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UPSC Mains GS-3

ENVIRONMENT AND BIODIVERSITY

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FOR UPSC CIVIL SERVICES EXAMINATION

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Previous Year Questions (GS 3)

2024

1. Industrial pollution of river water is a significant environmental issue in India. Discuss the various mitigation measures to deal with this problem and also the government's initiatives in this regard. (10 Marks)
2. What role do environmental NGOs and activists play in influencing Environmental Impact Assessment (EIA) outcomes for major projects in India? Cite Your examples with all important details. (10 Marks)
3. Flooding in urban areas is an emerging climate-induced disaster. Discuss the causes of this disaster. Mention the features of two such major floods in the last two decades in India. Describe the policies and frameworks in India that aim at tackling such floods (15 Marks)

2023

4. 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)
5. 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)
6. 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)
7. 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)

2022

1. Each year a large amount of plant material, cellulose is deposited on the surface of Planet Earth. What are the natural processes this cellulose undergoes before yielding carbon dioxide, water and other end products? (2022)
2. Discuss in detail the photochemical smog emphasizing its formation, effects and mitigation. Explain the 1999 Gothenburg Protocol. (2022)

3. 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 light of the Kyoto Protocol, 1997. (2022)
4. Explain the causes and effects of coastal erosion in India. What are the available coastal management techniques for combating the hazard? (2022)

2021

1. 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)?
2. 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?
3. Describe the major outcomes of the 26th session of the Conference of the Parses (COP) to the United Nations Framework Convention on Climate Change (UNFCCC)? What are the commitments made by India in this conference?

2020

1. How does the draft Environment Impact Assessment (EIA) Notification, 2020 differ from the existing EIA Notification, 2006?
2. What are the salient features of the Jal Shakti Abhiyan launched by the Government of India for water conservation and water security?
3. Suggest measures to improve water storage and irrigation system to make its judicious use under depleting scenarios.
4. What are the key features of the National Clean Air Programme (NCAP) initiated by the Government of India?

Ecology and Ecosystem

Threats to ecosystem:

- Habitat Loss and Fragmentation: Eg. Mining in Western Ghats
- Pollution: Contaminates ecosystems
- Climate Change: Rising temperatures disrupt ecosystems, leading to habitat loss, altered migration patterns, and increased extinction risks.
- 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 GMOs 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:
- Transition to renewable energy sources,
- 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: partnerships among governments, organizations, communities, and indigenous peoples

- Sustainable Development Planning: Integrate biodiversity considerations ensuring that economic development is balanced with environmental conservation.
- 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
- Creation of Indian Environment Service (IES): To recruit qualified and skilled human resources in the environment (Recommended by TSR Subramanian Committee)
- Circular Economy: Embracing the principles of a circular economy, where resources are reused, recycled, or repurposed to minimize waste.

Climate Change

Introduction

- Climate change is defined as a long shift in temperature and weather patterns. Such a shift can either be natural, such as volcanic activity or anthropogenic, such as the burning of fossil fuel. (United Nations)
- Climate change is the statistically significant and persistent variation in either the mean state of the climate or in its variability, over an extended period of time. (World Meteorological Organisation)
- 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.
- In 2022, the global mean temperature was 1.15°C above the average of the period between 1850-1900. (State of Global Climate Report, 2022 by WMO)

Climate Change - Causes

Natural Causes:

- Volcanic activity: emission of GHGs such as sulphur dioxide (SO2), water vapour, dust, and ash into the atmosphere.
- Oceanic circulation: Changes in the natural oscillations such as El Niño-Southern Oscillation (ENSO) and the Atlantic Multidecadal Oscillation (AMO), affect the distribution of heat and moisture.
- Variation in solar activity: Sunspot activity, fluctuation in incoming solar radiation etc. can influence climate change.

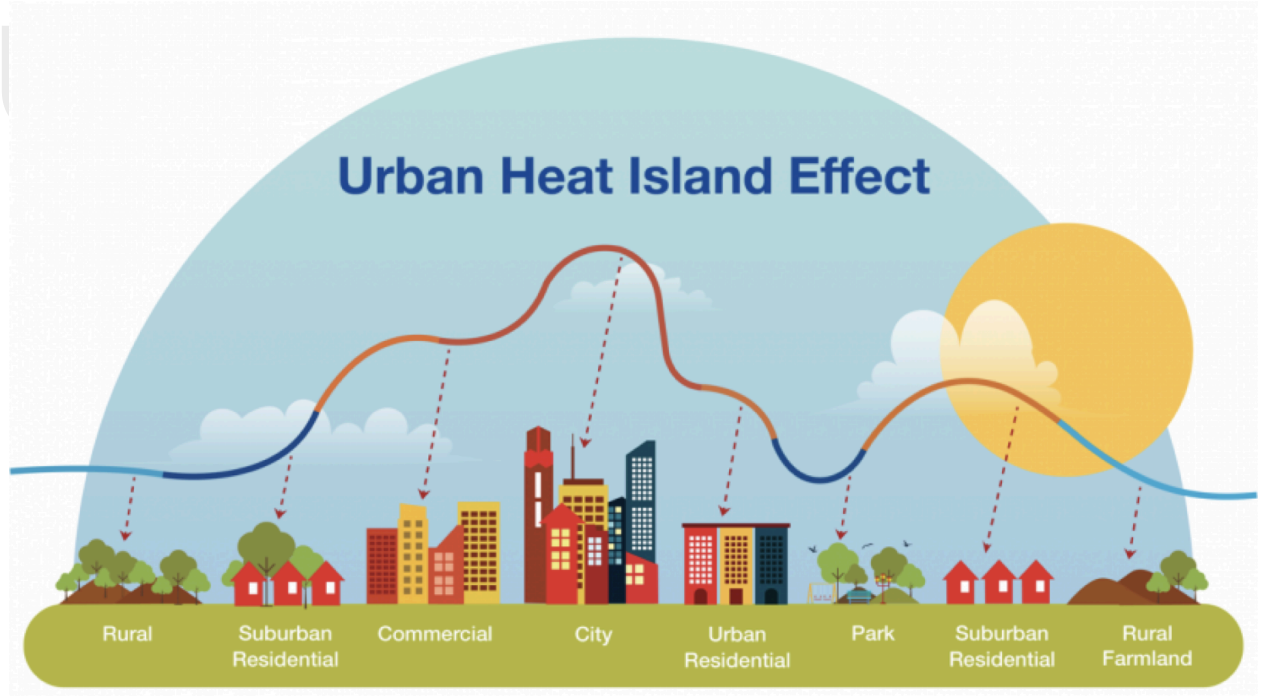
Anthropogenic Causes:

- Generation of electricity: Persistent burning of fossil fuels for the generation of electricity and heat. Eg. 60% + electricity in India is thermal power
- Deforestation: Forests have been cleared for pasture land, agriculture or for urban development. This has destroyed natural carbon sinks.
- Aerosols: Aerosols cause scattering and absorption the solar and infrared radiation. For instance, black and brown carbon has a warming effect on the Earth's atmosphere, while others, like sulphate droplets, cool it.
- Over-consumption: Consumerist lifestyle is responsible for a high carbon footprint.

- Transportation: Private vehicle emission is one of the major causes of GHG emissions in India and globally. (Share in India's Emissions (2019): 9%)
- Agricultural Emissions: Agriculture contributes 23% to global GHG emissions.

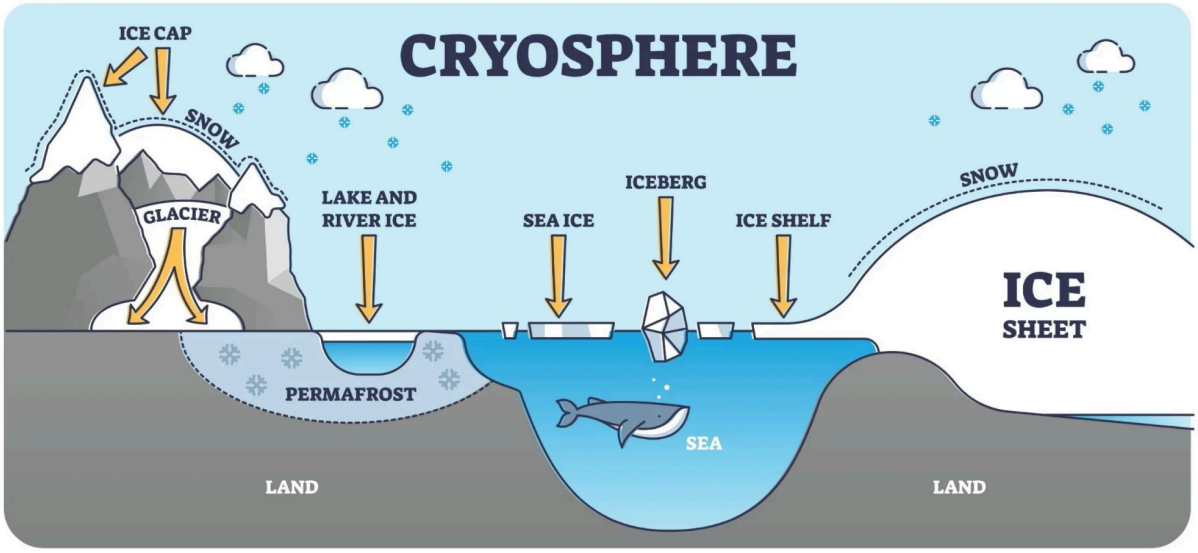
Climate Change - Consequences

- Heat Waves:
    - Frequency and severity of heatwaves have risen significantly in India over the last three decades (IMD and the Indian Institute of Tropical Meteorology (Pune))
    - Urban Heat Islands
    - Sunstrokes — deaths
    - Reduced human output
    - Expenditure on cooling appliances
    - Ecological damages. Eg. wildfires in Amazon, western ghats.



- Shrinking Cryosphere
    - Importance of Cryosphere: highest albedo, supply of freshwater.
    - Consequences:
        - Water scarcity
        - Rise of sea level

- Loss of coastal wetlands - due to submergence
- Habitat loss —> loss of biodiversity
- Coastal livelihood in danger - climate migrants
- Submergence of Small Island Developing States
- Changes in major weather patterns. Eg. Erratic monsoons.
- Salinisation of groundwater in coastal regions
- Change in vegetation due to loss of ice. Eg. Tundra in Arctic regions
- Carbon emission - carbon stored in ice caps will be released

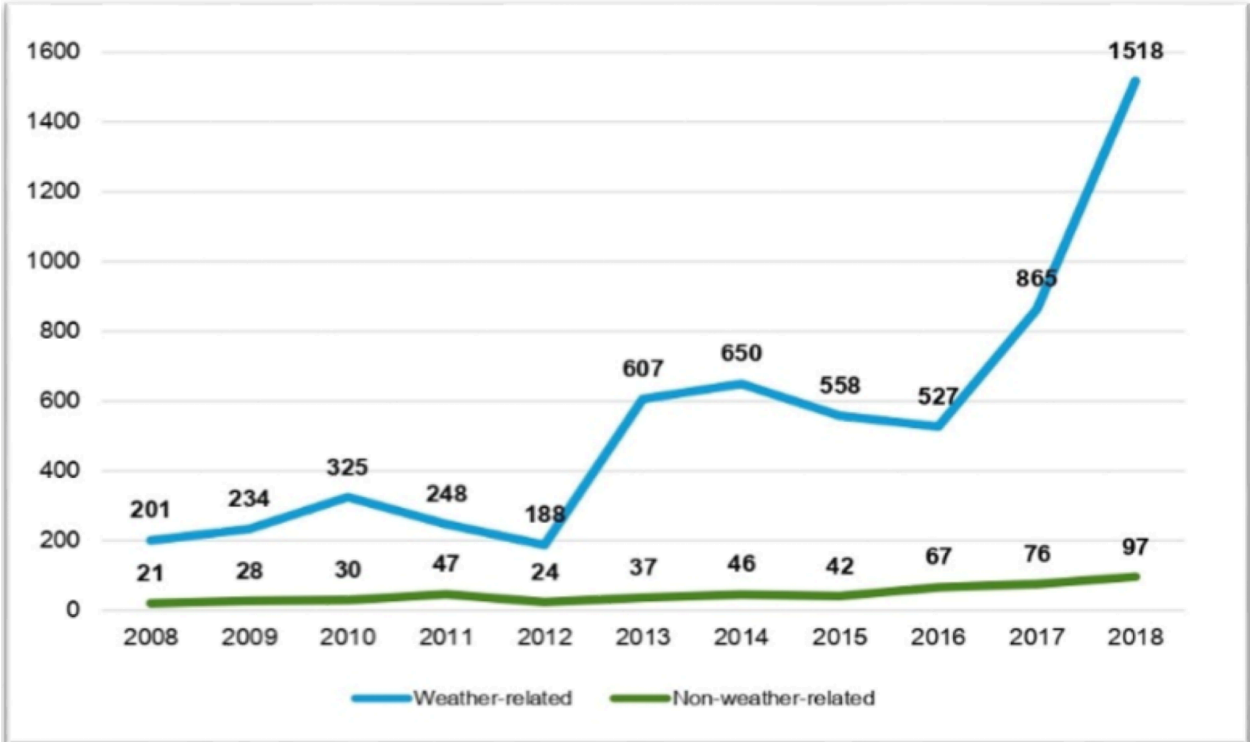


- Tropical cyclones - increased frequency: The Arabian Sea is heating rapidly and driving more cyclones, and excessive rainfall (excessive rainfall in sea → less moisture in monsoon winds → less rainfall on the mainland)
- Deterioration of Carbon sinks: High latitude forests store more carbon than tropical rainforests — one-third of the world's soil-bound carbon is in taiga and tundra areas.
    - In the 1970s, the tundra was a carbon sink but today, it is a carbon source.
- Carbon Dioxide Fertilization —> greening effect
- Ocean deoxygenation
    - Expansion of oxygen minimum zones (OMZs) in the world's oceans as a consequence of anthropogenic emissions of carbon dioxide.
    - Warmer oceans cause deoxygenation both because oxygen is less soluble in warmer water, and through temperature-driven stratification.
    - Deoxygenation —> acidification of oceans —> shell degradation
    - Loss of marine biodiversity (less O2 —> less phytoplanktons)

- Coral Bleaching (covered in Geography)
- Ocean acidification (covered in phase 1)
- Threat to biological diversity: For example, Bramble Cay melomys, the first mammal to go extinct due to climate change.
- Water stress and water insecurity: According to an estimate, due to climate change additional 1.8 billion people could be living in a water-scarce environment by 2080.
- Changing landscape: Shifts in temperatures and precipitation may reshape the boundaries between the landscapes including grasslands, shrub lands, forests and other ecosystems.
- Extreme climate events: More intense and devastating climate phenomena including, severe droughts, floods, storms, forest fires, etc.
- Economic loss
    - Money spent on adaptation/mitigation to climate change
    - Rebuilding post extreme climatic event and
    - According to the RBI's report, by 2030, extreme heat and humidity may adversely affect labour hours and up to 4.5 % of India's GDP could be at risk.
    - climate change could cost about 5 to 20% of the annual global GDP.

Social cost of carbon: The economic losses suffered due to the emission of one ton of carbon dioxide into the atmosphere. India's social cost of carbon: $86 per ton of CO2

- Social Consequences
    - Food security
    - Displacement and migration (Climate Migrants): 'climate refugees'. For instance, according to an estimate, by 2050, 17% of Bangladesh would be flooded, which may lead to 20 million climate refugees from Bangladesh, Sea level rise (Sundarbans), floods (Ganges, Brahmaputra basins), drought (central India, Vidarbha, Telangana, Rayalaseema), etc.
    - Health: Increased risk of new infectious diseases and spread of infection with climate refugees.
    - Social instability: Climate change exacerbates geopolitical tension and social inequality.



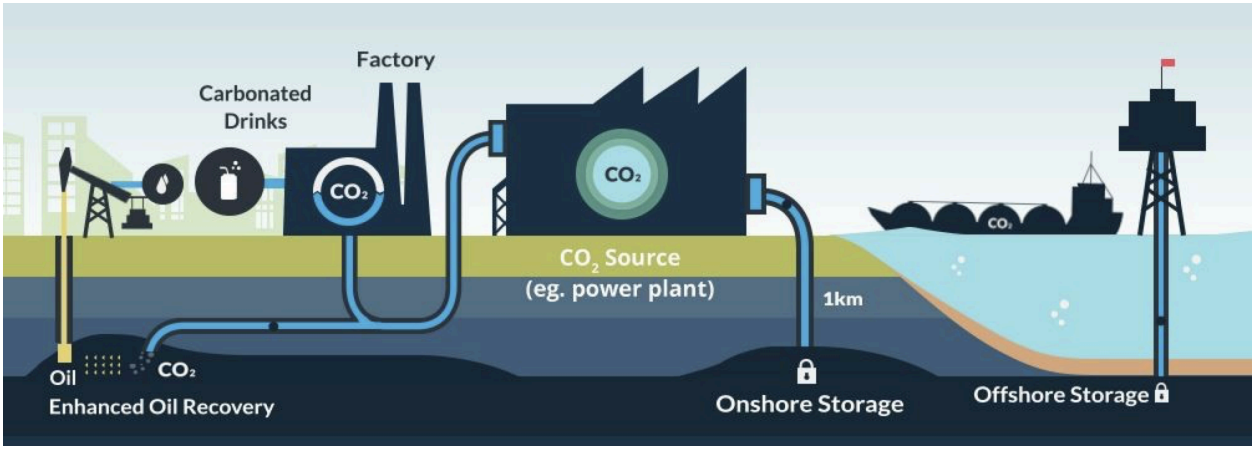
Impact of Climate Change on Vulnerable Sections

- **Children:** 6.7 million Children displaced in India alone (2016-2021) due to weather-related events. (UNICEF)
- **Women:** Only 2% of gender-tagged international adaptation finance is gender-responsive. (Adaptation Gap Report).
- Elderly: Heat-related deaths among those over 65 rose by 70% in 2 decades. (WHO)
- Rural Poor: Poor households lose 5% of their total income due to heat stress relative to better-off in an average year.

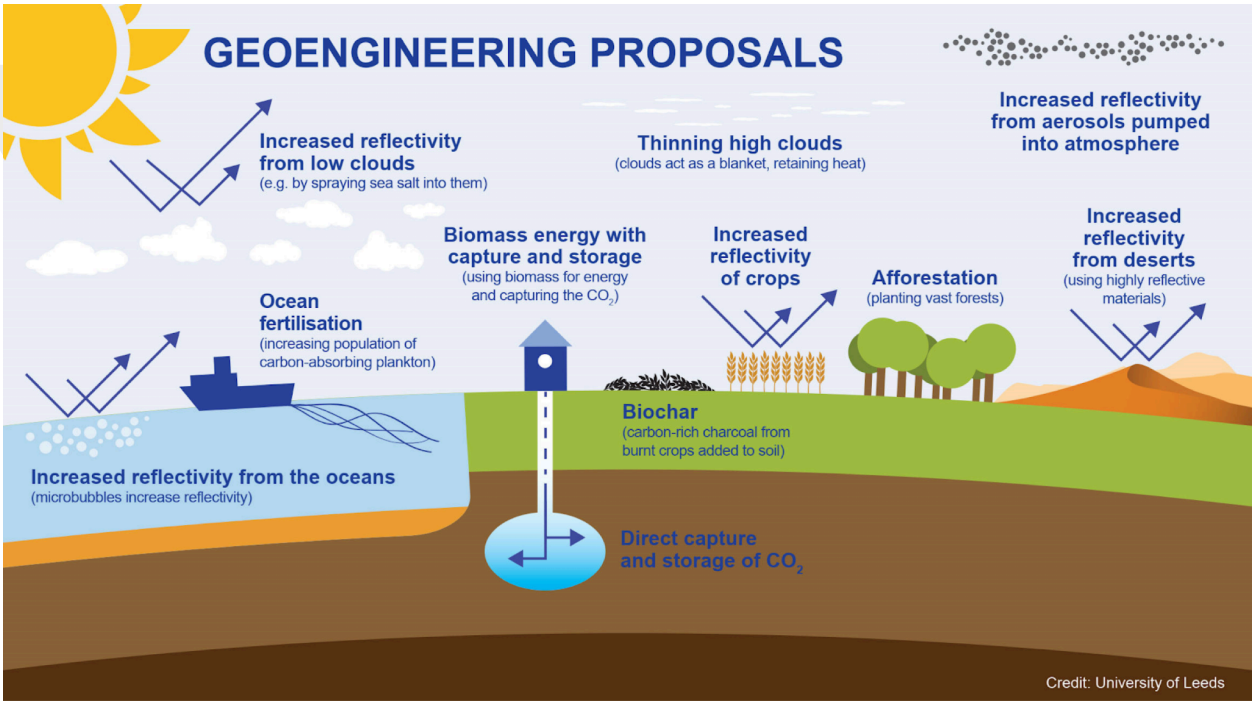
Climate change - mitigation

Involves avoiding and reducing GHG emissions into the atmosphere or removing them from the atmosphere

- Renewable energy
- Clean coal technology - coal purification, minimising emissions from coal, electrostatic precipitators
- Carbon Capture and Storage (CCS) —> Carbon Capture, Utilisation and Storage



- Carbon sequestration - Green carbon, blue carbon
- Geo-engineering - Emerging technologies that could manipulate the environment and partially offset some of the impacts of climate change.



Climate change - efforts

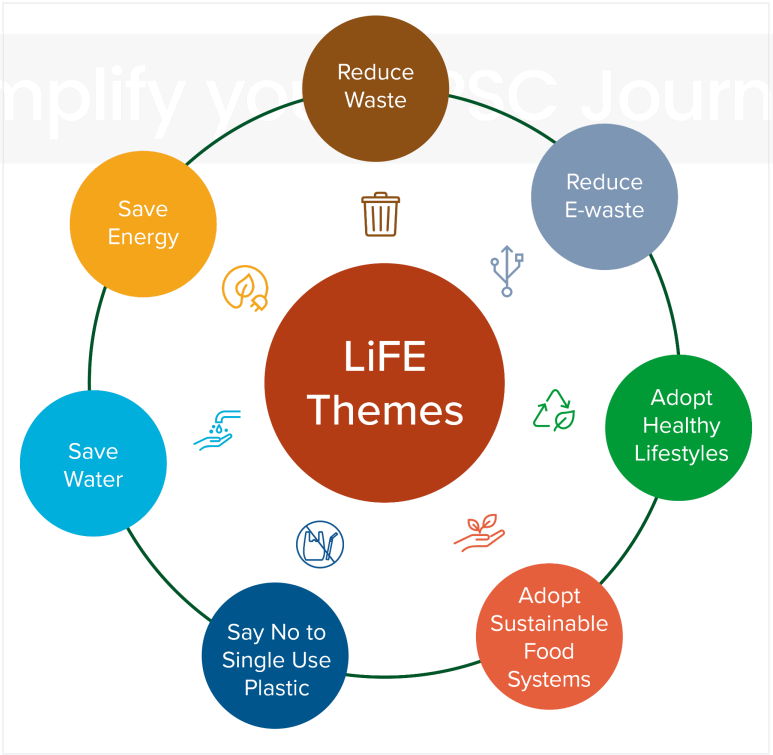
International Efforts:

- United Nations Framework Convention on Climate Change (UNFCCC): to stabilize greenhouse gas concentrations "at a level that would prevent dangerous anthropogenic (human-induced) interference with the climate system".
- 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.
- 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.
- Carbon Border Adjustment Mechanism (CBAM): An initiative by the European Union that would levy a carbon tax on products imported which are made from unsustainable processes.
- 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

National Efforts:

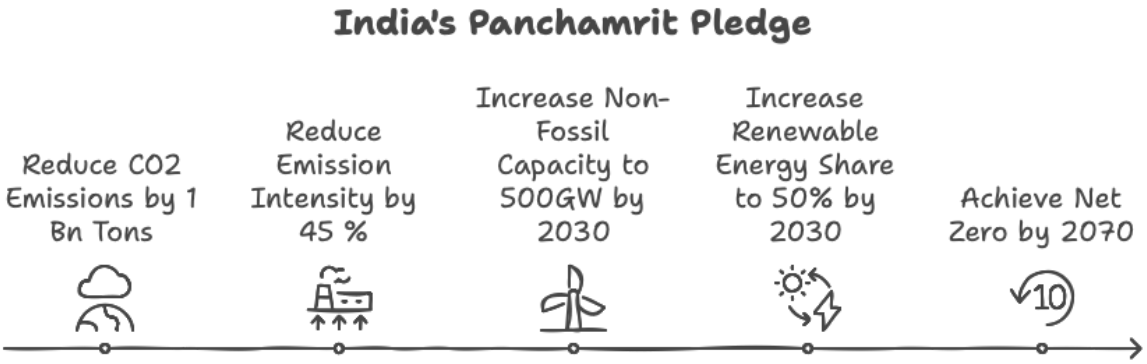
- National Action Plan on Climate Change (NAPCC):

- **Mission LiEF:** Changing lifestyle by inculcating long-term environmentally friendly habits



- **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 the Indian economy's emission intensity by 45%.
- Increase non-fossil fuel energy capacity to 500GW by 2030.
- Increase renewable energy share in the energy mix to 50% by 2030.
- Net zero by 2070.



Challenges to India's Climate Action

- High coal dependence - 65% Electricity using coal
- Environment vs Development:
- Population
- Agriculture emissions
- Flaws in Legal systems

Climate Justice

- Climate justice means putting equity and human rights at the core of decision-making and action on climate change.
- The concept has been widely used to refer to the unequal historical responsibility that countries and communities bear in relation to the climate crisis
- Acknowledges the social dimensions of climate change which affects people of different classes, races, genders, geographies, and generations unequally.
- Highlights concerns of vulnerable countries and communities

Fig. 6 Pillars of Climate Justice

UNFCCC (United Nations Framework Convention on Climate Change)

What is COP under UNFCCC?

- The Conference of Parties (COP) serves as the main governing body of the United Nations Framework Convention on Climate Change (UNFCCC).
- The UNFCCC is a 1992 treaty uniting 198 members (197 nations plus the European Union) against the threats of climate change.
- Each year, the COP gathers to review national emission data, monitor progress, and shape global climate policy.

Key milestones of COP

- **Kyoto Protocol (1997):** Established at COP3, it mandated emissions reductions for industrialised countries, setting a collective target of a 4.2% reduction by 2012 from 1990 levels.

- **Copenhagen Accord (2009):** COP15 introduced the 2°C warming limit and the concept of developed countries funding climate actions in vulnerable nations, though it fell short of delivering a new binding treaty.
- **Paris Agreement (2015):** At COP21, the landmark Paris Agreement set a goal to limit global warming to below 2°C, ideally at 1.5°C, and introduced Nationally Determined Contributions (NDCs) for each country.
- **Glasgow Pact (2021):** COP26 led to the "Glasgow Pact," which included commitments to reduce coal usage and phase out inefficient fossil fuel subsidies, marking coal in a UN climate agreement for the first time.
- **Loss and Damage Fund (2023):** COP28 launched a fund to support countries affected by climate disasters, addressing long-standing calls for financial assistance to those bearing the brunt of climate change.

Issues in COP

- Failure to deliver climate finance:
    - Developed countries, despite their 2009 pledge to provide $100 billion annually to developing nations, have yet to meet this promise.
    - A 2021 UN report projected that developing nations would require $6 trillion per year through 2030 to fulfil their climate goals, highlighting a vast shortfall in funding.
- Insufficient emission reductions:
    - While COP summits have led to emission pledges, these efforts remain inadequate.
    - The International Energy Agency's COP28 report indicated that, even with existing pledges, the world risks surpassing the critical 1.5°C warming threshold.
- Lack of consensus wrt Rules on Global Carbon market ,
- Focus is on reducing coal based emissions. Ignoring other fossil fuel like oil and gas.
- Limited Climate finance - inadequate to meet adaptation finance gap.
- Promotion of Marine geo engineering technologies - harms ignored
- Greenwashing: to persuade the public that an organisation's products, aims, and policies are environmentally friendly.

Way Forward

- Augmenting climate finance (Talanoa dialogue)
- Adhere to the Precautionary principle. Eg. Geoengineering
- Capacity building: eg. Funding to developing countries via GEF.

COP28

- 1st Global Stocktake Text: to assess individual countries' efforts to reduce Greenhouse Gas (GHG) emissions and transition to renewable energy sources. (Under Paris Agreement)
- Transitioning Away from Fossil Fuels - to achieve net zero by 2050
- Global Goal on Adaptation (GGA): enhancing adaptive capabilities, and minimising vulnerability for sustainable development.
    - Calls for doubling adaptation finance
    - The explicit 2030 date has been integrated into the text for targets on water security, ecosystem restoration, and health.
- Loss and Damage Fund: agreement reached to operationalise it.
    - Will be managed by World bank
- Global Renewables and Energy Efficiency Pledge -
    - Commit to work together to triple the world's installed renewable energy generation capacity by 2030
    - Collectively double the global average annual rate of energy efficiency improvements from around 2% to over 4% every year until 2030.
- The Global Cooling Pledge for COP 28: 66 countries committed to working together to reduce cooling-related emissions across all sectors by at least 68% globally relative to 2022 levels by 2050.
- Declaration to Triple Nuclear Energy: by 2050
- Green Credit Mechanism: a mechanism to incentivise voluntary pro-planet actions (launched by India and UAE)
    - replicate Carbon Credit Mechanism for other environmental actions, like water conservation or soil improvements
- Global River Cities Alliance (GRCA): launched at COP 28

- Led by the National Mission for Clean Ganga (NMCG) under the Ministry of Jal Shakti, Government of India.
- Highlights India's role in sustainable river-centric development and climate resilience.
- This platform will facilitate knowledge exchange, river-city twinning, and dissemination of best practices.

UNFCCC COP29

Key Highlights

- Location: Baku, Azerbaijan.
- New Climate Finance Goal: New Collective Quantified Goal on Climate Finance (NCQG). It aims to triple climate finance for developing countries to USD 300 billion per year by 2035 from the previous goal of USD 100, with developed countries taking the lead.
    - It also makes a general call on all actors to scale up climate financing to USD1.3 trillion per year by 2035 from all public and private sources to help developing countries mitigate and adapt to climate impacts.
- Carbon Markets Agreement: COP29 reached a landmark agreement to finalise the mechanisms for carbon markets, including country-to-country trading and a centralised carbon market under the United Nations (UN)
- Declaration on Reducing Methane: Over 30 countries, including the US, Germany, UK, and UAE, endorsed the COP29 Declaration on Reducing Methane from Organic Waste (India is not a signatory).
- Indigenous Peoples and Local Communities: COP29 reinforced the importance of Indigenous Peoples and local communities in addressing climate change.
    - COP29 adopted the Baku Workplan and renewed the Facilitative Working Group (FWG) mandate under the Local Communities and Indigenous Peoples Platform (LCIPP).
- Gender and Climate Change: A decision was made to extend the Lima Work Programme on Gender (LWPG) for another 10 years, reaffirming gender equality in

climate action and the need for a new gender action plan to be adopted at COP30 (Belém, Brazil).

- Baku Harmoniya Climate Initiative for Farmers: The COP29 Presidency in partnership with the Food and Agriculture Organization (FAO) launches the Baku Harmoniya Climate Initiative for Farmers.
    - It is a platform that brings together the dispersed landscape of existing climate initiatives in the field of food and agriculture, in order to make support for farmers easier to find and to facilitate access to finance.

Biodiversity

Biodiversity is defined as the variability among living organisms from all sources, including diversity within species, between species, and of ecosystems. (UN CBD)

- Approaches of conservation
    - In situ
    - Ex situ
- Important Efforts: CBD, CITES

Biodiversity in India

- Biodiversity Hotspots: India has 4 biodiversity hotspots out of 36
- Mega Biodiversity Nations: With 2.4% of the world's land area, India accounts for about 7-8% of recorded species of the world.
- High Endemic Diversity: 6,500 native plants
- Tropical Forests:
- 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: 91,000 species (6.5% of global fauna)

Threats to Biodiversity

- Natural:
    - Natural Disasters - eg. Amazon Forest Fire
    - Climate Change: Natural variations in climate. Eg. Mass Extinctions
    - Disease Outbreaks
    - Geological Events: Tectonic shifts, geological uplifts, and land subsidence can change habitats
    - Natural Climate Variability: Natural climate cycles like El Niño, La Niña
- Anthropogenic:
    - Habitat Loss and Fragmentation: Deforestation, urbanisation, and land conversion for agriculture (Rainforest: reduced from 14% area to 8%) —> Barrier effect (inbreeding)
    - Pollution: Air, water, and soil pollution from human activities

- Invasive Species: Non-native species outcompete native species, prey on them, or introduce diseases. Eg. Nile perch in Lake Victoria led to extinction of 200+ fish species, Destruction of shola grasslands
- Genetic Pollution: Loss of unique genetic traits in wildlife populations
- Illegal Wildlife Trade - hunting and Poaching
- Man-Animal conflicts

- The World Wide Fund for Nature (WWF) identified six key threats to biodiversity. They are: Agriculture, hunting, logging, pollution, invasive species, and climate change.

Consequences of Biodiversity loss

- Food Security: Eg. Loss of pollinators and decline in fish stocks due to biodiversity loss threaten agricultural productivity and food security.
- Economic Losses: Biodiversity loss impacts sectors such as tourism, forestry, fisheries, and pharmaceuticals
- Disruption of Ecological Balance: Biodiversity loss can result in the proliferation of invasive species and imbalances in ecosystems.
- Increased Vulnerability to Climate Change (Loss of resilience) : Eg. Mangroves
- Loss of Genetic Diversity: Biodiversity loss reduces the genetic variability within species, making them more vulnerable to environmental changes, diseases, and reduced adaptation abilities.
- Increased Risk of Infectious Diseases: eg. zoonotic diseases
- Social and Political Conflicts: between communities as access to dwindling resources becomes a source of tension
- Disrupted Ecological Feedback: Biodiversity loss can disrupt critical feedback mechanisms within ecosystems, such as predator-prey interactions, nutrient cycling, and energy flow

Efforts/Initiatives of Biodiversity Conservation

- Wildlife Protection Act (1972): This act provides legal protection to wildlife, and their habitats, and regulates hunting, poaching, and trade in wildlife and their products.

- Forest Conservation Act (1980): This act regulates the diversion of forest land for non-forest purposes and ensures the conservation of forests and wildlife habitats.
- Environmental Impact Assessment (EIA) Notification (1994):
- Biological Diversity Act (2002): This act aims to conserve biological diversity, regulate access to biological resources and associated knowledge, and ensure equitable sharing of benefits arising from their use.
- Protected Areas under Biodiversity Act: NP, WLS, CR, etc.
- Species-Specific Conservation Programs: Project Tiger, Project Elephant, Project Snow Leopard, Vulture Restaurants, Dolphin Conservation Program, etc.
- Restoration and Afforestation: National Afforestation Program (NAP), Green India Mission (GIM), Compensatory Afforestation Fund Management and Planning Authority (CAMPA), etc.
- Global Initiatives: CBD, CITES, WWF (NGO), REDD+, Man and Biosphere Program, Ramsar Convention, Bonn Convention, etc.
- Citizen led efforts: Chipko movement (by Bishnoi community), Appiko Movement, Narbada Bachao Andolan, etc.

Way Forward

- Conservation and Habitat Protection: Eg. Increasing National Parks
- Sustainable Land and Resource Use (Eg. Fishing)
- Combat Illegal Wildlife Trade
- Climate Change Mitigation and Adaptation
- Integration of Conservation into Policies
- Shailesh Nayak Committee 2015: On Coastal Regulation Zone
- Kasturirangan Committee 2015: on conservation of Western Ghats
- Madhav Gadgil in 2010: Eco sensitive zones / W. Ghats
- Protecting Sacred Groves

Man-Animal Conflict

- Reasons:
    - Habitat loss and fragmentation
    - Population growth

    - Illegal Activities - poaching, timber
    - Adverse climatic events. Eg. Draughts
    - Changing agricultural patterns. Eg. Sugarcane
- Impacts:
    - Loss of life and property
    - Retaliatory killing of wild animals
- Way forward:
    - Use of technology - trackers, drones, GPS, etc.
    - Integrated wildlife corridors. Eg. Eco Bridges (see image)
    - Buffer zones outside protected areas

Conservation

Forest Conservation

- Forest conservation is the practice of planning and maintaining forested areas for the benefit and sustainability of future generations.
- India's INDC: To create additional carbon sink of 2.5 to 3 bn tonnes of CO2 equivalent through additional forest and tree cover by 2030
- National Forest Policy, 1988 aims to have min. 33% of area under forest cover and tree cover.
- India State of forest report 2021: Forest and Tree Cover is is 24.62% of total area
- 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.

Significance of Forests

- Habitat for plants/animals (home to 80% of the world's terrestrial biodiversity)
- Provides humans - food, medicines, shelter, timber etc.
- Ecosystem services - recreational activities, soil and air purification, nutrient recycling, prevents soil erosion, etc.
- Climate change mitigation - Carbon sink (green carbon)
- 300 mn + people live in forests globally

Threats to Forests

- Natural: forest fires, disasters (floods, landslides, etc.), invasive species, plant/animal diseases
- Anthropogenic: Climate change, deforestation, monoculture, overgrazing, diversion of land, pollution, shifting cultivation, developmental projects, urbanisation, etc.

Consequences of Forest degradation

- Impact on Water Cycle
- Biodiversity: Every year, deforestation causes the extinction of around 50,000 species
- Economic Impact: deforestation can impact 7% of GDP by 2050

- Drastic temperature variation
- Increased Greenhouse Gases
- Soil Erosion and Flooding

Policies/Acts for Forest Conservation

- Forest Conservation Act, 1980: regulates diversion of forests for non-forest purpose
- Wildlife Protection Act 1972 - creates protected areas (NP, WLS)
- Environment Protection Act
- National Afforestation Program and National Mission for Green India
- Compensatory Afforestation Fund Management and Planning Authority (CAMPA)
- Forest Fire Prevention and Management Scheme
- National Green Tribunal Act, 2010 - for speed justice delivery involving environmental protection, the preservation of forests and other natural resources

International efforts for forest Conservation

- UNFCCC Forest Principles: recommendations for the conservation and sustainable development of forestry
- Convention on Biological Diversity
- Bonn Challenge - 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.
- REDD, REDD+
- Forest Carbon Partnership Facility

Hurdles in Forest Conservation

- Limited Budget
- Poor enforcement mechanisms
- Top down approach - low involvement of local communities in forest conservation
- Definition of forest covers includes plantation (eg. Coffee plantations)
- Forest conservation vs. rights of indigenous people.

Way forward

- Policy reforms - budget, capacity building, clear policies, updates as per changing circumstances, strict enforcement mechanisms

- Expansion of protected areas
- Encourage community based forest management (bottom up approach)
- Innovative techniques - eg. Social forestry, Agro-forestry, Environmental Fiscal Reforms
- Controlling forest fires

Mangroves

- Mangroves are salt-tolerant vegetation that grows in intertidal regions of rivers and estuaries. They are referred to as 'tidal forests'
- Over the past century, India lost 40% of its mangrove cover.

- **Importance of Mangroves**
  - Edge Effect - high species diversity
  - Provide ecological niches - serve as feeding, breeding, and nursery grounds for fisheries and also provide timber and wood for fuel.
  - They are most productive terrestrial ecosystems
  - Act as water filters and purifiers as well
  - Act as shock absorbers during disasters
  - Employment opportunities to local communities

- **Causes of mangrove degradation**
    - Sea Level Rise And Coastal Erosion
    - Reduction In River Water Levels - low rainfall, dams
    - Invasion By Alien Species
    - Pollution
    - Climate Change

- **Efforts**
    - Mangrove Initiative for Shoreline Habitats & Tangible Incomes (MISHTI) scheme - aimed at increasing the mangrove cover in India.
    - Global Mangrove Alliance (GMA): The goal of doubling mangrove coverage over existing levels by 2030
    - Mangroves for the Future (MFF): by IUCN and UNDP - gender integrated mangrove restoration
    - Blue Carbon Initiative - mitigating climate change through the conservation and restoration of coastal and marine ecosystems.
    - International Society for Mangrove Ecosystem (ISME): NGO

- **Way forward**
    - Use of bio-restoration to revive degraded stretches of mangroves
    - Maintaining species diversity while restoration
    - Systematic and periodic environmental monitoring of existing mangroves
    - Private sector cooperation
    - Community participation
    - Cultural practices can be leveraged in mangrove conservation: eg. Sacred Groves

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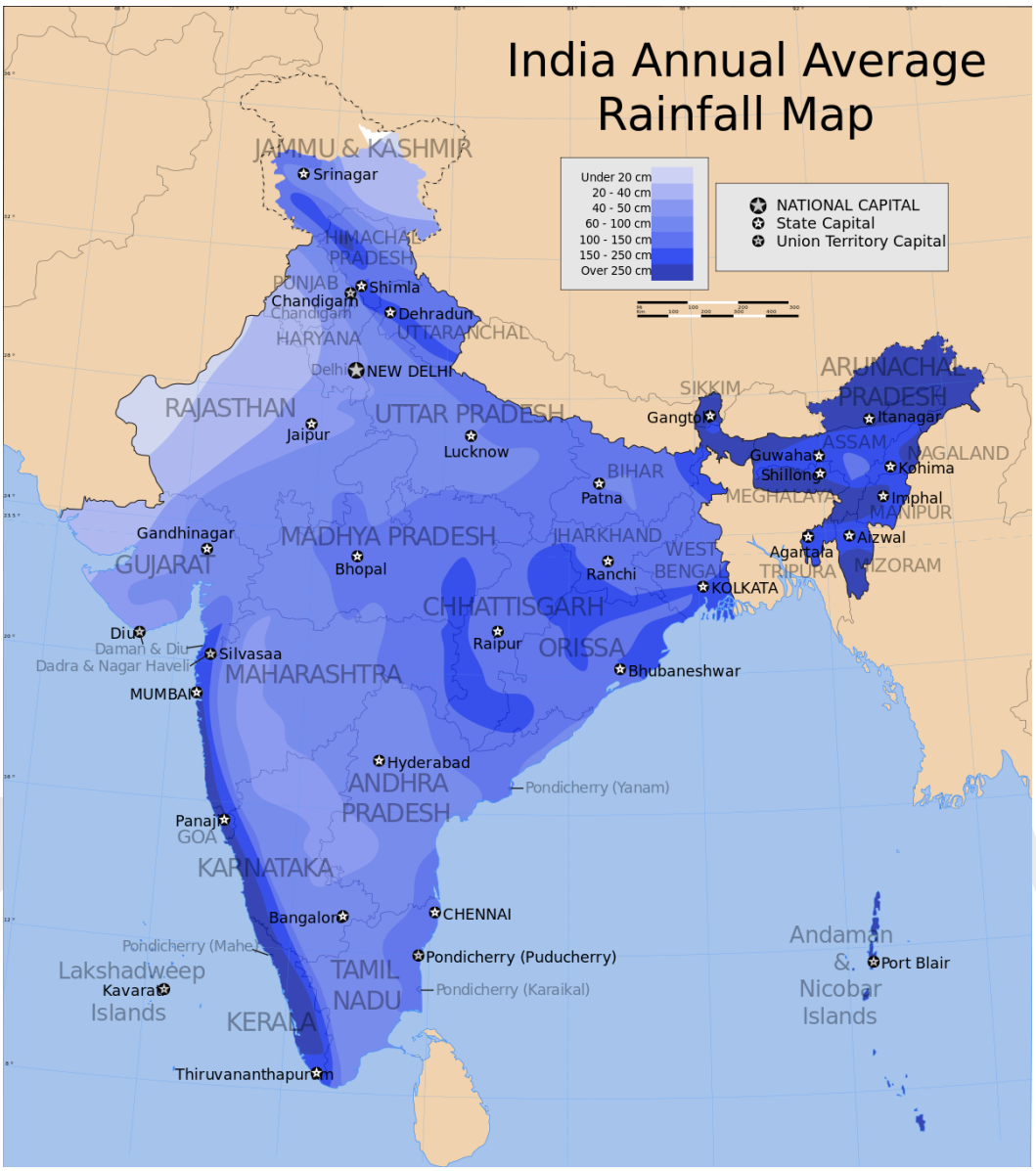
Water Conservation

- 100 cities (30 in India) face risk of severe water scarcity by 2050 (WWF)
- SDG6 - Clean water and Sanitation
- Over 70% of India's surface water (rivers, lakes) and groundwater is polluted.
- Key terminologies
    - Water scarcity: lack of adequate availability or supply of water.
    - Water stress: refers to the ability, or lack thereof, to meet human and ecological demand for water. It is caused either due to water scarcity or the unusable nature of the available water
    - Water risk: Probability of experiencing a harmful water-related event.

Issues related to Water

- Spatial and temporal variation in water (see map below)
- Increasing demand - falling per capita availability.
- Over-exploitation and depletion of groundwater
- Faulty cropping pattern
- Water quality: sewage and wastewater drainage into water bodies, the release of chemicals and effluents
- Poor storage infrastructure (only 6% rainwater is stored in India)



Impacts

- Economic Risks: Agriculture, industry
- Threat to livelihood of men, animals and trees (threat to biodiversity)
- Risk to food security - as Indian agriculture is mostly rainfed
- Health and Sanitation - 21% of communicable diseases in India are linked to unsafe water and the lack of hygiene practices (World Bank)
- Inter-state river water dispute
- Risk of energy shortages: thermal power plants need water

Groundwater Depletion - Causes

- Unsustainable usage of water: Overexploitation (water table in India declining every year by 0.4m)
- Over-dependence on Monsoon - if monsoon is weak then ground water is stressed
- Agriculture - irrigation (unsustainable crops like sugarcane)
- There are limited storage facilities owing to the hard rock terrain in central India.

Water Conservation - Efforts/Measures by Government

- Water - state subject
- National Water Policy (2012) - advocates for rainwater harvesting & conservation of water.
- Central Ground Water Authority (CGWA) has issued directions under the Environment Protection Act, 1986, for mandatory Rain Water harvesting for all target areas
- Central Ground Water Board (CGWB) envisages the construction of 1.11 crore rainwater harvesting & artificial recharge structures
- Creation of a new Ministry of Jal Shakti by merging Ministries of Water Resources, River Development & Ganga Rejuvenation with Drinking Water & Sanitation for dealing with all matters relating to water at one place in an integrated manner.
- Atal Mission for Rejuvenation and Urban Transformation (AMRUT)
- Pradhan Mantri Krishi Sinchayee Yojana – Watershed Development Component (PMKSY-WDC).

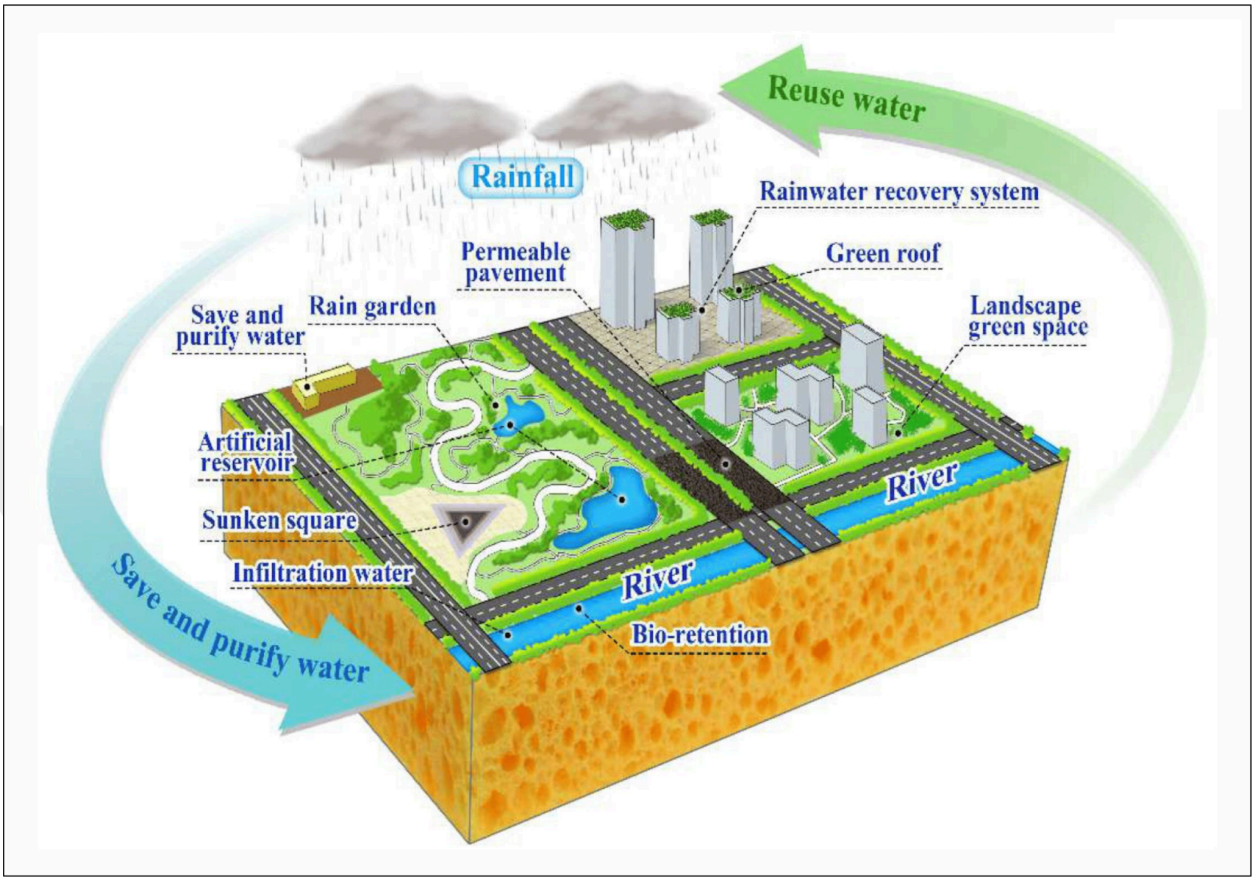
Water Conservation - Government Schemes/Initiatives:

- Atal Bhujal Yojana - Promote panchayat led groundwater management & behavioural change with a primary focus on demand-side (water consumption) management
- Jal Shakti Abhiyan - aims to make water conservation a ‘people’s movement’
- Jal Jeevan Mission - Envisions providing safe and adequate drinking water through individual household tap connections by 2024 to all households in rural India.
- Micro Irrigation Fund under NABARD

Water Conservation - Way Forward

- Clean water sanctuaries: planting organic food forests or fruit forests in floodplains

- Creating more Sponge Cities: cities in which water is Conserved + Stored + Recharged + Sustainably used. (fig. Sponge city)
    - It will create additional groundwater, reduce flood risks, reduce groundwater pollution, reduce burden on drainage systems, green urban spaces - aesthetic value, biodiversity conservation
- Promoting Micro irrigation
- Increasing water storage capacity



Water Conservation - Way Forward

- Sustainable irrigation practices - eg. Micro irrigation such as Drip irrigation (government has initiated schemes like the DRIP programme, Per drop more crop, Krishi Sinchai Yojana to ensure economical water use practices in agriculture)
- Policy reforms - eg. sugarcane farming
- Constructing farm ponds, check dams, etc
- Need for greater regulation & strict penalties
- Artificial recharge of tube wells, Water reuse, afforestation, etc.

Energy Conservation

- Energy conservation involves using energy efficiently, reducing wastage, and adopting technologies and practices that optimize energy usage.
- India is the world's third largest producer of renewable energy, with 40% of its installed electricity capacity coming from non-fossil fuel sources.
- INDC: reducing the carbon intensity by 45% by 2030

Importance of Renewable Energy

- Sustainable - clean, inexhaustible
- Energy Security - currently India depends on imports for coal and fossil fuels
- Environment friendly
- Creates employment
- Power supply: Providing 24*7 power supply to 100% of the households

Renewable Energy - Challenges

- High Capital Cost
- Unreliable and interrupted: eg. solar, wind
- Integration with the Main Grid
- Requires large area
- Unique challenges associated with - Solar, Wind, Hydro, geothermal, tidal
- Distribution companies (DISCOMS) in India are loss-making and unable to build infrastructure to help transition to renewable energy sources.
- Availability of critical minerals - eg. for solar panels

Measures to boost renewable energy

- IREDA - An NBFC promoting, developing & extending financial assistance for setting up projects relating to new & renewable sources of energy
- Green Bonds for Funding Renewables
- Energy Conservation Act 2001 - Legal framework that regulates energy consumption and promotes energy efficiency

- The Bureau of Energy Efficiency is a statutory agency under the Ministry of Power
- Energy Conservation Building Code (ECBC) - for commercial buildings

HOME WORK (Read these topics from any standard source that you are referring)

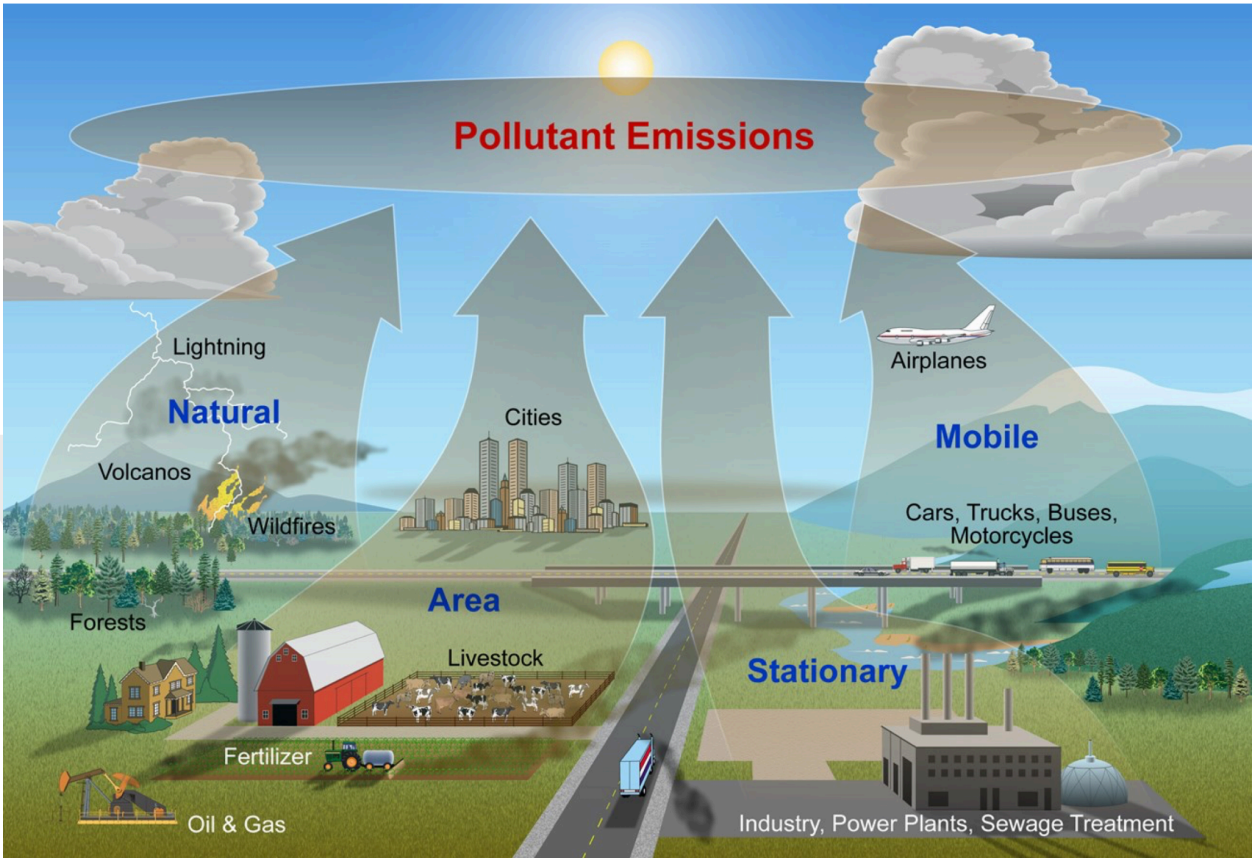
- Solar Energy - Importance, challenges, way forward
- Wind Energy - Importance, challenges, way forward
- Hydel Energy - Importance, challenges, way forward
- Biofuels - Advantages, Disadvantages, way forward, (Methanol Economy)
- Hydrogen economy - current state, scope, challenges

Pollution

Any undesirable change in physical, chemical or biological characteristics of air, land, water or soil.

Air Pollution

Sources



Causes (you can divide it in Natural and Anthropogenic)

- Vehicular pollution and Industries (Combustion of fossil fuels)
    - SOX, NOX, CO, CO2, VOCs, PM2.5, PM10
- Emissions from Agriculture, Waste Treatment and Biomass Burning - Methane, Ammonia, N2O etc.
    - Stubble Burning
- Indoor Air Pollution - causes about 3.8 million premature deaths each year.
- Fuel adulteration
- Waste Incineration/pyrolysis

Consequences

- Deaths: kills 800 people every hour or 13 every minute.
- Socio Economic Impacts: Impairs cognitive functioning and decision-making. It has a negative economic impact on work productivity. 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.
- Environmental Consequences: Acid rain, ocean acidification, smog, biodiversity loss, degradation of ecosystem, Eutrophication, global warming, ozone depletion, etc.

Initiatives in India

- National Clean Air Programme (NCAP): aims 40% reduction in particulate matter concentration by 2026.
- Graded Response Action Plan (GRAP)
- BS 6 Norms
- National Air Quality Index (AQI): Monitors 8 pollutants
- Pradhan Mantri Ujjwala Yojana (PMUY): Provides gas connections
- National Air Quality Management Commission: for Delhi NCR
- Vehicle scrappage policy

Way Forward

- Shutting of industries causing pollution
- Reducing vehicular pollution
    - EVs
    - Public transport. eg. Bus Rapid Transit (BRT) systems in Mexico City
    - Promoting walking and cycling (using Behavioural economics for this)
- Polluter pays principle
- Technological solutions
    - Oxy-furnace in industry
    - Anti-smog water guns or smog towers
    - Photovoltaic paints containing TiO2 - removes volatile organic compounds
    - WAYU- Wind Augmentation PurifYing Unit: by CSIR-NEERI (see image below)

    - Using zigzag technology in brick kilns
- Water sprinkling
- Mechanised sweeping of roads
- Arresting stubble burning: chemical treatment, use of mechanised equipments such as happy seeder, rotavire, etc., diverting stubble for bio-fuel production
- Stricter enforcement of emission controls
    - PUC norms
    - Emission treatment by Industries
- Citizen participation and the media

Home work: Delhi Air Pollution - Causes (study the issue of stubble burning in detail), impacts, current efforts, way forward

Practice Question

Mumbai, Delhi and Kolkata are the three mega cities of the country, but air pollution is a much more severe problem in Delhi compared to the other two. Why is this so?

Water Pollution

- Water pollution is the contamination of water bodies, usually as a result of human activities.
- SDG 6 (Clean Water & Sanitation): “Ensure universal access to and sustainable management of water and sanitation”.
- SDG 14: "Conserve and sustainably use the oceans, seas and marine resources for sustainable development”.
- 70 percent of the freshwater sources in India are contaminated (NITI Aayog)

Causes

- Discharge of wastewater from industries (Industrial Pollution). Eg. Petroleum
- Mining —> Heavy metal pollution (lead, nickel, chromium, cadmium, Mercury, copper)
- Thermal pollution
- Radiation leakage (radiation exposure) into water bodies. E.g., Fukushima Daiichi nuclear disaster.
- Underground water pollution due to leaching
- Drinking water pollution: Pollutants like fluorides, uranium, heavy metals and nutrients like nitrates and phosphates are common.
- Sewage water: contains human and animal ex- creta, food residues, cleaning agents, detergents, etc.
- Agricultural Runoffs:
- Uranium contamination due to overexploitation and uranium mining. Eg. in alluvial aquifers of Rajasthan
- Arsenic pollution - agriculture, mining, and manufacturing.
- Fluoride Pollution
- Invasive Aquatic Species. Eg. Water hyacinth

Effects

- Lower Dissolved Oxygen: due to higher biological and chemical oxygen demand —> threaten or even eliminate sensitive organisms such as plankton, molluscs, and several species of fish.
- Threaten the survival of several species. (Pollutants + changed temperature)

- Threats To Aquatic Species: Biocides, polychlorinated biphenyls (PCBs) and heavy metals are highly toxic to aquatic species.
- Diseases: Cause of water-borne diseases such as jaundice, cholera, typhoid, amoebiasis etc.
- Mercury Compounds In Wastewater: They are converted by bacterial action into extremely toxic methyl-mercury —> can cause the Minamata disease.
- Water Contaminated With Cadmium: causes itai-itai /ouch-ouch disease.
- Adverse Impact On The Water Bodies: eg River pollution
- Drinking water crisis

Marine Pollution

- Oil spills: leakage during marine transport, leakage from underground storage tanks, and during offshore oil production.
- Eg. Oil spill accident in the East China Sea in 2018 released more than 1,36,000 tonnes of volatile petroleum.

Marine Plastic Pollution

- Every year, at least 14 million tonnes of plastic end up in the ocean,

Marine Pollution - Causes

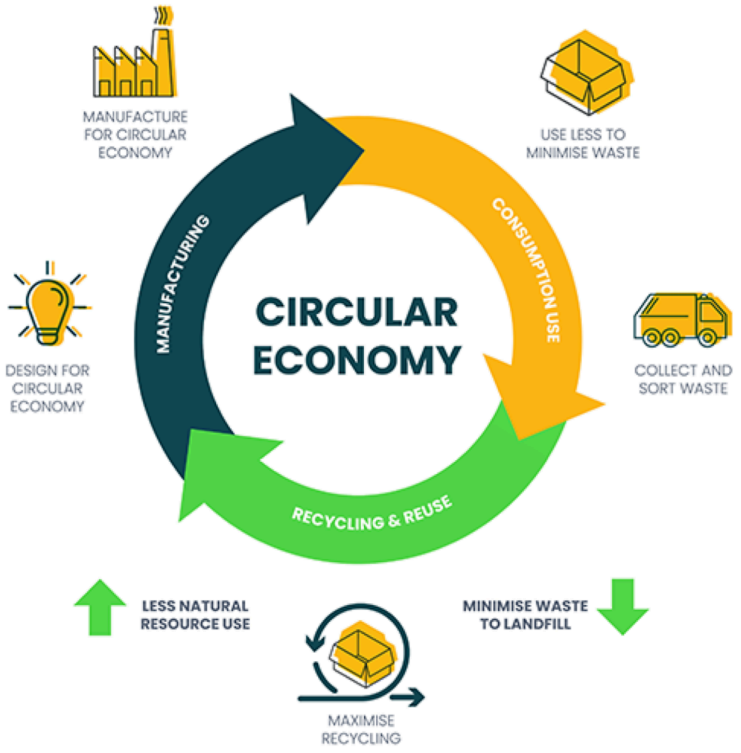
- Plastic Pollution. Eg. Great Pacific Garbage Patch (North Pacific Gyre).
- Oil spills
- Sewage or polluting substances flow through sewage, rivers, or drainages directly into the ocean.
- Toxic Chemicals from Industries
- Land Runoff: Land-based sources account for approximately 80% of marine pollution.
- Ocean Mining: Drills up to 3.5 km down into the ocean.
- Atmospheric Acidity (due to pollutants in air) Impacts Oceanic Ecology

Marine Pollution - Impacts

- Cutting off oxygen - as density of oxygen is low —> leads to death of aquatic organisms
- Difficulty in regulating marine animals body temperatures by coating feathers of seabirds, fur with oil spills which leads to hypothermia.
- Causes damage to their organs, impairing reproduction.
- Habitat Destruction: Eg. coral reefs, seagrass beds, and marshes
- Collapse of food web
- Threats to coastal ecosystem
- Threats to livelihood of communities depending on oceans

Controlling water pollution

- Bioremediation is the use of microorganisms (bacteria and fungi) to degrade environmental contaminants into less toxic forms.
- Limit agricultural Pesticides: Encourage organic farming & eco-friendly pesticide use.
- Eco-friendly wastewater/sewage treatment.
- Circular economy
- Reduce plastic use.



River Pollution

Sources

- Excess fertilizers and pesticides- runoff and drainage.
- Chemicals & Effluents: Industrialisation along the river belt. Eg. river Yamuna is 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
- Washing & Sewage: Laundering clothes on river banks
- Cremation & Last Rites: Cremation grounds in rural India are located on the banks of rivers like Varanasi.
- Sand Dredging
- 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.

River Pollution - Consequences

- Loss of Livelihood, impact on flora and fauna, marine pollution, food security, water security, diseases, loss of agricultural productivity, economic impacts

River Pollution - Schemes/Policies/Initiatives

- National River Conservation Plan
- National Water Monitoring Programme (NWMP) of CPCB.
- Namami Gange programme.
- Creation of sewerage infrastructure under schemes like Atal Mission for Rejuvenation and Urban Transformation (AMRUT) and Smart Cities Mission.
- Water Prevention and Control of Pollution Act, 1974
- To assess the efficacy of river cleaning programmes, the CPCB has been ordered by NGT to launch a nationwide programme on biodiversity monitoring and indexing of the rivers.
- River Cities Alliance for sustainable management of urban rivers.

Constraints

- Improper management of surface runoff, domestic discharge, agricultural affluents etc.
- Suboptimal performance of Sewage treatment plants (STs) due to inappropriate technology and capacity.
- Changes in flow of water due to climate change, temporal and spatial variation of rainfall.
- Growing urbanization and industrialisation in close vicinity of river streams.
- Lack of regular river quality monitoring.

Way forward

- Strict implementation of recycling and reuse of wastewater after treatment.
- The drains shall discharge sufficiently treated effluent in proportion to self-cleaning capacity of rivers.
- Effective Solid waste management.
- Suitable bioremediation measures to not discharge untreated water directly to the river.
- Widespread and intense awareness programme to inform them about the serious implications of river pollution.
- Provide sufficient water in the river for ecological flow and dilution, by:
    - Constructing storage structures at the upstream, which can continuously release discharge for meeting dilute requirementsts.
    - Improving water use efficiency so that less diversion of water is needed for consumptive usage.

Home work

- Soil Pollution - causes, consequences, solutions
- Waste management in India - current scenario, issues, way forward

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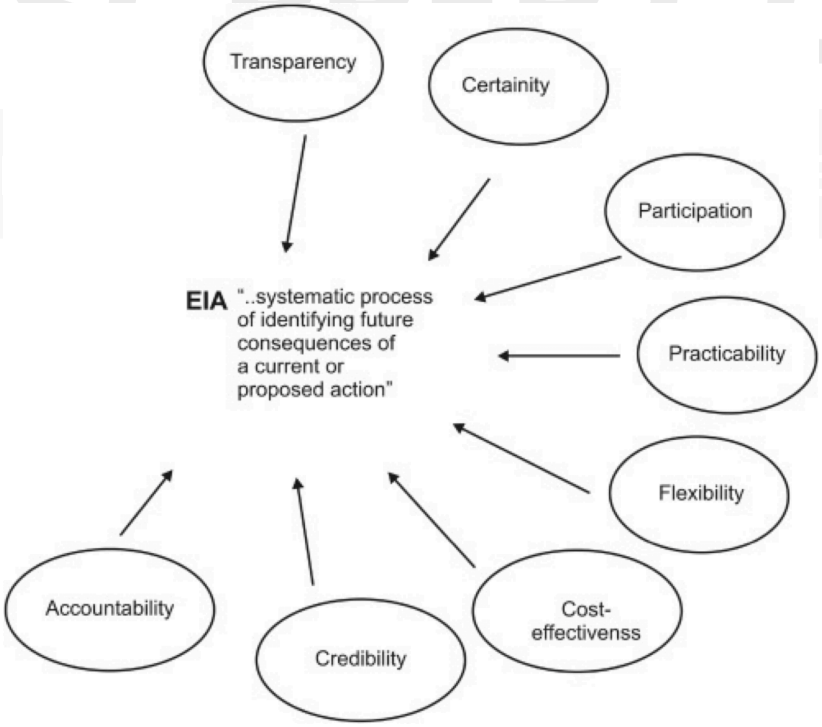
Environmental Impact Assessment (EIA)

It is a tool used to identify the environmental, social and economic impacts of a project prior to decision-making. (UNEP)

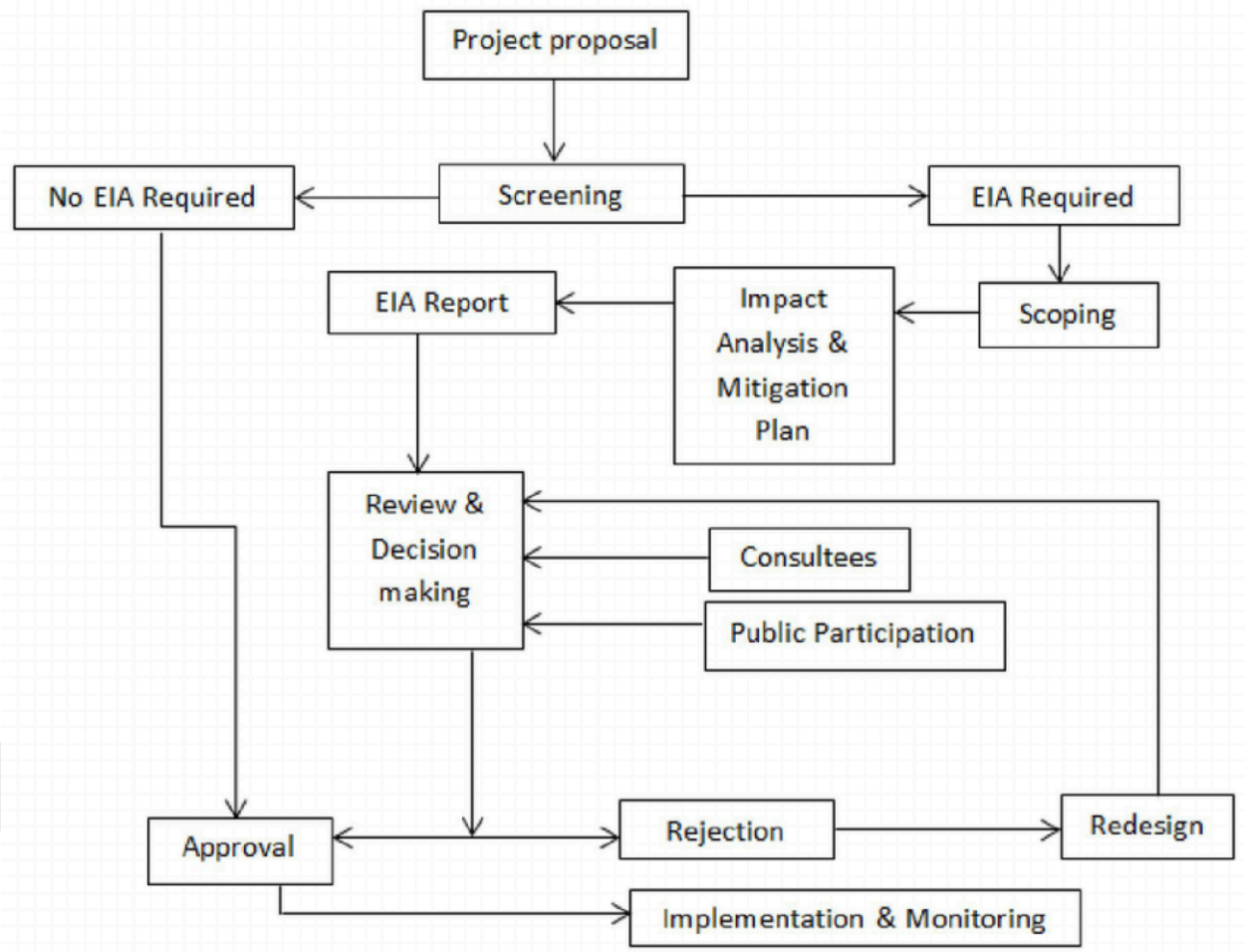
Objectives (given by Brundtland Commission)

- 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 from serious environmental harm and irreversible changes.
- Preserve the ecology, natural environment, and resources that have been evaluated. And Strengthen the proposal's social components.

Guiding principles of EIA:



Process of EIA



Benefits

- EIA links environment with development for environmentally safe and sustainable development.
- It provides a cost-effective method to eliminate or minimize the adverse impact of developmental projects.
- EIA encourages the adaptation of mitigation strategies.
- It makes sure that the developmental plan is environmentally sound and within limits of the capacity of assimilation and regeneration of the ecosystem

Shortcomings

- There are several projects with significant environmental impacts that are exempted either because they are not listed in schedule I of EPA, or their investments are less than what is provided for in the notification
- It is found that the teams formed for conducting EIA studies lack field experts such as environmentalists, wildlife experts, anthropologists, and social scientists.
- Public comments are not considered at the early stage, which often leads to conflict at the later stage.
- Quality of EIA Reports
- Lack of Credibility

Recommendations to Improve EIA

- Independent EIA Authority & sector wide EIAs are needed.
- Transparency: Dissemination of all information related to projects from notification to clearance to the public.
- Applicability: All those projects where there is likely to be a significant alternation of ecosystems need to go through the process of EC, without exception.
- Public hearing: Public hearings should be applicable to all hitherto exempt categories of projects.
- Quality: All EIA reports should clearly state what are the adverse impacts that a proposed project will have. This should be a separate chapter and not hidden within technical details.
- Avoid conflict of interest: It is critical that the preparation of an EIA is independent of the project proponent.
- Composition of expert committees: The present executive committees should be replaced by expert peopleexpert people from various stakeholder groups, who are reputed in environmental and other relevant fields.
- Stringent punishments

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