural productivity, leading to reduced food security and increased vulnerability to climate change.
- **Economic Losses:** Biodiversity loss impacts tourism, forestry, fisheries, and pharmaceuticals, resulting in revenue loss, job cuts, and increased social and political conflicts over dwindling resources.
- **Disruption of Ecological Balance:** Leads to the proliferation of invasive species, imbalances in ecosystems, and disrupted ecological feedback mechanisms like predator-prey interactions and nutrient cycling.
- **Increased Vulnerability to Climate Change:** Reduces ecosystem resilience, making ecosystems less capable of responding and recovering from climate change impacts and other disturbances.
- **Increased Risk of Infectious Diseases:** Biodiversity loss increases the prevalence of zoonotic diseases by disrupting ecological balances and changing human-wildlife interactions.
- **Loss of Genetic Diversity:** Reduces genetic variability within species, making them more susceptible to environmental changes, diseases, and decreasing their adaptability and resilience.

GOVERNMENT INITIATIVES FOR BIODIVERSITY CONSERVATION

- **Legal and Policy Frameworks:** Encompassing laws and regulations governing biodiversity conservation, forest preservation, environmental impact assessment, and biodiversity management. Examples include the Wildlife

Protection Act,1972; Forest Conservation Act,1980; EIA Notification, 2006 and National Wildlife Action Plan (2002-2016).

- **Conservation Programs:** Initiatives dedicated to safeguarding specific species, such as Project Tiger, Project Elephant, Project Snow Leopard, Crocodile Conservation Project, and Dolphin Conservation Program.
- **Research and Capacity Building:** Undertaken by institutions and organizations engaged in biodiversity research, capacity enhancement, and professional training for researchers and practitioners. Key entities include the National Biodiversity Authority (NBA), Indian Council of Forestry Research and Education (ICFRE), and Zoological Survey of India (ZSI).
- **Global Initiatives:** International agreements, conventions, and organizations committed to global biodiversity conservation and environmental protection. Examples include the Convention on Biological Diversity (CBD), Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), Man and the Biosphere Programme (MAB), and World Wide Fund for Nature (WWF) etc.

WAY FORWARD

- **Conservation and Habitat Protection:** Establish and expand protected areas, and implement effective management practices for long-term viability.
- **Sustainable Land and Resource Use:** Promote sustainable practices in agriculture, forestry, and fishing to minimise habitat destruction and overexploitation.
- **Climate Change Mitigation and Adaptation:** Reduce greenhouse gas emissions, limit global warming, and enhance ecosystem resilience to climate change.
- **Integrated Policy and Holistic Approach:** Integrate biodiversity considerations into land-use planning and decision-making processes, enforcing strict regulations, and embracing the One Health concept to include all living organisms and invisible biota into conservation efforts, supported by research and monitoring.

COMMITTEES AND COMMISSIONS

- **Madhav Gadgil in 2010:** Eco sensitive zones- The Ministry of Environment & Forests had constituted the Western Ghats Ecology Expert Panel (WGEEP) under the Chairmanship of Prof Madhav Gadgil in 2010.
- **Kasturirangan Committee 2015:** On conservation of Western Ghats.
- **Shailesh Nayak Committee 2015:** On Coastal Regulation Zone.

BIOLOGICAL DIVERSITY (AMENDMENT) ACT, 2023

This Act amends the Biological Diversity Act of 2002, which was enacted in India to help preserve biological diversity. It also helps India fulfill its obligations under the Convention on Biological Diversity (CBD).

The amendment in 2023 aims to streamline processes related to the use of biological resources, promote research and the use of traditional Indian medicine systems, and reduce burdens on stakeholders.

Key Changes Made by the Amendment:

- **Faster Research and Patent Processes:** The amendment simplifies and speeds up the process of research and obtaining patents related to biological resources in India. This aims to encourage more innovation in the field.
- **Promoting AYUSH Systems of Medicine:** The amendment removes some hurdles for registered AYUSH medical practitioners (practitioners of traditional India medicine like Ayurveda, Yoga, Unani, Siddha, and Homeopathy) and the traditional knowledge holders while using biological resources.
- **Decriminalization:** The amendment decriminalizes certain minor offenses under the original Act.
- **Exemption for Codified Traditional Knowledge:** Users of "codified traditional knowledge" (knowledge documented in ancient texts) are exempted from certain requirements under the Act.
- **Focus on Cultivating Medicinal Plants:** It promotes the cultivation of medicinal plants, reducing collection pressure on wild populations.
- **Powers & Functions of NBA/SBB:**
  - The amendments to Section 7 have conferred authority upon the State Biodiversity Boards (SBBs), compelling Indian entities to fulfill Access and Benefit Sharing (ABS) fees.
  - The transfer of biological resources or associated knowledge no longer necessitates dual approval for research results. However, the requirement for prior approval persists when transferring research results.
- **Approval for IPR:** Approval is required from foreign entities before they can acquire intellectual property rights (IPR) related to Indian biological resources. On the other hand, Indian entities only need to undergo registration

with the National Biodiversity Authority (NBA). However, if these entities plan to commercialize the IPR, prior approval from the NBA becomes mandatory.

The Biological Diversity Act, 2002, plays a vital role in safeguarding India's biodiversity and ensuring its sustainable utilization. However, ongoing discussions and efforts are crucial to address challenges and ensure its effectiveness in achieving its objectives in the long run.

COP 15 OF CONVENTION ON BIOLOGICAL DIVERSITY

The **15th Conference of Parties (COP15) to the UN Convention on Biological Diversity (CBD)** adopted the **Kunming-Montreal Global Biodiversity Framework (GBF) 2022.**

HIGHLIGHTS OF COP 15 OF CONVENTION ON BIOLOGICAL DIVERSITY

- **Global Biodiversity Framework**: The COP 15 global biodiversity framework sets targets such as protecting 30% of land and sea areas and reducing chemical pesticide and fertilizer use by 50% by 2030.
- **Four overarching goals for 2050:**
  - Halt human-induced species extinction
  - Sustainable use of biodiversity
  - Equitable sharing of benefits
  - Closing the biodiversity finance gap of $700 billion per year
- **Addressing Biodiversity Loss**: The conference of COP 15 acknowledged the drivers of biodiversity loss, including habitat destruction, overexploitation, and climate change, emphasizing the need to protect and restore biodiversity for sustainable production and consumption.
- **Financial Resources**: It stressed financial mobilization for biodiversity conservation, calling for increased funding, investment, and private sector involvement.
- **Indigenous People and Local Communities**: COP 15 valued indigenous people and local communities, stressing their crucial role in biodiversity conservation through rights, knowledge, and active engagement.
- **Fair and Equitable Sharing of Benefits**: It also emphasized fair benefit sharing from genetic resources, respecting indigenous rights and ensuring equitable distribution of biodiversity benefits.

About Global Biodiversity Framework Fund (GBFF)

- **Purpose :** To finance the implementation of Kunming-Montreal Global Biodiversity Framework (GBF).
- **Focus Areas under Funds:**
  - **Indigenous Communities:** As much as 20% of the funds would support Indigenous-led initiatives to protect and conserve biodiversity.
  - **Support for Small Island Developing States and Least Developed Countries,** which will receive more than a third of the fund's resources.

INDIGENOUS PEOPLE AND FOREST CONSERVATION

According to the UN, Indigenous Peoples are inheritors and practitioners of unique cultures and ways of relating to people and the environment. They have sustained cultural, social, political and economic characteristics that are distinct from those of the dominant societies in which they live.

ISSUES OF THE INDIGENOUS PEOPLE

- **Disruption After Designation of the Status of World Heritage Site**: After designation of World Heritage Site indigenous people became away from their natural habitats.
- **Lax implementation of the Forest Rights Act:** Many states in India have a dismal record in implementing the Forest Rights Act (FRA).
- **Development vs Conservation**: Often, the land claimed by Indigenous people has been snatched away for building dams, mining, laying railway lines and roads, power plants, etc.
- **Illegal Encroachment of Land**: According to the government records more than three lakh hectare of reserved forest land is under encroachment.

ROLE OF INDIGENOUS PEOPLE IN FOREST CONSERVATION

- **Conserving natural flora**: The magico-religious belief of plants' tribal communities as a god and goddess habitat leads to their conservation in their natural habitat.

- **Application of Traditional Knowledge**: Indigenous people and biodiversity complement each other. Over time, the rural communities have gathered a pool of indigenous knowledge for the cultivation of medicinal plants and their propagation.
- **Conserving the Sacred Groves**: India's ethnic people have played a vital role in preserving the biodiversity of several virgin forests and have conserved flora and fauna in sacred groves of tribals.
- **Sustaining Biodiversity:** Their way of life which is in harmony with nature makes it a sustainable way of living.

<table>
<tr><td colspan="1">CASE STUDY (AKA TRIBES OF ARUNACHAL PRADESH)</td></tr>
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- The indigenous knowledge system of the Akas is beneficial for preserving the forest's resources. Not all plant species are taken out of the forests.
- In a similar way, these folks do not kill or consume certain animals. The young and pregnant animals in the forests are spared. Certain plants' young saplings are left alone.
- From the neighbouring forests, only plant components that are necessary are taken.
- As a result, these individuals have established an environmentally beneficial relationship with the local forest ecology.

WAY FORWARD

- **Recognition of the Rights of the Indigenous People**: To preserve the rich biodiversity of the region.
- **Effective Implementation of the FRA**: Through effective trust building between its agencies working in the area and the indigenous people by treating them as equal citizens like everyone else in the country.
- **Traditional Knowledge of the Tribal People for Conservation**: The **Biodiversity Act, of 2002** mentions the equitable sharing of the benefits arising out of the use and knowledge of biological resources with the local communities.

The maintenance of a forest's natural resources, which are advantageous to both people and the environment, is known as the conservation of forests. As a result, there is a need for public awareness through a variety of measures for the protection of forests and awareness of people, which is essential for sustaining an environment that is in a proper state of balance.

FOREST CONSERVATION

- Forest conservation is the **practice of planning and maintaining forested areas** for the benefit and sustainability of future generations. Forest conservation involves the upkeep of the natural resources within a forest that is beneficial for both humans and the ecosystem.
- The **forest cover is defined** as 'All land more than one hectare in area, with a tree canopy density of more than 10% irrespective of ownership and legal status'

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<tr><td>FACT-WISE</td></tr>
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- As per **India State of Forest Report 2021,** the total forest and tree cover in India is 80.9 million hectares, which is **24.62%** of the geographical area of the country.
- **Case Study**: Deforestation and destruction of wetlands are among the leading causes of annual floods in heavily urbanized areas in Kerala and the cities of Mumbai and Chennai.
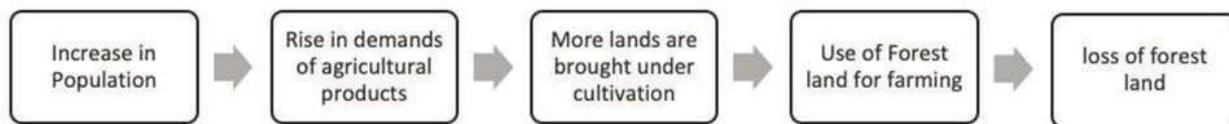
BENEFITS OF FOREST CONSERVATION

- **Forest restoration is a crucial climate mitigation strategy:** They regulate ecosystems, protect biodiversity, and play an integral part in the carbon cycle.
- **Ecosystem services:** Encompass a range of vital functions, including preventing soil erosion, purifying water and air, replenishing groundwater, regulating the microclimate, supporting recreational activities, and acting as a buffer during natural disasters such as floods.
- **Habitats for biodiversity and livelihood for humans:** Forests are home to 80% of the world's terrestrial biodiversity and provide livelihoods for millions, including indigenous peoples.
- **Carbon storehouses:** After oceans, forests are the world's largest storehouses of carbon, providing critical ecosystem services.
- **Water purification:** Forests act as "living filters" for rivers and streams, reducing pollutants and absorbing sediments.

- **Economic importance:** Forests provide jobs for over 13 million people globally and support more than 1 billion rural people for food and livelihoods.

> **KEYWORDS:** Living filters; Unmatched biodiversity; Forest restoration; Habitats for biodiversity and livelihood for humans; storehouses of carbon; Reduces the ambient temperature; Purifies the air; Ambient noise; Healing environment; Rainwater buffer; Land use and rapid exploitation; Conversion to agriculture; Habitat loss; Sacred grooves; Shifting cultivation; Community Forest Rights.

THREATS TO FORESTS

Natural Threats	• **Forest Fire, Climate Change, Invasive Species, Floods, Landslides, Plant Diseases, Insects and Pests**
Anthropogenic Threats	• **Land Use And Rapid Exploitation:** Since 1850, roughly 35% of anthropogenic CO2 emissions resulted directly from land use changes, especially from forest conversions. • **Pollution:** Like most of the countries, India is also struggling with the quantities of plastic waste generated by humans which poses a serious threat to the forests. • **Shifting Cultivation Practice:** Such as slash and burn agriculture and are responsible for clearing approx. 5 lakh hectares of forests annually. • **Developmental Projects:** Like hydroelectric projects, dam construction, mining activities, etc., result in massive destruction of forests. • **Increasing Population:** High demand for fuelwood and food due to increasing population creates pressure on forest resources. • **Urbanization:** The rapid establishment of industries and urban cities is another reason for increased demand and leads towards deforestation.

Increase in Population → Rise in demands of agricultural products → More lands are brought under cultivation → Use of Forest land for farming → loss of forest land

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CONSTITUTIONAL AND OTHER MANDATE

- **Seventh Schedule**: The 42nd Amendment to the Indian Constitution of 1976 moved forests from the State List to the Concurrent List of the Constitution.
- **SDG 15**: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.

CONSEQUENCES OF LOSS OF FORESTS
- **Impact on Water Cycle:** About 30% of the world's freshwater supply is provided by tropical rainforests. Deforestation reduces the moisture released into the atmosphere, causing rainfall to decrease.
- **Impact on Biodiversity:** Every year, deforestation causes the extinction of some 50,000 species of animals, plants, and insects. Studies show that by the end of the twenty-first century, about 40% of Southeast Asia's plant and animal species will be extinct.
- **Economic Impact:** Some studies predict that by 2050, deforestation and other factors will have reduced the global GDP by 7%.
- **Impact on Human Health:** Directly or indirectly, deforestation can serve as a conduit for the spread of a variety of infectious diseases. Due to close proximity, the **Nipah virus** spread from fruit bats to pigs and eventually to humans.
- **Other Impact:**
  - **Loss of Habitat**: Impacting wildlife as 70% of land animals and plant species live in forests.
  - **Temperature Variations**: Loss of forest causes drastic temperature variation from day to night, much like a desert, which can be fatal for many species in forest.

- o **Increased Greenhouse Gases**: In addition to the loss of habitat, the lack of trees also allows a greater amount of greenhouse gases to be released into the atmosphere.
- o **Soil Erosion and Flooding**: Without forests, the soil erodes and washes away, causing increased soil erosion and flooding.
- o **Loss of Net Present Value**: It is a mandatory one-time payment that a user has to make for diverting forestland for non-forest use, under the Forest (Conservation) Act, 1980.

EFFORTS TO CONSERVE AND PROTECT FOREST

NATIONAL LEVEL:

- **Indian Forest Policy, 1952:** The colonial forest strategy, which recognised the need to grow forest cover to one-third of the total land area, was only extended in this way.
- **Forest Conservation Act 1980:** This Act made it clear that carrying out sustainable agroforestry in forest regions requires central authorization. A violation or absence of a permit was considered a crime.
- **Forest Policy of 1988:** Focusing on the ecological importance of the woods and participatory management, it marked a very big and categorical shift away from economic concerns.
- **National Green Tribunal Act, 2010:** This was done in order to quickly and effectively resolve cases involving environmental protection, the preservation of forests and other natural resources, as well as the enforcement of any environmental legal rights.
- **Compensatory Afforestation Fund Act, 2016:** In order to minimize the effects of diverting such forest land, it seeks to provide an appropriate institutional mechanism at the Centre as well as in each State and Union Territory to ensure prompt utilization of funds in an effective and transparent manner in lieu of such diverted forest land.

INTERNATIONAL LEVEL:

- **United Nations Conference on Environment and Development (1992):**
  - o **Rio Declaration on Environment and Development:** It contained 27 principles that were supposed to guide countries in future sustainable development.
  - o **Agenda 21:** It is an action plan concerning sustainable development, but it is non-binding.
  - o **Forest Principles:** It makes many recommendations for the conservation and sustainable development of forestry and is non-binding.
- **Convention on Biological Diversity (CBD) 1992:** It is a step towards conserving biological diversity or biodiversity with the involvement of the entire world.
- **Forest Conservation Programme (FCP):** The goal of the FCP is to maintain and restore forest ecosystems (where necessary) to promote conservation, sustainable management, and equitable distribution of the full range of forest goods and services.
- **Bonn Challenge:** It is a global effort to bring 150 million hectares of the world's deforested and degraded land into restoration by 2020, and 350 million hectares by 2030.
- **Other:** REDD, REDD+, Forest Carbon Partnership Facility, etc.

WAY FORWARD

- **Protected Areas**: Wild Life (Protection) Act provides better protection to wildlife, including threatened species and their habitat.
- **Promoting Social Forestry**: It makes use of fallow and underutilized land to meet the needs of feed and fuelwood while protecting deeper forests from exploitation.
- **Promoting Agro Forestry:** Agroforestry systems, like new forests, can greatly aid in recovering the carbon that has been lost owing to the clearing of forests
- **Reforestation and Afforestation**: The "sustained yield concept" dictates that whenever timber is removed, either by block cutting or by selective cutting, the denuded area must be reforested.

INDIA STATE OF FOREST REPORT (ISFR) 2021

Key Findings:
- **T**he Total Forest and Tree cover is 24.62% of the geographical area of the country: The Total Forest cover is 7,13,789 sq km which is 21.71% of the geographical area of the country. The Tree cover is 2.91% of the geographical area of the country.
- **Trees Outside Forests (TOF):** TOF: 29.29 million hectares (36.18% of the total forest and tree cover of India). States having the largest extent of TOF: Maharashtra followed by Odisha and Karnataka.

- **The top five states in terms of increase in forest cover**: Andhra Pradesh> Telangana> Odisha> Karnataka> Jharkhand. **Largest forest cover in India:** Madhya Pradesh > Arunachal Pradesh > Chhattisgarh > Odisha > Maharashtra
- The states from the Northeastern region of the country have the highest percentage of forest cover w.r.t. total geographical area of the state. Mizoram (84.53%) > Arunachal Pradesh (79.33%) > Meghalaya (76.00%) > Manipur (74.34%) > Nagaland (73.90%).
- Forest cover in the hill districts is 40.17% of the total geographical area of these districts. A decrease of 902 sq km (0.32%) in 140 hill districts of the country.
- The total forest cover in the tribal districts is 37.53% of the geographical area of these districts.
- The total forest cover in the North-Eastern region is 64.66% of its geographical area. The current assessment shows a decrease in forest cover to the extent of 1,020 sq km (0.60%) in the region.
- **Total Carbon Stock:** The total carbon stock in forests is estimated as 7,204.0 million tonnes an increase of 79.4 million tonnes since 2019.
- **Forest Prone to Fire:** The analysis reveals that 22.27% of the forest cover is prone to a forest fire.
- **Bamboo Forests:** The total bamboo-bearing area of the country is estimated as 1,49,443 sq km. There is a decrease of 10,594 sq km in the bamboo-bearing area as compared to the estimate of ISFR 2019.

THE FOREST (CONSERVATION) AMENDMENT ACT 2023

The Act amends the Forest (Conservation) Act of 1980 to extend its applicability to specific categories of land. This encompasses land officially designated as a forest under the Indian Forest Act of 1927 or documented as such in government records following the enactment of the 1980 Act.

KEY FEATURES
- **Land under the purview of the Act:**
  o Forest land declared/notified under the Indian Forest Act, 1927, or any other law.
  o Land notified as a forest on or after October 25, 1980, in a government record.
  o Excludes land changed from forest use to non-forest use before December 12, 1996, by authorized state/UT authorities.
- **Exempted categories of land:**
  o Exempts specific types of forest land, such as those along rail lines or public roads, roadside amenities (up to 0.10 hectare).
  o Exempts forest land within 100 km from international borders, Line of Control, or Line of Actual Control for strategic projects.
  o Exempts land (up to 10 hectares) for security-related infrastructure or defense projects.
  o Exempts land proposed for defense projects, paramilitary camps, or public utility projects (up to five hectares) in left-wing extremism affected areas.
- **Assignment/leasing of forest land:**
  o Requires prior approval from the central government for state governments to assign forest land to any entity (including government-owned and controlled entities).
  o The central government sets specific conditions that must be met for approval.
- **Permitted activities in forest land:**
  o Forest land de-reservation or non-forest use is prohibited without prior approval from the central government.
  o Recognizes particular exempted actions intended for non-forest purposes, including conservation, administration, and development endeavors.
  o The Bill adds activities like zoos, safaris, ecotourism facilities, silvicultural operations, and others to the list.
  o The central government has the authority to define terms and conditions in order to designate certain surveys as not falling under the category of non-forest purposes.
- **Power to issue directions:**
  o Authorizes the central government to provide directives for the execution of the Act to any authority or organization affiliated with or acknowledged by the central, state, or union territory.

CHALLENGES
- Centralization of power in the Forest Clearance Act has led to bureaucratic delays, corruption, and accountability issues, as authority shifted from states to the central government.
- The Act overlooks the rights of local communities, particularly tribal and forest-dwelling people, who rely on forests for their livelihood and cultural practices.

- The Act fails to address root causes of deforestation like population pressure, poverty, landlessness, and unsustainable development, neglecting ecological and social aspects of conservation.
- Emphasis on quantity over quality of forest cover results in insufficient focus on regeneration and restoration of degraded forests.
- Misinterpretation and misuse of the Act by various stakeholders, including the forest department, industry, judiciary, and civil society, has led to justifying encroachment and exploitation of forest land.
- Legal conflicts and uncertainties arise from challenges to the Act by environmental activists and affected communities in the courts.

WAY FORWARD

- Decentralize and democratize forest governance through involvement of state governments, local bodies, and community institutions.
- Recognize and respect customary and statutory rights of forest-dependent people, ensuring their participation and benefit-sharing in conservation.
- Address socio-economic and environmental drivers of deforestation with a holistic approach.
- Establish clear criteria and guidelines for forest land diversion, ensuring compliance and enforcement.

The **Forest (Conservation) Act, 1980,** plays a crucial role in balancing the needs of development with the imperative of forest conservation. It reflects the recognition of the ecological importance of forests and the need to ensure sustainable development practices to protect the environment and biodiversity.

Supreme Court's Interim order on Forest Conservation (Amendment) Act, 2023

The Supreme Court (SC) recently directed the Government to follow the definition of "forest" as laid down in the 1996 judgment in T.N Godavarman Thirumulapad v. Union of India.

- **T N Godavarman Case (1996):** Definition of "forest" expanded to include:
  - All areas recorded as "forest" in any government (Union and State) record, irrespective of ownership, recognition, and classification.
  - All areas conforming to the "dictionary" meaning of forest.
  - Areas identified as "forest" by expert committees set up by State governments following the 1996 order.
- **Forest Conservation (Amendment) (FCA) Act, 2023:** Specified forest land as:
  - Land declared/notified as a forest under the Indian Forest Act, 1927 or other laws.
  - Land recorded in Government records as forest, on or after 1980.
  - Excludes land officially changed from forest use to non-forest use on or before 1996.
- **Van (Sanrakshan Evam Samvardhan) Rules, 2023:** Rule 16 mandates State Governments/UT Administrations to prepare a consolidated record of lands falling under the provisions of the Forest Conservation (Amendment) (FCA) Act, 2023, within one year. This includes forest-like areas identified by Expert Committees, unclassed forest lands, or community forest lands.

CONSERVATION OF WESTERN GHATS

The Western Ghats, stretching across six States in India, is home to many endangered plants and animals, and is designated as a UNESCO World Heritage site.

The Western Ghats are vital for hydrological functions, influencing monsoon patterns, mitigating climate change through CO2 sequestration, and supporting forest-based industries and tourism.

FACTWISE

- **Species Diversity**: Home to an estimated 5,000 species of flowering plants, 508 bird species, and 139 mammal species.
- **Endemism**: Around 30% of flowering plant species, 77% of amphibian species and 66% of reptile species in the Western Ghats are endemic, found nowhere else on Earth.
- **Degradation**: According to a recent study by the Indian Space Research Organisation, the Western Ghats has experienced a loss of 35% of its forest cover over the last 90 years.

THREATS TO THE WESTERN GHATS

- **Threats Related To Mining:**
  - o **Demand For Iron Ore**: With a steep increase in iron ore prices and demand for lower grade ores, mining activities have grown rapidly especially in Goa and often in violation of all laws, resulting in serious environmental damage and social disruption.
  - o **Sand Mining**: it has emerged as a major threat in Kerala. Unsustainable mining has increased vulnerability to landslides, and damaged water sources and agriculture, thus negatively affecting the livelihoods of the people living in those areas.
- **Livestock grazing:** High densities of livestock (cattle and goats) grazing within and bordering protected areas is a serious problem that is causing habitat degradation throughout the Western Ghats.
- **Plantations**: Plantations owned by private individuals and the corporate sector continue to grow in the Western Ghats and constitute an important source of fragmentation of natural habitat.
- **Climate Change**: The changes in land use and deforestation have led to big variations in the duration and intensity of rainfalls. Climate change has been considered a cause of floods in many regions in the recent past.

WAY FORWARD

- **Policy Change**: There is a need for policy changes that promote better management of human-wildlife conflict, financial incentives to encourage environmentally conscious farming and other incentive schemes such as payments for ecosystem services.
  - o **Land Use Policy And Law Enforcement**: It should ensure that illegal hunting, deforestation, land-use change and other human activities that contribute to livelihoods but hamper biodiversity conservation are kept in check.
- **Balance of Efforts**: A balance between conservation efforts and development should be sought and concerned state governments should come to a consensus for the implementation of ESA in the Western Ghats.
- **Western Ghats Ecology Expert Panel (2011):** Restricting all development activities in high priority ESA 1 category.
  - o Madhav Gadgil Committee recommended that all of the Western Ghats be declared as the Ecological Sensitive Areas (ESA) with only limited development allowed in graded zones.
- **Implementing The Recommendations Of The Kasturirangan Committee (2012):**
  - o **Bring area under ESA**: Instead of the total area of Western Ghats, only 37% of the total area is to be brought under ESA.
  - o **Complete Ban**: On projects of mining, quarrying and sand mining in ESA.
  - o **No Thermal Power Projects**: To be allowed and hydropower projects are allowed only after a detailed study.

The Western Ghats face challenges such as deforestation and habitat loss, but they hold immense importance as a global biodiversity hotspot. Conservation and sustainable management are crucial for preserving the Western Ghats' ecological integrity and the well-being of nature and people.

INDIAN FOREST & WOOD CERTIFICATION SCHEME (IFWCS)

MoEFCC launched Indian Forest & Wood Certification Scheme (IFWCS)

- **Purpose: IFWCS is the National forest certification scheme of India,** aimed at promoting Sustainable Forest Management and sustainable management of Trees outside Forests (TOF) across the country.
- **Voluntary Certification:** It offers voluntary third-party certification.
- **Applicability:** IFWCS is applicable nationwide, covering forest areas and TOF plantations on government, private, agroforestry, and other lands.
- **Incentives:** Provides market incentives to entities, including state forest departments, individual farmers, or Farmer Producer Organizations, that adhere to responsible forest management and agroforestry practices.
- **Certification Types:** Offers three types of certification: Forest management certification, TOF management certification, and Chain of Custody Certification (for traceability of forest products).
- **Criteria:** Forest Management certification is based on the Indian Forest Management Standard, consisting of 8 criteria, integrated into the National Working Plan Code 2023.

MANGROVES

Mangroves are **salt-tolerant vegetation** that grows in intertidal regions of rivers and estuaries. They are referred to as 'tidal forests' and belong to the category of 'tropical wetland rainforest ecosystem'. **Globally Mangrove forests** occupy around 2,00,000 square kilometres across the globe in tropical regions of 30 countries.

FACT-WISE

- The **2021 Forest Survey Report (FSR)** estimates that 4,992 square kilometres of land in India are covered by mangroves.
- Mangrove covers **0.15 percent of total geographical area.**
- Over the past century, the nation lost 40% of its mangrove cover. According to a research, Kerala, for example, has lost 95% of its mangroves during the past three decades.

IMPORTANCE OF MANGROVES

- **Edge Effect:** Mangroves exhibit high species diversity at the interface of different habitats and serve as habitat and nursery for over 3000 fish species.
- **Carbon Sequestration:** Mangroves play a significant role in capturing and storing carbon.
- **Ecological Niches:** Mangroves provide feeding, breeding, and nursery grounds for a wide variety of organisms. They support fisheries and provide timber and fuel resources.
- **Water Filtration and Purification:** Mangroves act as natural filters, purifying water as it flows from rivers and floodplains into the ocean. This filtration helps protect coastal ecology, including coral reefs.
- **Employment Benefits:** Mangroves offer numerous employment opportunities to local communities, serving as a valued source of timber and fuel and supporting livelihoods in sectors like fisheries and tourism.
- **Shock Absorption:** Mangroves reduce the impact of high tides and waves, protecting shorelines from erosion and helping minimize the damage caused by disasters such as cyclones and tsunamis.

CAUSES OF DEPLETION OF MANGROVES

- **Sea Level Rise And Coastal Erosion**: Due to global warming, sea levels are continuously rising. The rising sea levels have flooded large areas of mangrove forests. This has resulted in their depletion.
- **Reduction In River Water Levels**: The mangroves are more prevalent in areas where the rivers meet the sea. The system requires a fine balance between salt and sweet water to survive.
- **Invasion By Alien Species**: The introduction of non-native and alien species of plants and animals is causing a threat to the endemic species of the region.
- **Damming Of Rivers**: Dams built over the river courses reduce the amount of water and sediments reaching mangrove forests, altering their salinity level.
- **Pollution**: Mangroves also face severe threats due to fertilisers, pesticides, discharge of domestic sewage and industrial effluents carried down by the river systems.
- **Climate Change**: Unusually low rainfall and very high sea surface and air temperatures caused severe threats to the survival of mangrove forests.

EFFORTS TAKEN TO PROTECT THESE MANGROVES

- **MISHTI Scheme: Budget 2023-24** announced the **MISHTI, or "Mangrove Initiative for Shoreline Habitats & Tangible Incomes,"** which aims at mangrove plantation along the coastline and on salt pan lands.
- **National Coastal Mission Programme:** Central Sector Scheme under National Coastal Mission Programme on Conservation and Management of Mangroves and Coral Reefs
- **SAIME Initiative:** Under Sustainable Aquaculture In Mangrove Ecosystem (SAIME) initiative, farmers are planting mangrove trees around shrimp ponds in West Bengal.
- **Global Mangrove Alliance (GMA):** India joined the Global Mangrove Alliance during COP 27. It aims for doubling mangrove coverage over existing levels by 2030.
- **Mangroves for the Future (MFF):** IUCN and the United Nations Development Programme (UNDP) are the co-chairs of the initiative. According to reports, the organisation is "doing gender-integrated mangrove restoration and sustainable development initiatives in numerous Asian countries.
- **Blue Carbon Initiative**: The International Blue Carbon Initiative is focused on mitigating climate change through the conservation and restoration of coastal and marine ecosystems.

- **International Society for Mangrove Ecosystem (ISME)**: The ISME is a non-governmental organization established in 1990 to promote the study of mangroves with the purpose of enhancing their conservation, rational management and sustainable utilization.

CASE STUDY

- Another excellent example is the restoration of the mangroves in Guyana. In their initiatives to strengthen Guyana's beaches' resistance to flooding and coastal erosion, women took the lead in a major way.
- A woman-led volunteer group for mangrove awareness and restoration as well as the "Mangrove Cooperative Society" to assist other women with training and resources on endeavours like beekeeping were both founded as a result of the active participation of women.

WAY FORWARD
- **Systematic and periodic environmental monitoring of existing mangroves**: There should be documentation of various faunal species dependent on these forests.
- **Use of bio-restoration to revive degraded stretches of mangroves**: These techniques help maintain the original biodiversity. Ecological restoration revives the mangroves at a faster rate than natural regeneration.
- **Community participation for conservation and management**: Communities dependent on these forests can be supported to take up alternative economic activities to increase the sustainable use of these mangroves. E.g.: Bon Bibi is a forest goddess worshiped by people of different faiths (Hindus & Muslims) in the Sundarbans.

CORAL REEFS

Coral reefs are underwater plants composed of the skeletons of colonial marine invertebrates called coral. Coral reefs are **one of the most biologically diverse marine ecosystems** on the Earth. Coral reefs play an important role in marine ecosystems and **support the habitats** of flora and fauna in the sea.

GROWTH CONDITIONS FOR CORAL REEFS
- **Temperature of water**: The temperature of the water should not be below 20°C. The most favourable temperature for the growth of the coral reefs is between 23°C to 25°C.
- **Saline condition**: Corals can survive only under saline conditions with an average salinity between 27%. to 40%.
- **Shallow water**: Coral reefs grow better in shallow water having a depth less than 50 m. The depth of the water should not exceed 200m.

IMPORTANCE OF CORAL REEFS
- **Biodiversity Hub:** Coral reefs sustain biodiversity, functioning as the ocean's counterpart to tropical rainforests, supporting thousands of species and enhancing biological productivity.
- **Habitat and Nutrition Source:** Coral reefs serve as vital habitats for marine organisms, providing shelter and nutrients essential for marine food chains and assisting in carbon and nitrogen fixation.
- **Economic Engine:** Coral reefs contribute significantly to the economy, generating billions of dollars annually through fishing and tourism industries, such as the Great Barrier Reef's contribution of over $1.5 billion to the Australian economy yearly.
- **Climate Record Keepers:** They offer a historical climate record, reflecting past environmental conditions, and aiding in the understanding of long-term climate change and seasonal variability in remote tropical oceans.
- **Natural Disaster Buffer:** Coral reef structures act as buffers, absorbing energy from waves and storms, mitigating damage to coastlines, preventing erosion, and reducing the impact of natural disasters on coastal communities.

FACTORS AFFECTING CORAL REEFS
- **Climate Impact:** Rising ocean temperatures threaten coral reefs globally, causing widespread decline due to coral bleaching and increased susceptibility to disease.
- **Overfishing:** Ecological imbalance arises from overfishing, disrupting the delicate marine ecosystem supported by coral reefs.
- **Coastal Development:** Construction of infrastructure and tourist resorts near coral reefs damages their delicate structure and ecosystem.
- **Pollution:** Direct dumping of pollutants elevates nitrogen levels in seawater, leading to algae overgrowth and poisoning of coral reefs.

- **Sedimentation:** Soil erosion from coastal development increases sedimentation in rivers, smothering corals by depriving them of essential light.
- **Invasive Species Threat:** Snowflake coral **(Carijoa Riisei)** poses a new threat to coral reef biodiversity, discovered off the coasts of Thiruvananthapuram and Kanyakumari, further exacerbating existing challenges.

FACT-WISE

- According to **Global Coral Reef Monitoring Network (GCRMN) report** in the last decade, the **world lost about 14 per cent of its coral reefs.**
- **IPCC** has predicted that global coral reefs would **decline by 70-90%** with global warming of 1.5°C by 2100 and go extinct, if it is 2°C or higher.
- **UN Report: The United Nations has reported that:**
  - 70% of the Earth's coral reefs are threatened,
  - 20% have been destroyed with no hope for recovery,
  - 24% are under imminent risk of collapse, and,
  - An additional 26% are at risk due to longer-term threats.
- The **TamilNadu Climate Summit 2.0** released a study report titled "Coral Reefs of the Gulf of Mannar: Decadal Changes in Status and Management Paradigms," highlighting a decline in live coral cover from 37% in 2005 to 27.3% in 2021.

METHODS OF CORAL RESTORATION

- **Biological restoration:** Biological restoration uses various methods involving coral growth and transplanting to assist in the restoration of a coral reef.
- **Structural restoration:** Structural restoration generally involves the construction of artificial reefs, sinking of wrecks, or relocation of rocks/dead coral heads.
- **Physical restoration:** Physical restoration involves addressing the conditions in which the corals are growing to improve their health, growth rates, or reproductive ability.

INITIATIVES TO PROTECT CORALS REEFS
- **Global initiatives:**
  - **International Coral Reef Initiative**: The International Coral Reef Initiative (ICRI) is an informal partnership between Nations and organizations which strives to preserve coral reefs and related ecosystems around the world.
  - **Coral Reef Breakthrough Initiative:** Launched by ICRI, the initiative aims to conserve, protect, and restore at least 125,000 km2 of shallow-water tropical coral reefs by 2030, with investments totaling USD 12 billion. This effort targets the resilience of over half a billion people globally.
  - **Global Coral Reef Monitoring Network (GCRMN):** It works through a global network of researchers to provide the best available scientific information on the health of coral reef ecosystems, for their conservation and management.
  - **Global Coral Reef Alliance (GCRA)**: GCRA is a worldwide coalition of volunteer scientists, divers, environmentalists and other individuals and organizations, committed to coral reef preservation.
  - **The Global Coral Reef R&D Accelerator Platform**: will advance the next generation of science and technology needed to secure a future for coral reefs in the face of climate change and other pressures.
- **National initiatives:**
  - **Mineral accretion technology**: In India, the Zoological Survey of India (ZSI), with help from Gujarat's Forest department, is attempting a process to restore coral reefs using "biorock" or mineral accretion technology.
  - **National Coastal Mission Programme**: It is to protect and sustain coral reefs in the country.
  - **Coastal Regulation Zone (CRZ) Protection**: Under the CRZ of 1991, all marine resources, including coral reefs, receive protection. CRZ-1 categorisation prohibits the construction of hotels or resorts on the coral reefs.
  - **Government oversight:** MoEFCC ensures adherence to guidelines and laws aimed at protecting coral reefs. Additionally, the State Wildlife department takes charge of coral care within protected areas located in coral reef regions.

CORAL BLEACHING

When the relationship between the marine algae that serve as the coral host and are a major source of the coral's colour breaks down coral bleaching results. A typical stress reaction of corals to several of the many stresses outlined above is coral reef bleaching. has released a report on the status of **coral reefs** across the world.

REASONS FOR CORAL BLEACHING

- **Rising Sea Temperature & El Nino**: Elevated ocean temperatures, particularly during El Nino events, harm corals by inducing bleaching and reef destruction.
- **Ocean Acidification:** Increased acidity in seawater impedes coral growth by affecting the formation of their calcareous skeletons.
- **Solar and Ultraviolet Radiation:** Changes in weather patterns lead to coral bleaching due to reduced cloud cover and increased radiation exposure.
- **Infectious Diseases:** Bacteria like vibrio shiloi thrive in warmer waters, hindering coral photosynthesis and causing further damage.
- **Chemical Pollution & Sedimentation:** Nutrient runoff fuels phytoplankton growth, leading to competition for space with corals, while sedimentation reduces light availability, hampering coral photosynthesis and growth.
- **Human-Induced Threats:** Overfishing, industrial pollution, coral mining, and coastal development exacerbate coral reef degradation, compounding natural stressors.

IMPACT OF CORAL BLEACHING

- **Affect the Food Chain:** Changes in coral ecosystems may have an impact on animals that rely on them, including fish and invertebrates that use living coral for food and refuge. Such marine animal losses could have an impact on the entire food chain.
- **Loss of Biodiversity:** When corals die as a result of bleaching, there may be declines in genetic and species diversity.
- **A Deterioration In The Economy:** Divers and other tourists are drawn to healthy coral reefs. Reefs that have been bleached and deteriorated may deter visitors, which could hurt the local economy.
- **Affects Food Availability:** Coral bleaching can significantly alter fish ecosystems, which has an impact on the availability of food. Fishing can suffer as a result, which can have an effect on the availability of food and related economic activity.
- **Impact on Coastal Protection:** By continuously absorbing wave energy from the ocean, coral reefs shield coasts from erosion and flooding as well as enhanced storm damage.

DETERIORATING GREAT BARRIER REEF

- UNESCO had recommended that its World Heritage Committee add the world's largest coral reef ecosystem in the northeast Australian coast to the World Heritage in Danger list, mainly because of rising ocean temperatures.
- **Concerns:**
  - **Rising Sea Temperature**: Coral along large swathes of the 2,300-kilometre reef has been killed by rising sea temperatures linked to climate change, leaving behind skeletal remains in a process known as coral bleaching.
  - **Coral Bleaching**: When corals face stress by changes in conditions such as temperature, light, or nutrients, they expel the symbiotic algae zooxanthellae living in their tissues, causing them to turn completely white.
  - **Australian Status Change**: In August 2019, Australia downgraded its long-term outlook to "Very Poor" for the first time and there are high chances that it will be considered for the List of World Heritage in Danger.

WAY FORWARD

- **Global Climate Action:** Prioritize efforts to limit warming in line with COP 21 goals to safeguard coral reefs.
- **Social Movement Formation:** Foster a prominent movement to alter societal behaviors toward sustainability and minimize coral reef impacts.
- **Multi-Stakeholder Engagement:** Involve industry leaders, governmental authorities, and financial ministries to educate and broaden the discussion on coral reef preservation.
- **Innovative Solutions:** Pursue interdisciplinary approaches, including scientific, managerial, and policy solutions, to address coral reef challenges and raise awareness.

50 YEARS OF PROJECT TIGER

Project Tiger, launched in 1973, is a flagship conservation program in India aimed at protecting the endangered Bengal tiger. The National Tiger Conservation Authority (NTCA) provides statutory authority to Project Tiger so that compliance of its directives become legal.

Achievements:

- **Increased tiger population:** The **2022 tiger census estimated a national population of 3,682 tigers,** marking a significant increase from 2010 and achieving the ambitious goal of doubling the tiger population from 2000.

- **Established tiger reserves:** Currently, **there are 54 tiger reserves across 18 tiger states,** encompassing over 75,000 km² of habitat.

- **Enhanced anti-poaching measures:** Increased patrolling, improved intelligence gathering, and stricter enforcement laws have helped curb poaching activities.

- **Community involvement:** Eco-development programs have provided alternative livelihoods for communities dependent on forest resources, fostering a sense of ownership and partnership in conservation.

Fig: Achievements of Project Tiger

INTERNATIONAL BIG CAT ALLIANCE (IBCA)

International Big Cat Alliance **was launched during the 50th anniversary celebration of India's Project Tiger** on April 9, 2023. IBCA is a global alliance that aims to conserve the world's seven main big cats: tiger, lion, leopard, snow leopard, puma, jaguar, and cheetah.

Goals:

- Provide a platform for member nations to share knowledge and expertise.
- Support recovery efforts in potential habitats.
- Protect and conserve the seven major big cats.

Benefits:

- **Technical and Financial Support:** Central repository for technical know-how and a corpus of funds.
- **Strengthening Conservation Efforts:** Enhances existing species-specific intergovernmental platforms, networks, and transnational conservation initiatives.
- **Training and Development:** Training frontline staff in member countries to garner local support for big-cat conservation and promoting research and development in wildlife monitoring.
- **Community Engagement**: Encouraging and training local communities near forests to develop eco-tourism and livelihood opportunities.
- **Integration with SDGs:** Recognizes the importance of aligning biodiversity policies with sustainable development goals for holistic conservation outcomes.

	PREVIOUS YEAR QUESTIONS	
1.	Define the concept of the 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
2.	How does biodiversity vary in India? How is the Biological Diversity Act, 2002 helpful in the conservation of flora and fauna?	2018

| 8 | WATER, WETLANDS AND COASTAL CONSERVATION |

"Note: *Read this chapter along with Chapter 9 Water Resources and their Management of Geography PRAHAAR Booklet for more comprehensive understanding."*

Water conservation is a critical global concern, **emphasized by the United Nations SDG 6,** which promotes clean water and sanitation for all. An integral part of this goal involves sustainable management of water resources and ensuring that every drop is used efficiently.

INTRODUCTION

Water Conservation refers to the efficient utilization and management of water resources to minimize unnecessary water usage and ensure the sustainability of freshwater supplies for current and future generations.

Water resource management includes planning, developing, distributing and managing the water resource leading to its optimum use.

FACT-WISE
- 96.5% of the total volume of world's water is estimated to exist as oceans and only 2.5% as freshwater.
- Nearly 70 per cent of this freshwater occurs as ice sheets and glaciers in Antarctica, Greenland and the mountainous region of the world, while a little less than 30% is stored as groundwater in the world's aquifers.
- India receives nearly 4% of the global precipitation and ranks 133 in the world in terms of water availability per person per annum.
    - The total renewable water resources of India are estimated at 1,897 sq km per annum.
    - By 2025, it is predicted that large parts of India will join countries or regions having absolute water scarcity.

Source: The UN World Water Development Report, 2003

SUSTAINABLE DEVELOPMENT GOAL 6

Aims to ensure water availability and sustainable management of water for all by 2030. By definition, this means "leaving no one behind".

Case Study: Bengaluru Water Crisis

The Bengaluru water crisis encompasses the ongoing challenge faced by one of India's largest and fastest-growing cities in ensuring a sustainable and dependable water supply for its residents.
- **Reduced Rainfall Impacting Reservoirs:** The water levels in key reservoirs like Harangi, Hemavathi, and Kabini in the Cauvery Basin stand at 39% of capacity in 2024 due to deficient North-East Monsoon.
- **Natural Water Body Destruction:** Concretization and degradation of natural lakes have diminished storage capacity from 35 tmcft in 1800 to 2 tmcft.
- **Groundwater Depletion:** Overexploitation of groundwater through bore wells and inadequate implementation of rainwater harvesting systems exacerbate the crisis.
- **Mismanagement and Inequitable Distribution:** Inefficient water management practices, including wastage, leaks, and unequal allocation of resources, compound the crisis.

MEASURES TAKEN BY THE GOVERNMENT TO DE-STRESS WATER SCARCITY:

- **Jal Shakti Abhiyan:** The campaign focuses on water conservation and security, emphasizing citizen participation. It targets water-stressed districts and blocks across the country.
    - **Catch the Rain Campaign** under JSA focuses on saving and conserving rainwater.
- **National Water Mission:** The mission focuses on integrated water resources development and management. It aims to increase water use efficiency by 20%.
- **Pradhan Mantri Krishi Sinchay Yojana (PMKSY):** With the motto of **'Har khet ko pani'** (water to every field) and 'More Crop per Drop', PMKSY aims to enhance water use efficiency in agriculture.
- **Jal Jeevan Mission :** Aims to provide 55 liters of potable water per capita per day to every rural household through Functional Household Tap Connections(FHTC) by 2024.

- **Jal Kranti Abhiyan:** This initiative aims to transform villages and cities through block-level water conservation schemes. Its goal is to convert at least one water-scarce village in each district into a water surplus village by adopting holistic conservation and management techniques.
- **Atal Bhujal Yojana:** Geared towards sustainable groundwater management, this scheme encourages community participation in select over-exploited and water-stressed areas.
- **Restructured National Rural Drinking Water Programme:** This program aims to improve piped drinking water coverage in rural areas and elevate the level of service delivery, with a specific focus on addressing water quality issues in affected habitations.

Vision for a Water Sensitive City
A water sensitive city is a livable environment with diverse water sources, ecosystem services, and engaged communities making informed decisions for water conservation and environmental health.

A Water Sensitive City is
Liveable + Resilient + Sustainable + Productive

ENVIRONMENTAL CONCERN OF THE RIVER LINKING PROJECT

- **Change Of Natural Course:** Rivers often change courses. E.g. Teesta was earlier a tributary of Ganga but now is a tributary of Brahmaputra.
  - The local ecosystems along these rivers have adapted to these changes and are accustomed to them.
  - This could render the dams, checks and canals useless.
- **Impact Of Large Construction:** The project envisages many dams, canals and drains which will have a huge impact on the environment and biodiversity. E.g. Ken-Betwa link endangers 8% of the Panna Tiger reserve.
  - We have modified the ecosystems of the rivers to a great extent. This situation will worsen due to climate change, which will further intensify changes in the flow and distribution of species.
- **Impact On Flora:** Plant guilds (ecosystems that help each other's productivity) will perceive the change in the flow of rivers as external stress and may respond accordingly.

WETLANDS CONSERVATION

A wetland is a distinct ecosystem that is flooded or saturated with water, either seasonally or permanently.
Under the **Ramsar International Wetland Conservation Treaty,** wetlands are defined as: "Wetlands are areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water depth of which at low tide does not exceed six meters".

FACT-WISE
• In India there are over 7 lakh wetlands i.e 4.86% of total geographic area of the country.   • 80 wetlands are considered as Wetlands of International importance i.e. Ramsar wetlands. (As of 2024)   • As per Wetlands International, India lost 2 out of 5 wetlands in last 3 decades.

RAMSAR CONVENTION ON WETLANDS:
- The Ramsar Convention, established in 1971, serves as the sole global treaty dedicated to wetland conservation, boasting 169 Contracting Parties and designating 2,234 wetland sites spanning 215 million hectares.
- It addresses the urgent need to combat wetland habitat loss driven by a lack of understanding about their crucial ecological functions.

SIGNIFICANCE OF WETLANDS
- **Climate Change Mitigation And Adaptation**: they have mitigation effects through their ability to sink carbon, and adaptation effects through their ability to store and regulate water.
- **Groundwater Replenishment**: The surface water which is the water visibly seen in wetland systems only represents a portion of the overall water cycle which also includes atmospheric water and groundwater.
- **Flood Control:** They act as a barrier to absorb excess water.
- **Shoreline Stabilization And Storm Protection:** Tidal and intertidal wetlands protect & stabilize coastal zones.
- **Nutrient Retention**: Wetland vegetation uptake and stores nutrients found in the surrounding soil and water.
- **Aquaculture**: Wetlands are used to harvest fish/aquatic animals for human consumption and pharmaceuticals.
- **Kidneys of the Landscape**: Wetlands possess biofilters, hydrophytes, and organisms that in addition to nutrient uptake abilities can remove toxic substances coming from pesticides, industrial discharges, and mining activities.

FACTORS RESPONSIBLE FOR DEGRADATION OF WETLANDS:

- **Urbanization**: Increasing pressure for the development of residential, industrial and commercial facilities. Urban wetlands are essential for preserving public water supplies. **For example,** Kolkata is considered an **"ecologically subsidized city"**.
- **Agriculture**: Vast stretches of wetlands have been converted to paddy fields.
- **Construction:** a large number of reservoirs, canals and dams to provide for irrigation significantly altered the hydrology of the associated wetlands.
- **Pollution**: Wetlands act as natural water filters. However, they can only clean up the fertilizers and pesticides from agricultural runoff but not mercury from industrial sources and other types of pollution.
- **Climate Change**: Increased air temperature; shifts in precipitation; increased frequency of storms, droughts, and floods; sea level rise etc could also affect wetlands.
- **Dredging**: The removal of material from a wetland or river bed lowers the surrounding water table and dries up adjacent wetlands.
- **Invasive Alien Species**: Exotic, introduced plant species such as water hyacinth and salvinia. They clog waterways and compete with native vegetation.

"WISE USE" OF WETLANDS
Meaning of Wise use of wetlands is the maintenance of their ecological character, achieved through the implementation of ecosystem approaches, within the context of sustainable development.

WETLAND PROTECTION EFFORTS IN INDIA

- **Water (Conservation and Management) Rules 2017 :** To conserve aquatic ecosystems through implementation of sustainable conservation plans.
  - ○ Goa government has issued a notification declaring several water bodies across the state as wetlands under the Wetlands Rules 2017.
- **Amrit Dharohar Scheme:** For protecting important wetlands that sustain aquatic biodiversity.
  - ○ Initiative under "green growth".
  - ○ To be implemented over the next three years to encourage optimal use of wetlands and enhance biodiversity, carbon stock, eco-tourism opportunities and income generation for local communities.
- **National Wetland Conservation Programme (NWCP)**: GoI operationalized NWCP in close collaboration with the concerned State Government during the year 1985-86.
  - ○ It aims for the conservation and wise use of wetlands in the country to prevent their further degradation.
- **The National Environmental Policy 2006**: It recognized the importance of wetlands in providing numerous ecological services.
  - ○ Based on recommendations made by the National Forest Commission.
- **National Wetland Protection Strategy: It should encompass -**
  - ○ Conservation and collaborative management;
  - ○ Prevention of loss and promotion of restoration.

WAY FORWARD

- **Wetlands as Solutions:** Recognize wetlands as vital solutions for land and water management challenges.
- **Integration with International Missions:** Ensure the incorporation of wetland roles and values into UNFCCC, MDGs, and SDGs implementation.
- **Planning, Management, and Monitoring:** While wetlands under the Protected Area Network have management plans, others require similar attention.
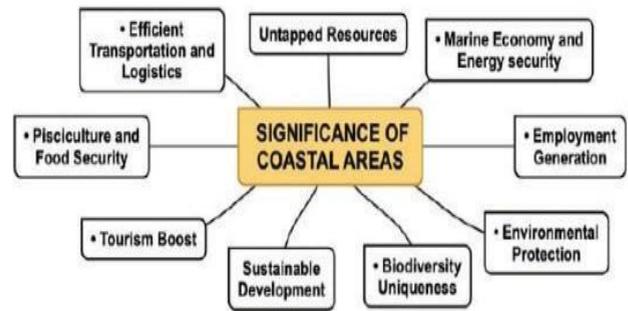
COASTAL CONSERVATION

- Coastal conservation is the protection and preservation of coastal ecosystems to prevent the over-exploitation of flora and fauna and natural resources found in them.
- India's coastal ecosystems comprising mudflats, sandy beaches, estuaries, creeks, mangroves, coral reefs, marshes, lagoons, seagrass beds, and sandy and rocky beaches extend to 42,808 km.
- They are known for their high biological productivity, which provide a wide range of habitat for many aquatic flora and fauna.

- The total length of the coastline of the mainland, Lakshadweep Islands and Andaman and Nicobar Islands is 7,516.6 km, spread across nine states, borders a 2.02 million sq. km area of Exclusive Economic Zone (EEZ extend to a maximum of 200 nautical miles from the baseline) in the sea.
- **SDG GOAL 14 - Life below water:** conserve and sustainably use the oceans, seas and marine resources.

GOVERNMENT INITIATIVES TO CONSERVE COASTS

- **Draft Environmental and Social Management Framework:** To enhance the resilience of the lives and livelihoods of the most vulnerable populations, particularly women, in the coastal areas of India.

- **Integrated Coastal Zone Management Plan**: It is a process for the management of the coast using an integrated approach, regarding all aspects of the coastal zone, including geographical and political boundaries.

- **Coastal Regulation Zone Notification (CRZ) 2019** classifies coastal area into different zones to manage infrastructure activities and regulate them.

- Three institutions responsible for implementation of CRZ are: **NCZMA** at Centre, **SCZMAS/UTCZMAs** in every coastal State and UT, **District Level Committees** in districts with a coastal stretch.

- **Coast Guard Act, 1978:** The ICG has been accordingly nominated in 1986 as the Central Coordinating Authority for oil-spill response in the Maritime Zones of India.

- **National Center For Sustainable Coastal Management:** It is established under the Ministry of Environment, Forest and Climate Change to undertake studies and research in the area of Coastal Zone Management including coastal resources and environment.

CAG REPORT ON CONSERVATION OF COASTAL ECOSYSTEM

- **National Coastal Zone Management Authorities (NCZMA)** is functioning as an ad-hoc body which is impacting consistency in coastal conservation.
- **State/UT Coastal Zone Management Authorities (SCZMA) are either delayed or non-existent:** Karnataka has still not constituted it while Goa, West Bengal and Odisha have delayed its reconstitution.
- **Several Projects Were Approved Despite The Eia Report Highlighting Inconsistency:** Indicate illegal construction activities (like reducing coastal space and effluent discharges).
- **Other Issues In EIA:** non-accredited consultants preparing EIA, outdated data being used, and non-evaluation of the environmental impacts of the project.
- **Recommendations:** NCZMA and SCZMA should be made permanent, proper ecological evaluation before granting clearances, preparing detailed map and management plans for coral reefs, turtle nesting sites etc.

SHAILESH NAYAK COMMITTEE (2014) REPORT ON COASTAL REGULATION ZONE

- **Importance:** The committee recommended relaxation on the terms set up by the CRZ 2011 notification.
- **Major objective**: To boost tourism, port construction and real estate.

WAY FORWARD
- **Shoreline Protection Using Coconut:** coir from coconut fibre is spun together into mats and logs and bonded together and suspended in water. This prevents coastal erosion from waves. E.g. Indonesia, Jersey (USA) etc.
- **Popularize The Use Of Natural Infrastructure Over Grey Infrastructure:** use of wooden logs, coconut and mangroves instead of cement or steel barriers is more desirable and sustainable.
- **Prevent Boring Water Near Coastal Areas:** It will prevent salty water from polluting freshwater in the water table.
- **Ban Trawlers:** Trawlers devastate submerged coastal bed which is the habitat of numerous species. Better fishing technology needs to be employed.
- **Integrated Coastal Zone Management Project:** Sponsored by the World Bank, it seeks to balance the diverse needs of development with the protection of vulnerable ecosystems

Coastal management is important to develop and sustainably utilize the coasts for sustainable development. What is required is the use of technology, community participation and the removal of bottlenecks like lack of coordination at various levels.

COASTAL ADAPTATION

Coastal adaptation refers to the strategies put in place to address and mitigate the impacts of climate change, sea-level rise, and other environmental changes on coastal areas.

NEED FOR COASTAL ADAPTATION TO CLIMATE AND HERITAGE
- **Rising Sea Levels:** Melting polar ice caps cause coastal erosion, flooding, and saltwater intrusion.
- **Climate Change:** Increases in severe weather events such as hurricanes, storm surges, and heavy rainfall lead to flooding, erosion, and infrastructure damage.
- **Population Growth:** Densely populated coastal areas require adaptation measures to protect lives and property, with two-thirds of cities over five million people at risk.
- **Biodiversity and Ecosystems:** Protecting coastal ecosystems like wetlands, mangroves, and coral reefs is crucial as they provide habitats and storm surge protection.
- **Cultural Heritage:** Coastal regions often hold significant cultural heritage, necessitating protection of historical sites and communities, such as the folk art forms Kolkali and Parichakali in Lakshadweep.

ADVANTAGES OF COASTAL ADAPTATION
- **Economic Diversification:** Coastal adaptation can drive economic growth by creating new industries in climate-resilient infrastructure, renewable energy, and eco-tourism, leading to job creation and business opportunities.
- **Biodiversity Enhancement:** Effective coastal adaptation helps restore and preserve natural ecosystems, supporting indigenous species and creating habitats for endangered or vulnerable species.
- **Disaster Risk Reduction:** Coastal adaptation reduces the vulnerability of coastal communities by implementing resilient infrastructure, early warning systems, and natural barriers, thus minimizing the impact of natural disasters like storms, tsunamis, and sea-level rise.
- **Sustainable Food Sources:** Practices such as aquaculture, sustainable fishing, and integrated farming in coastal areas ensure a steady supply of seafood and agricultural produce, securing livelihoods and contributing to global food security.

WAY FORWARD
- **Improved Infrastructure Resilience:** Retrofit infrastructure, design flood-resistant buildings, and enhance stormwater systems.
- **Expanded Adaptation Framework:** Integrate information collection, planning, implementation, and monitoring within existing coastal management.
- **Needs-Based Assessment:** Address inequality to highlight inequity at all levels.
- **Nature-Based Solutions:** Enhance natural defenses like mangrove restoration and wetland preservation.

ONE WATER APPROACH

It is an integrated planning and implementation approach aimed at effectively managing limited water resources to ensure long-term resilience and reliability, meeting the needs of both communities and ecosystems.

One Water Approach

One water approach, also known as **integrated water management or holistic water management,** emphasizes the **interconnectedness** of various water resources, including surface water, groundwater, and rainwater, as well as the water cycle as a whole.

- This approach recognizes that all water sources are interrelated and should be managed collectively to achieve sustainable and equitable water management outcomes.
- The one water approach promotes i**ntegrated planning, decision-making, and management practices** that consider the entire water cycle, from collection and treatment to distribution, consumption, and reuse.
  - It seeks to optimize water use efficiency, minimize waste, and enhance resilience to water-related challenges such as scarcity, pollution, and climate change impacts.

Key principles of the one water approach

- **Integrated Management:** Recognizing the interconnectedness of water resources and coordinating management efforts across different sectors and stakeholders to achieve multiple benefits and minimize trade-offs.
- **Sustainability:** Promoting sustainable water use practices that balance environmental, social, and economic considerations to meet the needs of present and future generations.
- **Resilience:** Building resilience to water-related risks and uncertainties by diversifying water sources, enhancing infrastructure reliability, and implementing adaptive management strategies.
- **Equity and Inclusivity:** Ensuring equitable access to water resources and involving diverse stakeholders, including marginalized communities and indigenous peoples, in decision-making processes.
- **Innovation and Collaboration**: Fostering innovation, technology adoption, and collaboration between government agencies, private sector entities, civil society organizations, and academia to address water challenges effectively.

HIGH SEAS TREATY

The UN High Seas Treaty, also known as the Treaty of High Seas or **Biodiversity Beyond National Jurisdiction (BBNJ) Treaty**, is a historic international agreement negotiated under the United Nations Convention on the Law of the Sea (UNCLOS) of 1982. It represents the first-ever treaty aimed at the protection of biodiversity on the high seas. The treaty establishes a legal framework to manage and conserve marine life in areas beyond national jurisdiction, placing about 30% of the world's international waters into protected areas by 2030.

Key Features:

- Aims to place 30% of the seas into protected areas by 2030.
- Establishes a legal framework for marine protected areas (MPAs) to protect wildlife and share genetic resources of the high seas.
- Covers environmental assessments to evaluate potential damage from commercial activities like deep-sea mining.
- Strengthens resilience with provisions based on the polluter-pays principle and mechanisms for disputes.
- Provides guidance for ocean management, recognizing indigenous peoples' rights and traditional knowledge.
- Establishes a conference of the parties (CoP) for accountability on governance and biodiversity, including a pledge to share ocean resources.

UN 2023 WORLD WATER CONFERENCE

Recently UN 2023 World Water Conference was held in New York. It is the most important UN based event on water supply, sanitation and hygiene in 46 years coinciding with the mid-term review of the International Decade for Action.

Key Outcomes of the Conference

- **New Water Action Agenda:** Consolidating voluntary commitments to expedite progress in the latter halves of the Water Action Decade 2018-2028 and the 2030 Agenda for Sustainable Development.
- **Capacity Building:** Emphasis on capacity building initiatives such as the Making Rights Real initiative and the Water for Women Fund.
- **Knowledge Facilitation:** Sharing knowledge through cross-learning tools like UNESCO's W12+ Blueprint.
- **Formal Agreements:** Call for formal agreements akin to the 2015 Paris climate accords.

WATER TRADING

Water Trading refers to the buying, selling, or leasing of water access rights, allowing its transfer from one user to another where market price of water reflects its demand and supply.
- NITI Aayog is developing a draft policy to facilitate trading in water on commodity exchanges, akin to gold, silver, and crude oil.
- The concept is already practiced in various countries such as Australia, Chile, and the USA.

Benefits of Water Trading:
- Better price discovery that leads to efficient use of resources and encourages water saving.
- Reduce government expenses on drought relief measures.
- Attract investments in the water economy through increased business opportunities.
- Increased flexibility to manage water availability and water use.
- Insure farmers against drought.

Concerns over Water Trading:
- Promote privatization of water resources (public good or a basic human right), leaving the state with no control over them.
- Against religious and cultural traditions of the community considering water with spiritual value.
- Politically sensitive issues due to greater impact on poor and marginalized sections of society.

	PREVIOUS YEAR QUESTIONS	
1.	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
2.	Explain the causes and effects of coastal erosion in India. What are the available coastal management techniques for combating the hazard?	2022
3.	How and to what extent would micro-irrigation help in solving India's water crisis?	2021
4.	What are the salient features of the Jal Shakti Abhiyan launched by the Government of India for water conservation and water security?	2020
5.	Coastal sand mining, whether legal or illegal, poses one of the biggest threats to our environment. Analyze the impact of sand mining along the Indian coasts, citing specific examples.	2019
6.	What is a wetland? Explain the Ramsar concept of 'wise use' in the context of wetland conservation. Cite two examples of Ramsar sites from India.	2018
7.	Not many years ago, river linking was a concept but it is becoming a reality in the country. Discuss the advantages of river linking and its possible impact on the environment.	2017
8.	Rehabilitation of human settlements is one of the important environmental impacts which always attract controversy while planning major projects. Discuss the measures suggested for mitigation of this impact while proposing major developmental projects.	2016
9.	The Namami Gange and National Mission for Clean Ganga (NMCG) programmes and causes of mixed results from the previous schemes. What quantum leaps can help preserve the river Ganga better than incremental inputs?	2015
10.	What do you understand by a run of the river hydroelectricity project? How is it different from any other hydroelectricity project?	2013
11.	Enumerate the National Water Policy of India. Taking the river Ganges as an example, discuss the strategies which may be adopted for river water pollution control and management. What are the legal provisions for the management and handling of hazardous wastes in India?	2013

9 CLEAN ENERGY AND ENERGY CONSERVATION

"Let us turn to the Sun to power our future" - **PM Narendra Modi**

INTRODUCTION

Clean energy and energy conservation are crucial aspects of addressing climate change and promoting sustainable development. Clean energy refers to renewable sources like solar, wind, hydro, and geothermal power, which minimize greenhouse gas emissions and reduce dependence on fossil fuels.

Energy conservation involves using energy efficiently, reducing wastage, and adopting technologies and practices that optimize energy usage.
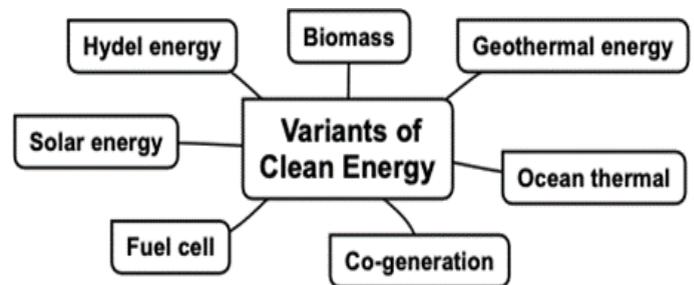
FACT-WISE

- **India is the world's third largest producer of renewable energy**, with about 45% of its installed electricity capacity coming from non-fossil fuel sources.
- Total Installed Capacity of Renewable Energy Sources: **199.85 GW (as of April 2024).**
- **Installed capacity for Renewables: Wind power**: 45.8 GW, **Solar Power**: 82.63 GW, **Biomass/Cogeneration**: 10.2 GW, **Small Hydro Power**: 4.94 GW, **Waste To Energy**: 0.55 GW and **Large Hydro**: 46.85 GW
- India ranks 4th globally in Renewable Energy Installed Capacity, 4th in Wind Power capacity, and 5th in Solar Power capacity, according to the REN21 Renewables 2023 Global Status Report.
- India has set a target of achieving 500 GW of non-fossil energy energy capacity by 2030 (Panchamrita).

INDIA'S TARGETS

- **Electric Power:** India has set ambitious targets including reducing the carbon intensity of the nation's economy by less than 45% by the end of the decade, achieving 50% cumulative electric power from renewables by 2030, and attaining net-zero carbon emissions by 2070.
- **Green Hydrogen:** The country aims to produce five million tonnes of green hydrogen by 2030, supported by 125 GW of renewable energy capacity.

KEY HIGHLIGHTS OF THE UNION BUDGET

Union Budget 2023-24
- Green Growth is identified as one of the seven priorities in the SAPTARISHI framework.
- Allocation of $2.4 billion for the National Hydrogen Mission to produce 5 million metric tonnes (MMT) of green hydrogen by 2030, with an additional $36 million in the budget.
- Support for 4 GWh of Battery Energy Storage Systems through Viability Gap Funding.
- Emphasis on pumped storage projects with the formulation of a detailed framework

Interim Union Budget 2024-25
- Allocated Rs 10,000 crore for a grid-based solar power scheme i.e Rooftop Solar Scheme: PM Suryodaya Yojana
- Viability gap funding for offshore wind energy for an initial capacity of 1 GW.
- Allocated Rs 600 crore for the National Green Hydrogen Mission, marking a substantial increase of 102% compared to the previous year's budget of Rs 297 crore.

IMPORTANCE OF RENEWABLE ENERGY

- **Sustainable:** Renewable energies are sources of clean, inexhaustible and increasingly competitive energy.
- **Mitigate climate change and global warming:** Renewables do not emit greenhouse gases in energy generation processes, making them the cleanest, most viable solution to prevent environmental degradation.

- **Reducing energy dependence:** The indigenous nature of clean sources gives local economies an advantage and brings meaning to the term "energy independence". Dependence on fossil fuel imports can compromise the security of the energy supply.
- **Creating employment opportunities:** Renewable energy particularly installation and services (e.g., solar energy, wind energy, etc.) can create local job opportunities.
- **Power supply:** Providing 24*7 power supply to 100% of the households, a sustainable form of transport is some of the goals that can only be achieved through sustainable power that comes from renewables.

KEYWORDS

Reverse bundling; Renewable Purchase Obligations (RPO); Energy Efficiency; Effective Energy Transition; Gate Closure; Issues of Intermittent; 24*7 Power for All; Smart metering.

ISSUES AND CHALLENGES WITH RENEWABLE ENERGY

- **Higher Capital Costs:** While renewable energy systems need no fuel and can deliver substantial long-term savings, their up-front costs can still be prohibitive.
- **Unreliable and interrupted:** Renewable energy systems rely on natural resources such as sunlight, wind, and water, and therefore, their electricity generation can be as unpredictable as the weather.
- **Integration with the Main Grid:** Integrating the renewables with the main grid is the area India needs to work on. To accelerate the uptake of renewables, storage and battery solutions are needed in large quantities.
- **Consequences of Hydropower plants:** The dams destroy the habitat of the aquatic organisms and also hinder their migration pattern.
- **Agricultural Sector:** Much power is consumed in the agricultural sector. The challenge is to provide sufficient power and energy to every household and to the agricultural sector as well.

INDIA'S ENERGY TRANSITION STRATEGY

- India recognizes the importance of a just energy transition and is actively developing a strategy to address the socio-economic challenges associated with shifting to cleaner energy sources. Here are some key elements of India's strategy for a fair energy transition: Accelerate renewable energy deployment, Promote domestic manufacturing, Optimize coal use and Implement supportive policies.
- India's strategy for a just energy transition aligns with its commitment to clean energy targets, including the aim of reaching net-zero emissions by 2070.

INDIA'S EFFORT TO PROMOTE CLEAN ENERGY

- India is actively promoting clean energy and sustainable development. The country has set ambitious targets for renewable energy capacity, particularly in solar and wind power.
- Some initiatives taken by the Government to boost renewable energy in the country includes:
  o National Solar Mission, PM KUSUM, Atal Jyoti Yojana (AJAY), Grid Connected Solar Rooftop Scheme, Solar Parks and Ultra Mega Solar Power Projects, National Green Hydrogen Mission, National Bioenergy Policy, National Offshore Wind Energy Policy etc.
- Through international collaborations, policy incentives, and innovative programs, India is driving the adoption of clean energy technologies. Examples include International Solar Alliance, Global Biofuel Alliance.
- These efforts create opportunities for job growth, enhance energy security, and improve the overall quality of life.

PANCHAMRITA : INDIA'S CLIMATE COMMITMENTS AT COP26 SUMMIT IN GLASGOW

- Achieve the target of Net Zero by the year 2070.
- Increase non-fossil energy capacity to 500 GW by 2030.
- Meet 50 percent of its energy requirements from renewable energy by 2030.
- Reduce the total projected carbon emissions by one billion tonnes from now till 2030.
- Reduce the carbon intensity of its economy by less than 45 percent by 2030.

SOLAR ENERGY

- In the broadest sense, solar energy supports all life on earth and is the basis for almost every form of energy we use.
- The radiation that is received from the sun and utilized in the form of electricity and thermal energy by using various available technologies like photovoltaic panels, solar heaters etc.

FACT-WISE
• Globally, India ranks 5th in terms of installed solar power capacity. • India's INDC's commitment includes 100 GW of solar power out of 175 GW of renewable energy by 2022 (India missed it). • Installed solar capacity has grown to 82.63 GW. (April 2024) • Rooftop solar power accounts for 2.1 GW, of which 70% is industrial or commercial. • India's solar waste is estimated to be around 1.8 million by 2050 also needs to be tackled.

BENEFITS OF SOLAR ENERGY

- **Access to Electricity:** Provides clean and reliable power, especially in remote and rural areas.
- **Environmental Preservation**: Reduces air pollution, conserves resources, and supports a healthier environment.
- **Energy Security:** Decreases dependence on non-renewable energy imports, enhancing self-sufficiency.
- **Economic Development:** Supports industrial growth and agriculture by ensuring a stable and cost-effective power supply.
- **Cost & Supply:** Promotes self-sufficiency, lowers power generation costs, boosts industries, and creates employment opportunities.
- **Environmental Concern:** Replaces fossil fuel-based thermal energy, mitigating climate change and global warming.

CHALLENGES WITH SOLAR ENERGY

- **Infrastructure Restructuring:** The fundamental restructuring of India's power and energy infrastructure is a significant challenge.
- **High Costs and Competition:** Solar power generation costs are higher compared to coal, and there is competition from ultra-supercritical coal power plants, which are cheaper and more efficient.
- **Transmission & Distribution Losses:** High transmission and distribution losses, approximately 40%, make solar energy generation less feasible.
- **Policy and Legal Issues:** India faces legal challenges at the WTO regarding its domestic content requirements, and there are inconsistencies in solar policies for rooftop and open access projects.
- **Domestic Market and Financing Issues:** Manufacturers focus on export markets, reducing local supply, and there are financing, storage, and transmission issues in establishing solar rooftops, along with low tariffs and unsigned power supply agreements by DISCOMs.

GOVERNMENT INITIATIVES ON SOLAR ENERGY

- **National Solar Mission (NSM) (2010)**: Aims to achieve a total solar capacity of 100 GW by 2022 through a combination of policy initiatives, financial incentives, and capacity-building programs.
- **Solar Rooftop Program (2010):** Promotes solar panel installations on rooftops with financial incentives, subsidies, and net metering policies for residential, commercial, and industrial buildings.
- **PM-KUSUM (2019):** Provides solar pumps to farmers and promotes solar energy generation on uncultivable land, targeting 25,750 MW solar capacity by 2022.
- **Atal Jyoti Yojana (AJAY) (2016):** Provides solar power to rural areas through solar streetlights, home lighting systems, and off-grid solar power plants.
- **International Solar Alliance (ISA) (2015):** Co-founded by India to promote global solar energy adoption, technology transfer, and investment in solar projects.
- **One Sun, One World, One Grid (OSOWOG):** Aims to build a global ecosystem of interconnected renewable energy resources, primarily solar, for seamless sharing.

WAY FORWARD

- **Promoting Decentralized Plants:** Implement schemes to encourage rooftop solar and other solar appliances, similar to existing LED distribution programs.
- **Hybrid Solar Plants and Financing Mechanisms:** Develop hybrid solar-wind plants and introduce innovative financing measures such as Clean Energy Fund, generation-based incentives, and green bonds to support renewable energy projects.
- **Embrace the circular economy for PV waste** to improve domestic manufacturing.

INTERNATIONAL SOLAR ALLIANCE (ISA)

The International Solar Alliance (ISA) is a joint effort of India and France to mobilize efforts against climate change through deployment of solar energy solutions.

- It was conceptualized on the sidelines of the 21st Conference of Parties COP21, 2015 to the UNFCCC.
- It aims to promote solar energy and reduce reliance on fossil fuels, aligning with the objective of ensuring access to affordable and sustainable energy for all as stated in SDG 7.
- ISA is guided by **"Towards 1000" strategy** which aims:
  - To mobilise USD 1000 billion of investments in solar energy solutions by 2030
  - Delivering access to 1000 million people using clean energy solutions
  - Installation of 1000 GW of solar energy capacity

CHALLENGES

- **Import Dependence:** India relies heavily on imported solar products, especially from China.
- **Legal Issues:** India's domestic content requirement is under WTO legal challenges, complicating the balance between domestic goals and international commitments.
- **Dumping and Competition:** Chinese imports and strong manufacturing base challenge local manufacturers and erode profits.
- **Technical Knowledge and Technology Barriers:** Many ISA member countries lack technical capabilities, and patent restrictions hinder access to advanced solar technologies.
- **High Capital Costs and Funding Constraints:** Solar installations remain expensive, high tariffs deter cost-effective development, and there is no fixed mechanism for funding mobilization.

WAY FORWARD

- **Sustainable Finance:** Strong financial measures are required to finance the solar projects. Innovative steps like green bonds, institutional loans and clean energy funds can play a crucial role.
- **Promote International Cooperation:** Foster partnerships with initiatives like the United Nations Sustainable Energy for All (SEforALL) and the International Renewable Energy Agency (IRENA).
- **Waste Management:** India needs a Solar Waste Management and Manufacturing Standards Policy.

ONE SUN-ONE WORLD-ONE GRID (OSOWOG)

- India and the UK launched the OSOWOG initiative at COP26, envisioning a global interconnected renewable energy network. The initiative aims to leverage solar energy resources, attract investments, and address socio-economic challenges.

SIGNIFICANCE

- **Cost Reduction and Asset Utilization:** Integration would lead to reduced project costs, increased efficiencies, and enhanced asset utilization for all participating entities.
- **Incremental Investment:** Existing grid infrastructure eliminates the need for parallel grids, minimizing additional investment requirements.
- **Economic Benefits:** Enhanced renewable energy utilization supports poverty alleviation, while positively impacting water, sanitation, food, and socio-economic challenges.
- **Growth of Management Centers:** National renewable energy management centres in India can evolve into regional and global management centres.
- **Global Leadership:** India's proactive stance during the COVID-19 pandemic positions it as a leader in evolving global strategies.

CHALLENGES

- **Cybersecurity Threats:** Interconnected grid management faces the risk of cyber-attacks, deterring participation and raising concerns regarding critical national infrastructure.
- **Unpredictable Supply:** Intermittent generation and daily/seasonal variability of renewable energy pose challenges to reliable supply.
- **Technological Complexities:** Long-distance power transmission projects face energy loss, incompatible networks, and increased risk of blackout spillover.
- **Political Implications:** Strategic denial of service during conflicts may be used as a tool to extract political concessions.
- **Regulatory Hurdles:** Coordinating among multiple jurisdictions, regional planning, and shared investment costs can present regulatory challenges.

WAY FORWARD

- **Cybersecurity Measures:** Provide support and establish standards to protect grids against cyber-attacks, ensuring the security of energy utilities and operations.
- **Governing Institutions and Market Frameworks:** Develop governing institutions and regional market frameworks through political negotiations for effective coordination.
- **Fair Trade and Domestic Reforms:** Encourage fair trade, transparency, and domestic reforms, setting standards for digitized cross-border pricing and trading exchanges.

PM Suryodaya Yojana: A Rooftop Solar Scheme in India
The Interim Budget 2024 announced that one crore households will receive rooftop solar installations through the Pradhan Mantri Suryodaya Yojana.
Key provisions:
- **Installation of System**: Households that have a monthly electricity consumption of less than 300 units a month will be able to install a mid-sized system with the government bearing the expense.
- **Rise in Subsidy**: The subsidy will increase to 60% from 40% and the rest will be financed by a private developer who is affiliated to a public sector enterprise connected to the Power Ministry, earlier the remainder having to be borne by the consumer.
- **Mechanism of Net-Metering**: The surplus electricity produced by households can be sold back to the grid to make good the loan, though the actual way of implementation can be complex.

WIND ENERGY

Wind energy is a form of renewable energy which is generated by converting the kinetic energy present in the wind into mechanical energy which is, in turn, converted into electricity.

FACTS-WISE

- Globally, India ranks **4th** in terms of installed wind power capacity.
- **India's electricity generation from wind**: 45.8 GW (as of April 2024).
- **More than 95% of commercially exploitable resources are located in seven states**: Andhra Pradesh, Gujarat, Karnataka, Madhya Pradesh, Maharashtra, Rajasthan and Tamil Nadu.
- **Potential**: According to the MNRE, the estimated potential of generating wind energy in India, at a max height of 100 metres above the ground, is 302 GW.
- **Top Five nations'**: Germany, USA, Denmark, Spain and India account for 80% of the world's installed wind energy capacity.

IMPORTANCE OF WIND ENERGY

- **Alternative to fossil fuel:** A country like India or any region where energy production is based on imported coal or oil will become more self-sufficient by using alternatives such as wind power.
- **Climate change and global warming mitigation:** It does not contaminate, it is inexhaustible and reduces the use of fossil fuels, which are the origin of greenhouse gasses that cause global warming.
- **Scope in remote areas:** In remote areas or areas with a weak grid, wind energy can be used for charging batteries or can be combined with a diesel engine to save fuel whenever the wind is available.
- **Geographical advantages:** India is a country having around 7,700 km long coastline and in all of its exclusive economic zones, it has enough opportunity to harness wind energy.
- **Wind power is cost-effective:** Wind is one of the lowest-priced energy sources available today.

ISSUES AND CHALLENGES WITH WIND ENERGY

- **Lack of land availability:** The construction of wind energy farms requires large areas, and competition for suitable land with high wind speeds and grid connectivity has grown intense.
- **Not cost competitive:** Wind power must still compete with conventional generation sources on a cost basis. Depending on how energetic a wind site is, the wind farm may or may not be cost competitive.
- **Infrastructural lacunae:** good wind sites are often located in remote locations, far from cities where the electricity is needed. Transmission lines must be built to bring the electricity from the wind farm to the city.
- **Noise pollution and visual impacts:** Although wind power plants have relatively little impact on the environment compared to other conventional power plants, there is some concern over the noise produced by the rotor blades and aesthetic (visual) impacts.

- **Lethal to birds:** The turbine blades may damage local wildlife. Sometimes birds have been killed by flying into the rotors.

WAY FORWARD

- **Technology Advancements:** Improve wind turbine efficiency and reduce costs through ongoing research and development.
- **Grid Integration:** Enhance grid infrastructure and develop energy storage solutions to manage wind energy intermittency.
- **Policy Support:** Implement supportive policies and regulations like feed-in tariffs and tax incentives to boost wind energy growth.
- I**nternational Collaboration:** Share best practices globally and engage stakeholders to build support and accelerate wind energy deployment.

OFFSHORE WIND ENERGY

Recently, the Ministry of New and Renewable Energy (MNRE) issued a tender for the construction of India's first offshore wind projects.

About Offshore Wind Energy: Offshore wind energy is the generation of electricity from wind blowing across the sea.

National Offshore Wind Energy Policy, 2015

- The Ministry of New and Renewable Energy (MNRE) has set a target of installing 5 GW of offshore capacity by 2022 and 30 GW by 2030.
- The onshore wind energy potential estimated by the National Institute of Wind Energy (NIWE) stands at 300 GW at 100m hub height.
- In this scenario, offshore wind can be seen as a viable option in order to protect the precious land resources.
- India is blessed with a coastline of nearly 7,600 km with relatively shallow waters (within 12 nautical miles of the coast) near to shore in most parts showing good prospects of generating 127 GW of offshore wind energy.

Benefits of Offshore wind energy: Offshore wind turbines are more efficient, more land for projects and lack of physical interference etc.

Challenges in harnessing offshore wind energy

- Economic: High capital and operational expenditure, lack of dedicated supply chain, etc.
- Social-environmental: Potential impact on marine animals, shipping, etc.
- Regulatory challenges: Lack of concrete framework on offshore energy, regulatory hurdles in Marine National Park and Sanctuary Zones, etc.

INITIATIVES TAKEN FOR OFFSHORE WIND ENERGY

- National Offshore Wind Energy Policy, 2015.
- Global Collaborations on Facilitating Offshore Wind Energy in Iindia (FOWIND) with European Union.

HYBRID ENERGY

- Solar and wind power being variable in nature pose certain challenges to grid security and stability.
- Since the RE resources are intermittent in nature, therefore, hybrid combinations of two or more power generation technologies, along with storage can improve system performance.
- Superimposition of wind and solar resource maps shows that there are large areas where both wind and solar have high to moderate potential.

IMPORTANCE

- **Address Limitations:** Hybrid systems improve fuel flexibility, efficiency, reliability, emissions, and economics.
- **Efficiency:** Incorporating advanced devices and materials increases the overall efficiency of hybrid systems.
- **Maximization:** Combining conventional and renewable energy sources enhances power quality and maximizes renewable energy utilization.

NATIONAL WIND-SOLAR HYBRID POLICY MEASURES 2018

Hybridization of existing wind/solar PV plants: No additional connectivity or transmission capacity charges shall be levied by the respective transmission entity for hybridization at existing wind/solar PV plants.

Battery storage: Increasing wind and solar capacity in a hybrid plant reduces variability and boosts.

Regulatory requirements: The Central Electricity Authority and CERC shall formulate necessary standards and regulations for wind-solar hybrid systems.

Quality: For wind turbines, solar modules and balance of systems, the technical guidelines issued by the Ministry from time to time for grid-connected systems will be followed.

GEO-THERMAL ENERGY

- Geo-thermal energy refers to the energy source that is stored in the form of heat beneath earth's surface.
- Geothermal Energy can be utilized for both electric power production and direct heat applications including Ground Source Heat Pump (GSHP) for space or district heating, generating hot water for domestic or industrial use, etc.

SIGNIFICANCE OF GEOTHERMAL ENERGY

- **Environmentally Friendly:** It can meet future heating, cooling, and electricity demands while being eco-friendly.
- **Renewable:** It is a renewable energy source lasting until the Earth is destroyed by the sun in about 5 billion years.
- **Huge Potential:** Geothermal power plants could provide 0.0035 to 2 terawatts of power, with places like Puga village having over 100 MW potential.
- **Sustainable/Stable:** Unlike wind or solar, geothermal energy is a reliable and always-available resource.
- **No Fuel Required:** It doesn't need fuel like fossil fuels, which are finite and require extraction.

CHALLENGES OF GEOTHERMAL ENERGY

- **Location Restricted:** The largest single disadvantage of geothermal energy is that it is location specific.
- **Earthquakes:** It runs risk of triggering earthquakes due to alterations in the Earth's structure as a result of digging.
- **Associate other emissions:** like sulphur dioxide and hydrogen sulphide
- **High initial Costs:** Geothermal energy is an expensive resource to tap into, with price tags ranging from around $2-$7 million for a plant with a 1-megawatt capacity.

WAY FORWARD

- Conduct comprehensive geological mapping of potential geothermal energy sources.
- Provide incentives for research and development to create cost-effective and clean extraction technologies.

Ocean Thermal Energy Conversion (OTEC)

The **National Institute of Ocean Technology (NIOT)** is setting up an OTEC plant in Kavaratti, Lakshadweep.

- **Ocean Thermal Energy Conversion (OTEC)** is a process that utilizes temperature differences between ocean surface and deep waters to generate energy.
- OTEC systems require a temperature difference of at least 20°C to produce electricity.

Significance: It produces clean environmentally friendly renewable energy, OTEC can produce energy at all times (Constant clean source of energy).

NATIONAL BIOENERGY PROGRAMME

Bioenergy is a renewable energy derived from organic materials such as crop residues, wood, and animal waste, utilized for heating, cooking, electricity generation, and transportation. The Ministry of New and Renewable Energy announced the National Bioenergy Programme, continuing it from FY 2021-22 to 2025-26 for the first phase.

NBP comprises of three sub-schemes:

Waste to Energy Programme	Supports the establishment of large Biogas, BioCNG, and Power plants utilizing urban, industrial, and agricultural wastes/residues.
Biomass Programme	Aids in the manufacturing of briquettes & pellets and promotes non-bagasse-based cogeneration in industries for power generation.
Biogas Programme	Assists in setting up family and medium-sized Biogas units in rural areas.

BIOFUELS

Biofuels are renewable energy fuels derived from biomass like crop stubble, plant waste, and municipal solid waste. They are used either as standalone fuels or blended with diesel and petrol for applications such as transportation. Biofuels include bio-ethanol, bio-diesel, Compressed Biogas (CBG), and bio-hydrogen.

FACT-WISE

- India possesses a biomass resource of 500 million tonnes annually, with a surplus of 120 to 150 million tonnes.
- Moreover, biofuels alone contribute 12.83% to the overall renewable energy generation

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SIGNIFICANCE

- Decarbonising transport by providing low-carbon solution for sectors like trucking, shipping and aviation.

- Facilitates the transition to green energy, contributing to reduced reliance on fossil fuels. Biofuels will help achieve Panchamrit's Net zero target by 2070.
- Mitigates air pollution through clean cooking provision and reduced emissions from thermal power plants.
- Minimizes garbage dumped in landfills by converting organic waste into biogas and bio-manure.

GOVERNMENT INITIATIVES

- **Pradhan Mantri JI-VAN Yojana (2019):** Promotes advanced biofuel production from agricultural and forest residues, and municipal solid waste, and encourages research and development.
- **National Biofuel Policy (2018):** The government introduced a policy to increase biofuel blending in petrol and diesel, promoting biofuel production and consumption. It has the objective of reaching 20% ethanol-blending and 5% biodiesel-blending by the year 2030.
- **GOBAR (Galvanizing Organic Bio-Agro Resources) DHAN scheme, 2018:** It focuses on managing and converting cattle dung and solid waste in farms to useful compost, biogas and bio-CNG, thus keeping villages clean and increasing the income of rural households.
- **SATAT (Sustainable Alternative Towards Affordable Transportation):** to establish an ecosystem for CBG production for affordable transportation, benefiting vehicle users, farmers, and entrepreneurs.
- **SAMARTH (Sustainable Agrarian Mission on use of Agro-residue in Thermal Power Plants) scheme.**
- **Ethanol Blending Program (EBP) (2003):** A program encouraging the blending of ethanol with petrol, supported by incentives, procurement mechanisms, and infrastructure development.

CHALLENGES

- Lower efficiency compared to fossil fuels, requiring blending for optimal performance.
- Environmental concerns include increased methane emissions and pollution from burning organic materials.
- Risk of deforestation due to extensive wood and waste burning for energy production.
- High costs associated with biomass construction, including harvesting, transportation, and storage.
- Requires addressing efficiency and environmental impacts for sustainable deployment.

WAY FORWARD

- **Scale up Production:** Encourage investments and incentives for dedicated infrastructure for increased biofuel production, storage and distribution.
- **Diversify Feedstock:** Explore alternative feedstock options to ensure sustainable availability.
- **Advanced Conversion Technologies:** Invest in R&D for improved conversion processes.
- **International Collaboration:** Foster partnerships for knowledge sharing and access to advanced technologies.

NATIONAL BIOFUEL POLICY 2018

The **National Policy on Biofuels, 2018** provides a comprehensive framework for the development and promotion of biofuels in India.

Key Amendments to the National Policy on Biofuels, 2018:
- **More Feedstocks:** Government will allow additional feedstocks for biofuel production.
- **Ethanol Blending Target:** The target of 20% ethanol in petrol is advanced to 2025-26 from 2030.

- **SEZ/EoUs Promotion:** Biofuel production by units in Special Economic Zones (SEZ) and Export Oriented Units (EoUs) will be promoted under the Make in India program.
- **NBCC Membership:** Addition of new members to the National Biofuel Coordination Committee (NBCC).
- **Biofuel Export:** Permission for biofuel export in specific cases.

Significance of the Amendments:
- **Boost Make in India & Generate Employment:** Reduces petroleum imports and enhances biofuel production Attracts development of indigenous technologies, fostering job creation.
- **Promote Atmanirbhar Bharat:** Encourages self-reliance by allowing more feedstocks and aiming for energy independence by 2047.

- India launched the Global Biofuel Alliance on the sidelines of the G20 Summit in New Delhi. It is an effort to form an alliance of governments, international organizations, and industry to promote biofuels.
- **Aim:** Position biofuels as key to energy transition, contributing to jobs and economic growth by uniting major consumers and producers.
- **Members:** 19 countries and 12 international organizations, including major supporters like the USA (52% ethanol production), Brazil (30%), and India (3%).

Significance for India

- Strengthens India's global stance as a G20 presidency outcome.
- Opens avenues for Indian industries in technology and equipment exports.
- Boosts existing biofuel programs like PM-JIVAN Yojana, SATAT, and GOBARdhan, enhancing farmers' income and job creation.
- The global ethanol market, valued at USD 99.06 billion in 2022, is expected to grow at a CAGR of 5.1%, reaching USD 162.12 billion by 2032.
- IEA predicts a 3.5-5x growth in biofuels by 2050 due to Net Zero targets, offering significant opportunities for India.

METHANOL ECONOMY

- The Methanol Economy refers to a concept that proposes methanol as a potential alternative to fossil fuels. It involves utilizing methanol as a clean and sustainable energy carrier.
- Methanol can be produced from various sources such as natural gas, biomass, or even carbon dioxide.
- The Methanol Economy offers the potential for reduced greenhouse gas emissions and greater energy security.

FACT-WISE

- **Capacity**: India has an installed Methanol Production capacity of 2 MT per annum. As per the plan prepared by NITI Aayog, using Indian High Ash coal, Stranded gas, and Biomass can produce 20 MT of methanol annually by 2025.
- **NITI Aayog:** Methanol Economy will also create close to 5 million jobs through methanol production/application and distribution services.

BENEFITS OF METHANOL ECONOMY

- **Energy Security:** Methanol's potential as a substitute for petrol, diesel, and cooking fuel.
- **Import Dependency Reduction:** Cost-effectiveness of methanol and its potential to reduce fuel bills.
- **Cheaper and Efficient Fuel:** Methanol's affordability and cost advantage compared to other fuels.
- **Make in India Boost:** Promoting indigenous fuel production and fostering growth in the automobile sector.
- **Job Creation:** Potential for job creation in methanol production, application, and distribution services.
- **Near Zero Pollution:** Methanol's clean burning properties and reduced emissions.

INITIATIVES AND PROGRAMS

- **NITI Aayog's Roadmap:** Substituting a portion of crude imports with methanol by 2030.
- **Methanol Economy Research Program:** Focusing on methanol production from various sources, including coal and CO2.
- **Standards and Notifications:** BIS notification for blending 20% DME with LPG and regulations for different methanol blends.
- **Transportation and Railway Blending:** Evolving test standards and plans for blending methanol in transportation fuels. **Notification for M-15, M-85, M-100 blends** issued by the Ministry of Road, Transport and Highways.
- **Methanol Cooking Fuel Program:** Launch of Asia's first canister-based methanol cooking fuel program by Assam Petrochemicals.

ETHANOL BLENDING PROGRAM

Ethanol Blending: An ethanol blend is defined as a blended motor fuel containing ethyl alcohol that is at least 99% pure, derived from agricultural products, and blended exclusively with gasoline.

- The central government has advanced the target of 20% ethanol blending in petrol (also called E20), by five years to 2025, from 2030.

- The Government has also released an expert committee report on the 'Roadmap for Ethanol Blending in India by 2025'.

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- India has achieved 10% ethanol blending target in June 2022.
- Ethanol distillation capacities to double by 2025 and achieve a 20 % blending target.
- About 5 crore sugarcane farmers & their families and 5 lakh workers associated with sugar mills & other ancillary activities would be benefitted from this intervention.

SIGNIFICANCE OF ETHANOL BLENDING

- **Energy Security:** Expanded ethanol usage can contribute to lowering India's oil import bill, with potential savings of USD 4 billion (Rs 30,000 crore) annually through the E20 program.
- **Carbon Neutral and decarbonising economy:** Ethanol combustion from biomass is considered carbon neutral as the growing biomass absorbs CO2, potentially offsetting the CO2 emissions during ethanol burning.
- **Incentives for Farmers:** Ethanol procurement by oil companies benefits sugarcane farmers, while the government encourages water-saving crops like maize for ethanol production.
- **Employment generation:** Can lead to the expansion of sugarcane, corn, and grain plantations, the establishment of ethanol processing plants, and creates job opportunities.
- **International commitment:** It will help India to fulfill its pledge to reduce its carbon footprint from the 2005 levels by 33-35% by 2030.

CHALLENGES

- **Insufficient Production:** Domestic bioethanol production cannot meet the demand for blending with petrol at Indian OMCs.
- **Impact on Food and Water Security:** High demand for food grains and sugarcane (Water intensive crop) for ethanol production may impact food and water security by diverting agricultural resources away from food production.
- **Price Uncertainty:** Government-fixed prices for ethanol and sugarcane create investor concerns about bioethanol pricing.
- **Compatibility Issues:** Vehicle manufacturers need to optimize engines and develop parts compatible with higher ethanol blends.
- **Infrastructure Challenges:** Retail outlets need additional infrastructure for ethanol-blended fuel, causing space constraints.

WAY FORWARD

- **Uniform availability of ethanol blends:** All the states have to implement the amended Industries Development and Regulations Act for facilitating the Inter-state movement of ethanol.
- **Providing tax incentives:** to absorb the R&D cost on E20 compatible design
- **Augmenting Ethanol producing capacity:** To achieve 20% ethanol blending, India needs to increase sugarcane-based and grain-based ethanol production capacities by 78% and 187% respectively, as per NITI Aayog.
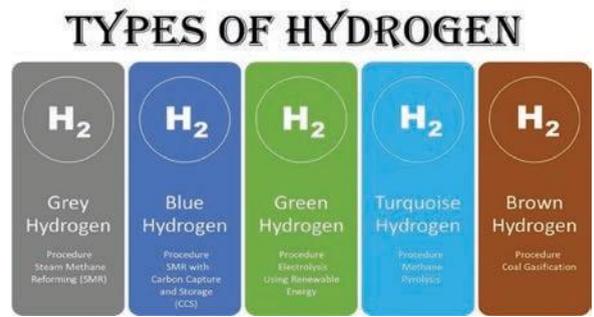
HYDROGEN-BASED ENERGY

Hydrogen is a clean fuel. It is an energy carrier that can be used for a broad range of applications. It could serve as a possible substitute for liquid and fossil fuels.

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- India consumes about 6 million metric tonnes of grey hydrogen per annum, which is about 8.5 per cent of the global hydrogen demand.
- India targets production of ~5 MMT of Green Hydrogen by 2030 under the National Green Hydrogen Mission.
- In October 2020, Delhi became the first Indian city to operate Hydrogen-enriched CNG (H-CNG) buses in a six-month pilot project.

ADVANTAGES OF HYDROGEN OVER CONVENTIONAL FUEL

- **High Calorific Value:** Hydrogen boasts nearly 2.5 times the energy per tonne compared to natural gas.
- **Abundant in the Environment:** Hydrogen is readily available in the environment.
- **Steel Production Alternative:** It serves as an alternative to coke and coal in steel production.
- **Fuel Cell and Electric Vehicle Usage:** Hydrogen can be utilized in fuel cells or electric vehicles.
- **Rapid Refueling:** Refueling can be performed at a fast rate.

TYPES OF HYDROGEN — Grey Hydrogen (Procedure Steam Methane Reforming (SMR)); Blue Hydrogen (Procedure SMR with Carbon Capture and Storage (CCS)); Green Hydrogen (Procedure Electrolysis Using Renewable Energy); Turquoise Hydrogen (Procedure Methane Pyrolysis); Brown Hydrogen (Procedure Coal Gasification)

ISSUES AND CHALLENGES

- **Expensive:** Although it is widely available, it is time-consuming to separate hydrogen gas from its companion substances.
- **Difficult to store:** Hydrogen is very difficult to store. Its transportation even in a small amount is very expensive.
- **Highly flammable:** Since it is a very powerful source of fuel, hydrogen can be very flammable. Hydrogen gas burns in air at very wide concentrations – between 4 and 75 per cent.
- **Not Easy to Replace Existing Infrastructure:** There is not much infrastructure that can support hydrogen as fuel. Also, cars need to be refitted in order to accommodate hydrogen as fuel.

GOVERNMENT INITIATIVES

- **National Hydrogen Energy Mission (2022):** Focus on the generation of hydrogen from green power resources. Aims to link India's growing renewable capacity with the hydrogen economy.
- **National Hydrogen Energy RoadMap (NHERM) (2003):** To accelerate the development of the hydrogen energy sector in India, an NHERM was prepared and adopted by the National Hydrogen Energy Board in January 2006 for implementation.
- **Hydrogen Hubs and Demonstration Projects:** The government plans to establish hubs and projects for research, development, and deployment of hydrogen technologies.
- **Green Hydrogen Auctions:** SECI proposed auctions to procure green hydrogen and create a market, encouraging investments in its production.
- **Hydrogen-Ready Policy Framework:** The government is developing a policy framework addressing regulatory and safety aspects of hydrogen utilization.

WAY FORWARD

- **Capacity-building:** India can leverage R&D investment, capacity building, and favorable legislation to create demand among its vast population.
- **Industry Collaboration:** Collaborative efforts between the government and industries are crucial for establishing a hydrogen economy in India.
- **Prioritizing Green Hydrogen:** Promotion of Green Hydrogen over other production methods.

NATIONAL GREEN HYDROGEN MISSION

The National Green Hydrogen Mission aims to position India as a global leader in green hydrogen production, reducing reliance on fossil fuels. India targets production of **5 MMT of Green Hydrogen by 2030** under the National Green Hydrogen Mission.

SUB-COMPONENTS OF THE MISSION

Strategic Interventions for Green Hydrogen Transition Programme (SIGHT)	Incentives to promote domestic manufacturing of electrolysers and green hydrogen production.
Pilot Projects	Support for pilot projects in emerging sectors to establish Green Hydrogen Hubs for large-scale production or utilization.
Strategic Hydrogen Innovation Partnership (SHIP)	Facilitation of a public-private partnership framework to drive research and development aligned with global standards.
Skill Development	Implementation of a workforce development program to enhance skills.

CHALLENGES IN SCALING UP GREEN HYDROGEN MARKET

- Low level of technology readiness.
- Insufficient renewable electricity availability.
- Lack of institutionalized mechanisms for tracking hydrogen production and consumption.
- Policy and regulatory uncertainty.
- Energy losses in hydrogen production and conversion.

WAY FORWARD

- Incentive programs for various components within the green hydrogen or ammonia production chain.
- Partial waivers on grid charges, taxes, and levies for electrolysers.

Expected outcomes of the National Green Hydrogen Mission by 2030

- 5 MMT Per Annum Production capacity
- 125 GW Renewable Energy Capacity Addition
- Rs 8 lakh crore+ Total Investments
- 6 lakh+ Full Time Jobs
- 50 MMT per annum CO2 Emissions Expected to be Averted

ELECTRIC VEHICLES POLICY

Electric Vehicles: Electric vehicles (EVs) use one or more electric motors for propulsion instead of an internal combustion engine (ICE).

NEED FOR A NATIONAL EV POLICY IN INDIA

- To Improve air quality of cities and fulfill the rising demand for EVs in India.
- **Achieve EV Targets by 2030:** 30% of private cars, 70% of commercial cars, 40% of buses, and 80% of two and three-wheelers.
- Fulfill international commitments, such as the Panchamrita target of net-zero carbon emissions by 2070.

GOVERNMENT STEPS TO PROMOTE EV

- National Electric Mobility Mission Plan (NEMMP) 2020.
- Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles in India (FAME India) Scheme.
- Reduced GST on electric vehicles from 12% to 5%.
- Green license plates are provided for battery-operated vehicles.
- Indian Railways aims to replace a significant portion of its fleet with EVs by 2025.

Challenges of EV Industry: Inadequate charging infrastructure, high costs of EVs, fire accidents, Limited domestic manufacturing capabilities and Import dependence for rare earth elements and Lithium.

WAY FORWARD

- Reduce upfront costs through enhanced subsidies and waiving road taxes.
- Promote other technologies such as flex-fuel vehicles and hydrogen-based vehicles.
- Expedite the extraction of lithium and formulate safety standards to build consumer trust.

Electric Mobility Promotion Scheme 2024
- It aims to further accelerate the adoption of Electric Vehicles in the country.
- It is for faster adoption of electric two-wheeler (e-2W) and three-wheeler (e-3W) to provide further impetus to the green mobility and development of electric vehicle (EV) manufacturing eco-system in the country.

BATTERY ENERGY STORAGE SCHEME

Energy storage is the capture of energy produced for later use to reduce imbalance between energy demand and energy production. Energy Storage Systems (ESS) can be used for storing available energy from Renewable Energy and further can be used during peak hours of the day.

- Government unveils BESS Scheme to energize the nation for a brighter tomorrow
- Projects with total capacity of 4,000 MWh to be developed by 2030-31
- Financial support of up to 40% of capital cost as budgetary support in the form of Viability Gap Funding
- Initial outlay of Rs.9,400 crore, including a budgetary support of Rs.3,760 crore
- Scheme expected to bring down cost of battery storage systems increasing their viability
- 85% of BESS project capacity to go to Discoms to benefit end consumers

FUTURE OF GREEN ENERGY IN INDIA

Green energy, derived from renewable and zero-emission sources, is poised to play a significant role in India's energy landscape. With increasing accessibility and favourable prospects, India stands to benefit from clean energy while overcoming challenges in its adoption.

OPPORTUNITIES AND PROSPECTS

- **Environmental Impact:** Clean energy offers significant carbon dioxide emission reductions and fuel demand savings, contributing to India's climate change mitigation efforts.

- **Energy Independence:** Diversifying the energy mix reduces dependence on imported fuels, enhancing energy security and reducing financial and environmental costs.
- **Cost Savings:** Renewable clean energy sources, such as solar and wind, provide inherent cost savings by eliminating the need for fuel extraction and transportation.
- **Growth Sectors:** The transition to renewable and clean energy presents opportunities in areas ranging from eMobility to power generation and storage, fostering economic growth and job creation.

CHALLENGES
- **Power Generation Reliability:** Dependence on uncontrollable natural resources poses challenges in ensuring consistent power generation from renewable sources.
- **Power Quality Issues:** Maintaining high power quality is crucial for stability and efficiency, requiring investments to address frequency disorder, voltage variations, and transmission line issues.
- **Resource Location:** Large space requirements for renewable energy plants, dictated by location, can be a constraint for users.
- **Information Barrier:** Lack of awareness about renewable energy benefits and investment opportunities hampers its adoption. **Cost Implications:** High initial installation costs pose hurdles for the development of renewable energy projects.

WAY FORWARD
- **Strengthen Infrastructure:** Expand transmission infrastructure for efficient intra and inter-state power transmission.
- **Investment in R&D:** Support research and development programs and human resource development, along with local content requirements.

Green Fuels Alliance India (GFAI)
- Denmark initiated GFAI to strengthen collaboration with India in sustainable energy, aligning with both nations' carbon neutrality goals.
- Focuses on advancing the green fuels sector, especially green hydrogen, through innovation and partnerships.
- Aims to establish an ecosystem supporting sustainable energy growth in India, involving businesses, government bodies, and research institutions.
- Arises from the Green Strategic Partnership signed in 2020 between India and Denmark, coinciding with India's target for carbon neutrality by 2070 and Denmark's top ranking in the 2024 Climate Performance Ranking.

PREVIOUS YEAR QUESTIONS		
1.	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
2.	Explain the purpose of Green Grid Initiative launched at the World Leaders Summit of COP26 UN Climate Change Conference in Glasglow in November 2021. When was the idea first floated in the International Solar Alliance (ISA)?	2021
3.	Describe the benefits of deriving electric energy from sunlight in contrast to conventional energy generation. What are the initiatives offered by our Government for this purpose?	2020

10   ENVIRONMENT IMPACT ASSESSMENT (EIA)

INTRODUCTION

UNEP defines Environmental Impact Assessment (EIA) as a tool used to identify the environmental, social and economic impacts of a project prior to decision-making. It aims to predict environmental impacts at an early stage in project planning and design, find ways and means to reduce adverse impacts, shape projects to suit the local environment and present the predictions and options to decision-makers.

- By using EIA both environmental and economic benefits can be achieved, such as reduced cost and time of project implementation and design, avoided treatment/clean-up costs and impacts of laws and regulations.
- The EIA is a mandatory requirement under the Environmental (Protection) Act, 1986 for 29 categories of developmental activities involving investments of Rs. 50 crores and above.

OBJECTIVES OF EIA OUTLINED BY BRUNDTLAND COMMISSION

- Design the project proposal with a greener approach.
- Ensure that resources are utilised effectively and appropriately.
- Identify appropriate actions to lessen the potential effects of the proposal.
- Enable informed decision-making for putting the proposal into action.
- Protect the health and safety of people.
- Serious environmental harm and irreversible changes.
- Preserve the ecology, natural environment, and resources that have been evaluated.
- Strengthen the proposal's social components.

GUIDING PRINCIPLES OF EIA

- **Participation:** It provides to inform and involves the interested and affected public and their inputs and concerns in the documentation and decision-making.
- **Transparency:** It ensures public access to the information, identifies the factors that are taken into account in decision making and acknowledges limitations and difficulties.
- **Efficient**: It imposes the minimum cost burdens in terms of time and finance on proponents and participants.
- **Accountability:** The decision-maker should inform decision-making and result in inappropriate levels of environmental protection and community well-being.
- **Credibility:** It involves professionalism, vigour, fairness, objectivity, impartiality, and balance and is subject to independent checks and verification.
- **Cost-effective:** The process should achieve the objectives of EIA within the limits of available information, time, resources, and methodology.
- **Integrated:** The process should address the interrelationships of social, economic and biophysical aspects.
- **Practicality:** The process should result in information and outputs which assist with problem-solving and are acceptable to and able to be implemented.
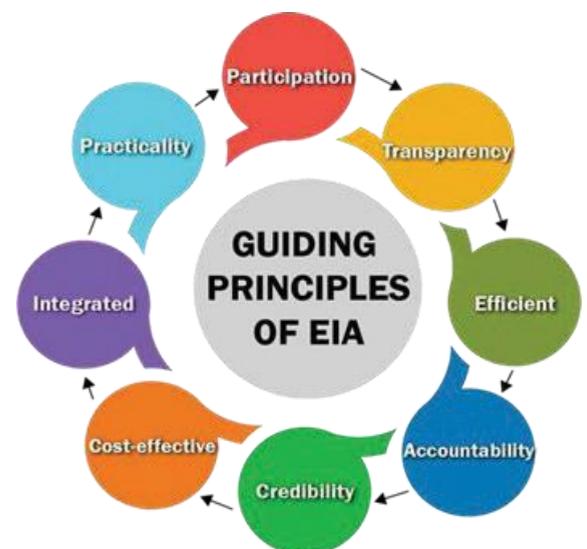
PROCESS OF EIA

- **Identification:** Of potential impacts, zone of impacts, mitigation possibilities and need for monitoring.
- **Screening:** for scale of investment, location and type of development and statutory clearance, if needed.
- **Scoping Alternative**: Identification and comparing alternative and its environmental attributes. Alternatives should cover both project location and process technologies.
- **Impact Prediction:** Predicting the positive and negative, reversible and irreversible and temporary and permanent impacts which presupposes a good understanding of the project by the assessment agency.
- **Mitigation:** actions and steps for preventing, minimizing or by passing the impacts or else the level of compensation for probable environmental damage or loss should be included.
- **Reporting:** by project authority which needs to furnish the Detail Project Report (DPR), Environment Impact Statement (EIS).
- **Public Hearing:** public and environmental groups living close to project site may be informed and consulted after completion of EIA report. The affected person may include: Bonafide local residents, local associations, Environmental groups active in the area or any other person located at the project site/sites of displacement.
- **Review:** Once the final report is prepared, it may be reviewed based on comment and input from stake holder.
- **Decision Making:** Keeping in mind the EIA, Impact Assessment Authority along with the experts consult the project- in-charge along with consultant to take the final decision.
- **Monitoring:** The various phases of implementation of the project are monitored.

Finally, an audit of the EIA process is carried out some time after implementation. The audit serves as useful feedback and learning function.

> **KEYWORDS:** Proactive Disclosure of Environmental Effects; Triple Bottom Line; 3Ps - People, Planet, Profit; Small Is Beautiful; Tragedy of commons; Polluter Pays Principle; Principle of trusteeship; Principle of Sustainability.

EIA NOTIFICATION, 2006

The 2006 Environment Impact Assessment Notification has decentralized the approval process for developmental projects, categorizing them into two groups: Category A and Category B.

For 'Category A' projects, a national-level appraisal is conducted by the Impact Assessment Agency (IAA) and the Expert Appraisal Committee (EAC), while **'Category B' projects** undergo appraisal at the state level.

State Level Environment Impact Assessment Authority (SEIAA) and State Level Expert Appraisal Committee (SEAC) are established to grant clearance to Category B projects.

After the 2006 Amendment, the EIA cycle involves four stages: Screening, Scoping, Public hearing and Appraisal. Mandatory environmental clearance is required for Category A projects, eliminating the need for the screening process.

On the other hand, Category B projects go through the screening process and are further classified into two types:

- Category B1 projects (Mandatory, requiring EIA)
- Category B2 projects (Exempt from EIA)

As a result, Category A and Category B1 projects undergo the complete EIA process, while Category B2 projects are excluded from the comprehensive EIA process.

ISSUES WITH NOTIFICATION

- **Lack Of Administrative Capacity:** To ensure compliance often renders long lists of clearance conditions meaningless.
- **Dampened The Spirit Of Liberalisation**: Leading to red tape and rent-seeking.
- **Screening**: Certain technological processes could be harmful to the environment.
- **Public Hearing Process**: A number of projects with significant environmental and social impacts have been excluded from the mandatory public hearing process.
- **Impact Prediction and Assessment of Alternatives:** Limited explanations are given both to quantitative estimation of the magnitude of impact and to the assumptions and judgments.
- **Scoping**: Public comments are not taken into account at the early stage, which often leads to conflict at the later stage of project clearance.
- **Formation of EIA Team**: Lacking expertise in various fields such as Anthropologists and Social Scientists to study the social impact of the project) or even wildlife experts.

DRAFT EIA NOTIFICATION,2020

EIA Notification, 2020	EIA Notification, 2006
• **Reduced Time for Public Hearings**: It reduces the notice period for public hearings from 30 days to 20 days. • **Exemption of Projects**: A, B1 and B2, category projects are exempted from public scrutiny. • **Post-Clearance Compliance**: To ensure that no further environmental damages take place. • **Annual Submission of Reports**: To submit compliance reports annually whereas as per the 2006 notification, the compliance report to be submitted every six months. • **No Public Reporting for Non-Compliance**: Rather, the government will take a look at reports only from the violator-promoter, government authority, Appraisal Committee or Regulatory Authority. • **Post-facto Clearance**: However the judiciary has held, as in the case of Alembic Pharmaceutical vs. Rohit Prajapati in April 2020 that "environment law cannot countenance the notion of an ex post facto clearance."	• **Categorization Of Projects**: Two categories namely; Category 'A' and Category 'B' based on their impact potential. • **Category Appraisal Authority**: Category 'A' is appraised at the Central level while Category 'B' is at the State level. • **Committees**: State-level Environment Impact Assessment Authorities and Committees (SEIAAs and SEACs) have been constituted for the purpose of appraisal of Category 'B' projects. • **International Practice Incorporation**: Improve the quality of EIA thereby improving the quality of decision-making and minimizing the delays. • **Public Consultation Process**: Two components i.e., comments through correspondence and by a public hearing at the site. • **NOCs**: It does not require No-Objection Certificates from other regulatory organisations like the SPCB or others.

Current status: The 2020 draft Environment Impact Assessment (EIA) Notification was criticized by many environmentalists and conservationists, who called for its withdrawal. The EIA Notification, 2006 remains the governing legislation for EIAs in India.

ISSUES ASSOCIATED WITH THE DRAFT EIA 2020

- **Opens The Floodgates Of Violations**: Post-Facto Clearance is likely to encourage industries to commence operations without bothering clearance.
- **Strengthens The Government But Weakens The Public**: The government's discretionary power will limit public engagement in safeguarding the environment.
- **Easy clearance For 'strategic' Projects**: This opens a window for clearance for any project deemed strategic without having to explain why.
- **Reduced time Means Reduced Awareness**: Reducing the notice period for a public hearing from 30 days to 20 days.
- **Non-conformity to International Frameworks And Conventions**: Like the Paris Climate Accord, etc.
- **Composition of Expert Committees**: The present executive committees should be replaced by experts' people from various stakeholder groups, who are reputed in environmental and other relevant fields.
- **Sector-wide EIAs needed**: There is a need to conduct policy-level and sector-wide EIAs in the form of strategic impact assessments.
- **Quality of EIA Reports**: The checklist needs to include impacts on agricultural biodiversity, biodiversity-related traditional knowledge and live hoods.
- **Public Hearings**: The public hearing should be held for all projects which are likely to have environmental and social impacts.

WAY FORWARD

- **Strengthening public participation and transparency:** Ensure meaningful public involvement at all EIA stages, with clear criteria for consultation, disclosure, and grievance redressal mechanisms.
- **Preventing post-facto clearance and violations:** Strict adherence to prior environmental clearance, stringent penalties for non-compliance, and timely enforcement. Enhance compliance reporting, monitoring, and involve independent agencies for verification.
- **Improving data quality and availability:** Ensure accurate, reliable, and updated data through standardized scientific methods. Promote the use of secondary data sources for validation, such as satellite imagery and GIS.

- **Enhancing capacity and expertise:** Ensure project stakeholders possess adequate capacity and expertise. Set minimum qualifications and accreditation for EIA practitioners, provide regular training programs, and encourage best practices and innovation.

EIAs are an important tool for ensuring that development projects are planned, designed, and implemented in a way that minimizes their negative impacts on the environment.

> **Some Case Studies to look at:**
> While the effectiveness of EIA in India is debated, there have been some notable success stories where it has demonstrably led to positive environmental outcomes. Here are a few examples:
> - **Gujarat RIL Refinery Expansion Project:** This case, though initially controversial, is often cited as an example of a comprehensive EIA leading to significant environmental improvements. The EIA identified potential impacts on air, water, land, and biodiversity and recommended mitigation measures like upgrading local infrastructure, providing healthcare, and managing pollution. While concerns remain about implementation, the project did incorporate many of the EIA's recommendations.
> - **Mumbai-Ahmedabad High-Speed Rail Corridor:** This project's EIA, conducted jointly by India and Japan, was lauded for its detailed assessment of potential impacts on various environmental components, including noise, wildlife, and water resources. The EIA also explored alternative alignments and mitigation measures, ultimately leading to a revised route with reduced environmental impact.

Environmental Supplement Plan (ESP)

> An Environmental Supplemental Plan (ESP) is an environmentally beneficial project or activity that is not required by law, but that an alleged violator of Environmental Impact Assessment Notification, 2006 agrees to undertake as part of the process of environmental clearance. **While not legally mandated, the ESP is part of the environmental clearance process.** The term "environmentally beneficial" signifies that an ESP aims to remediate, enhance, protect the environment, or mitigate risks to public health and the environment.

PARIVESH: A WEB-BASED PLATFORM FOR ENVIRONMENTAL CLEARANCES IN INDIA

PARIVESH is a crucial web-based platform in India for streamlining the process of acquiring environmental clearances. Launched in 2018 by the MoEFCC, it has revolutionized the way proposals are submitted, tracked, and monitored for environment, forest, wildlife, and Coastal Regulation Zone (CRZ) clearances.

BENEFITS OF PARIVESH

- **For proponents**: Reduced costs and time delays, improved transparency and predictability, easier access to information.
- **For authorities**: Streamlined workflow, improved efficiency and decision-making, better data management.
- **For the environment**: More sustainable development practices, reduced environmental impact of projects.

COMPARATIVE PERSPECTIVE: INDIAN EIA VIZ-A-VIZ OTHER COUNTRIES' EIA

EIA In India	EIA In Other Countries
• Legislated formally under the **Environmental Protection Act, 1986**	• Developed countries such as Canada and EU countries have **well framed legislation or directives**. Whereas, in many African nations, it is not mandatory.
• **Limited involvement** of government and public agencies in initial stages.	• Developed countries promote **active involvement of all stakeholders** from early stages itself. This prevent aftermath conflicts and makes process robust.
• Mainly focused on **environmental aspect**.	• Integrated approach, includes social and health factors.
• Screening based on **threshold values** on the size of the projects.	• Screening, for instance in Canada, is done by federal authority. In Japan, screening decision is taken by authorizing agency.

• Reports mostly in **English**. In some cases, executive summary is translated into local language.	• Reports mostly in **local languages**.
• Selection of consulting agency **based on fees** rather than expertise.	• Involvement of **experts**, focused on **multi-disciplinary approach.**
• EIA review is **not upto the mark**.	• **Two tier review**. First, after completion of EIA and other, before decision making.

**STRATEGIC ENVIRONMENTAL ASSESSMENT (SEA)**

- It is a set of policies, plans and programmes, keeping in mind that the process of evaluating environmental impacts at a strategic level, is not necessarily the same as that at a project level.
- It aspires for better coordination between pertinent agencies, innovative cross-sectoral actions, and recommendations for the quality of future project EIAs are all things that SEAs might offer.
- It can help to focus and streamline how environmental issues, including biodiversity, are considered during decision- making.

SOCIAL IMPACT ASSESSMENT (SIA)

Social Impact Assessment (SIA) is a systematic process used to identify, analyze, and evaluate the potential social impacts of a project, plan, or policy. It aims to understand how these interventions might affect individuals, communities, and society, considering both positive and negative consequences.

SIGNIFICANCE

- **People's ways of life:** that is, how they live, work, play and interact with one another on a day-to-day basis.
- **Cultures:** That Is Their Shared Beliefs, Customs, Values and Language or Dialect.
- **Community:** Its Cohesion, Stability, Character, Services and Facilities.
- **Health And Well-Being:** Health is a state of complete physical, mental, social and spiritual well-being and not merely the absence of disease or infirmity. India And SIA:
- The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act required SIAs in India in 2013.
- Any large project must undertake an SIA within six months of the project's commencement date in accordance with the 2013 land acquisition law.

Scoping → Profiling → Assessment → Mitigation → Monitoring
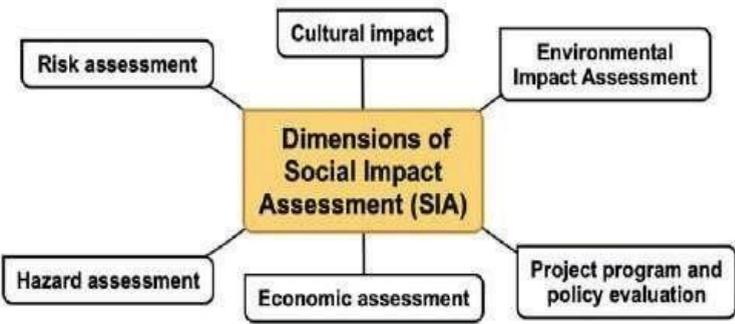
SIAs can be resource and time-intensive, which leads some business owners to view them as bureaucratic red tape. However, considering ethnic diversity and Agriculture as dominant occupations.

WAY FORWARD

- **Strengthening public participation and transparency:** Ensure meaningful public involvement at all EIA stages, with clear criteria for consultation, disclosure, and grievance redressal mechanisms.
- **Preventing post-facto clearance and violations:** Strict adherence to prior environmental clearance, stringent penalties for non-compliance, and timely enforcement. Enhance compliance reporting, monitoring, and involve independent agencies for verification.
- **Improving data quality and availability:** Ensure accurate, reliable, and updated data through standardized scientific methods. Promote the use of secondary data sources for validation, such as satellite imagery and GIS.

- **Enhancing capacity and expertise:** Ensure project stakeholders possess adequate capacity and expertise. Set minimum qualifications and accreditation for EIA practitioners, provide regular training programs, and encourage best practices and innovation.
- **Reduce The Time Period In Granting Clearances**: Bring down the average delay of 238 days in granting environmental clearance.
- **Policy Nature**: Grow now, and sustain later should not be the policy, as the notion is dangerously tilted against the concept of sustainable development.
- **Capacity Building:** NGOs, civil society groups and local communities need to build their capacities to use the EIA notification towards better decision-making on projects.

Strengthening the application of EIA is urgently needed, and fair and impartial decisions call for an independent EIA authority. **EIA has often fallen short of meeting the following aims like,** it takes place relatively late at the downstream end of the decision-making process after major alternatives and directions have been chosen.

PREVIOUS YEAR QUESTIONS		
1.	How does the draft Environment Impact Assessment (EIA) Notification, 2020 differ from the existing EIA Notification, 2006?	2020
2.	"In spite of adverse environmental impact, coal mining is still inevitable for development." Discuss	2017
3.	Environmental impact assessment studies are increasingly undertaken before the project is cleared by the government. Discuss the environmental impacts of coal-fired thermal plants located at Pitheads.	2014

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