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ENVIRONMENT AND ECOLOGY

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1. Environment and Sustainable Development

Basic Concepts of Environment and Ecology

- 'Eco mark' is given to Indian products that are environment friendly.
- Functions of environment: Supplying resources, sustaining life, providing aesthetic services.
- Exhaustible but renewable natural resources: Water in usable condition, Soil.
- Resources classified by origin: Biotic and Abiotic.
- Ecological Footprint is measured in Global Hectares.
- Bharati, the Indian research base in Antarctica, is located about 3000 km East of Maitri and facilitates year-round scientific research for the Indian Antarctic Programme.
- Centre of Science and Environment in New Delhi publishes 'Down to Earth' magazine.
- First Indian Research Station in the Arctic: Himadri.
- Environment planning organization: NEERI (National Environmental Engineering Research Institute).
- Eco-friendly agricultural practice: Organic farming.
- Mariculture (सागरीय कृषि): Related to cultivation of marine plants and animals.
- Biotic resources: Obtained from biosphere and have life (e.g., human, flora, fauna, fisheries).
- Non-renewable resources: Form over a very long geological time (millions of years) and are not easily reproduced.
- Renewable resources: Can be reproduced by physical, chemical, or mechanical processes relatively quickly.
- World Soil Day 2019 theme: "Stop Soil Erosion, Save our Future".
- World Environment Day: June 5th.
- World Nature Conservation Day: July 28th.
- International Earth Day (Earth Day): April 22nd.
- Laser system used for environmental monitoring: Lidar.
- Factors included in chemical environment: Water and soil.
- Definition of environment ("sum total of all conditions agencies..."): From Britannica Encyclopedia.
- A complete fertilizer always contains Nitrogen (N), Phosphorus (P), and Potassium (K).
- Non-renewable natural resource example: Fossil Fuels.
- Non-conventional raw material for paper production: Sugarcane bagasse.
- Science characteristics: Guided by natural law, testable, falsifiable. (Its conclusions are NOT permanent).
- "Limits to Growth" concept: Propounded by Club of Rome (1972); predicted limits within 100 years if trends continued unchanged.

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- Standard environment categories include Physical, Cultural, and Biological environment. (Operational Environment is not a general category).
- International Centre for Research on Agro-Forestry: Nairobi.
- Indian Institute of Forest Management: Bhopal.
- Central Agro-Forestry Research Institute: Jhansi.
- Tata Energy Research Institute (TERI): New Delhi.
- Population control is necessary to maintain environmental balance; rapid population increase destabilizes it.
- Organic farming does not use genetically modified seeds, synthetic pesticides or fertilizers; uses extensive crop rotation; employs ecologically protective practices.
- Conservation Agriculture practices: Adopting minimum tillage, using crop residues to cover soil surface, adopting spatial and temporal crop sequencing/crop rotations, avoiding monoculture.
- A country's natural capital includes forests, water, and minerals. (Roads are man-made capital).
- Application of gypsum is required more in the groundnut crop.
- Non eco-friendly tree: Eucalyptus (due to high water consumption).
- M. S. Swaminathan is recognized by UNEP as the 'Father of Economic Ecology'.
- Environmental impacts of agricultural practices: Synthetic fertilizers/pesticides may result in soil/water contamination; sustainable agriculture preserves soil health and biodiversity.
- International Ozone Day: September 16th.
- World Wildlife Day: March 3rd.
- Communication satellites typically use a Geosynchronous orbit.
- World Environment Day 2024 campaign in India: 'Ek Ped Maa Ke Naam' (tree plantation campaign).
- Organic farming involves: Use of vermicompost, natural pesticides like pyrethrin and rotenone, and copper sulfate. It does not use genetically modified organisms.

Biodiversity and Conservation (In-situ and Ex-situ)

- Champion of Earth Award 2022 recipients: Cecile Bibiane Ndjebet (Cameroon) and Purnima Devi Barman (India).
- Ministry of Environment, Forests and Climate Change (MoEFCC) is primarily concerned with biodiversity of lakes and rivers.
- Loss of biodiversity is caused by dumping of toxic waste into soil.
- Deforestation is responsible for frequent floods in rivers.
- Chico Mendes (not Fransisco Mendez) was known as 'Amazon Gandhi' for his environmental and social activism in the Amazon rainforest, not for work in the energy field.
- Kailash Sacred Landscape Conservation and Development Initiative (KSLCDI) is a collaboration among India, China, and Nepal.
- Important Environmental Days:
    - April 18: World Heritage Day
    - May 22: International Day for Biological Diversity
    - July 29: International Tiger Day
    - December 5: World Soil Day
- "Water Burial" won Best Film Award in Environment Conservation category at the 67th National Film Awards, 2021.
- Bombay Natural History Society (BNHS) is an independent, non-governmental research organization. It conserves nature through action-based research, education, and public awareness, including organizing nature trails and camps.
- Biological control describes the use of organisms (e.g., predators, parasites) to control pests.
- Crop rotation allows farmers to improve soil fertility, diversify crops, and reduce pesticide costs by naturally breaking the cycle of weeds, insects, and diseases.
- "Ottal" (The Trap) won the Best Film on Environmental Conservation/Preservation at the 62nd National Film Awards.

Climate Change: Causes, Impacts, Mitigation, and Adaptation Strategies

- National Mission for Sustainable Agriculture (NMSA): Launched in 2011-12, part of National Action Plan on Climate Change (NAPCC). Aims to enhance food security and make Indian agriculture resilient to climate change.
- Green India Mission: One of the eight missions under NAPCC. Aims to restore and enhance forest cover (targeting 10 million hectares) and respond to climate change through a combination of adaptation and mitigation measures.
- India's Long-Term Low Emissions Development Strategy (LT-LEDS): Envisions a just, smooth, sustainable transition from fossil fuels; increased use of biofuels; climate-resilient urban development; and financing sustainable development through Green Bonds.
- Urban Heat Island (UHI) Effect:
    - Definition: Specific areas within a city experience higher temperatures/heat loads than surrounding rural or less developed areas.
    - Nature: It is a local phenomenon.
    - Causes: Dark, impervious surfaces (e.g., concrete, asphalt) absorb more solar radiation; reduced vegetation and moisture content in soil (less evapotranspiration); anthropogenic heat sources (vehicles, industries, AC units); urban canyon effect from high-rise buildings trapping heat and reducing wind flow.
    - Impact of High-rise Buildings: Exacerbate UHI by blocking winds and trapping heat.
    - Reducing Factors: High wind velocity and high rainfall can help reduce UHI.
- Population Explosion: A primary driver leading to loss of forests, rapid urbanization, and increasing pollution.
- Earth Overshoot Day: Marks the date when humanity's demand for ecological resources and services in a given year exceeds what Earth can regenerate in that year. Directly indicates environmental degradation.
- Coal Usage: Judicious use is critical because burning coal causes air pollution, acid rain, and contributes significantly to global warming (via CO2 emissions).
- Carbon Credit: A tradable permit representing the right to emit one tonne of carbon dioxide (or equivalent greenhouse gases). It often signifies the difference between allowed and actually emitted carbon.
- Resilient Cities: Urban centers that can adapt, withstand, and recover from various shocks and stresses, including those posed by climate change, population growth, and globalization.
- Adaptation Gap Report: Released by the United Nations Environment Programme (UNEP).
- UNFCCC COP23 (23rd Conference of the Parties): Held in Bonn, Germany, in 2017 (presided over by Fiji).
- Important Environmental Days:
    - World Environment Day: June 5
    - Earth Day: April 22
    - World No Tobacco Day: May 31
    - International Day for the Preservation of the Ozone Layer (Ozone Day): September 16

Deforestation, Desertification, and Land Degradation

- Major causes of resource depletion/degradation: pollution, infrastructural development, over-consumption/exploitation, destruction of ecosystems, soil erosion, and deforestation.
- Soil erosion increases with high rainfall.
- Afforestation is a method to prevent soil erosion.
- Impacts of dams/reservoirs include loss of flora/fauna, reservoir-induced seismicity, and water-borne diseases; desertification is not a direct impact.
- Desertification leads to a decline in biological productivity.
- Desertification often occurs in hot desert areas.
- Contour bunding is recommended for lands with a slope less than 6%.

- Approximately 158 million hectares (mha) of India's total geographical area is under various kinds of land degradation.
- USLE stands for Universal Soil Loss Equation.
- Gypsum is used for the reclamation of sodic (alkaline) soils.
- Agricultural drought is soil moisture stress caused by an imbalance between available soil moisture and crop evapotranspiration.
- Acidic soils fix more phosphates.
- Environment-friendly farming practices in semi-arid areas include planting tree belts, crop rotation, and using organic fertilizers. Large-scale irrigation systems can be detrimental.
- Deforestation is a direct cause of loss of biodiversity, topsoil erosion, and global climate change, but not directly of species invasion.
- Land degradation is caused by soil erosion and waterlogging. Deforestation is a major cause of soil erosion.
- Large-scale land degradation in India is due to inadequate soil conservation measures and overgrazing.
- Soil erosion causes a huge loss of valuable nutrients and fertility.
- Soil erosion is largely a man-made phenomenon, caused by deforestation, overgrazing, shifting cultivation, and improperly constructed terrace outlets.
- Soil conservation methods include afforestation and slowing down water movement. Increasing the size of soil particles and regular application of fertilizers (primarily for fertility) are not direct soil conservation methods.
- India aims to achieve Land Degradation Neutrality (LDN) by the year 2030.
- The Mitti Bachao (Save the Soil) Movement started in Hoshangabad, Madhya Pradesh.
- Contour bunding is a soil conservation method used on sloping lands.
- In India, soil erosion is associated with deforestation and is intensified by a tropical climate.
- The United Nations Convention to Combat Desertification (UNCCD) aims to promote effective action through innovative national programmes and supportive international partnerships, and is committed to a bottom-up approach encouraging local participation. It focuses on all affected regions, particularly Africa.
- The Aral Sea has shrunk immensely/dried up due to human activities (e.g., diversion of rivers for irrigation).
- Nagaland mountains are becoming increasingly barren primarily due to shifting cultivation (Jhum).
- Alley cropping is a cropping system where crops are grown in the inter-spaces between rows of planted trees.
- The use of gypsum in fields is a solution for the problem of soil alkalinity (sodic soils).
- IMD (India Meteorological Department) defines severe drought when the deficiency of rainfall exceeds 50% of normal rainfall.
- Anthropogenic factors of desertification include overgrazing, changes in land use, and urbanization. Lesser rainfall is a natural factor.
- As per ISRO's 'Desertification and Land Degradation Atlas of India-2021', water erosion is the most significant process of desertification/land degradation after wind erosion in Rajasthan.
- Jhum, Bush fallow agriculture, and Slash and Burn agriculture are forms of shifting cultivation. Nomadic herding is not a form of shifting cultivation.

Ecosystem Structure and Function

- UN Decade on Ecosystem Restoration: 2021-2030.
- Dams & Reservoirs - Impacts: loss of flora and fauna, reservoir-induced seismicity, water-borne diseases.
- Dams & Reservoirs - No direct impact: desertification (often prevents, though downstream areas can experience altered hydrology).

Environmental Ethics and Human-Environment Interaction

- Environmental Ethics & Concepts:
- Anthropogenic Environment: An environment modified by human activities.

- Ecoradicals: Believe human societies are dangerously close to Earth's carrying capacity limits; advocate strict population control; stress less consumption-oriented and waste-producing lifestyles.
- Greenwashing: Conveying a false impression that a company's products/activities are eco-friendly and environmentally sound.
- Quotes & Slogans:
- "Earth provides enough to satisfy every man's need, but not every man's greed": Quote by Mahatma Gandhi.
- "Ecology is permanent economy": Slogan of the Chipko Movement.
- Key Books:
- Silent Spring: Book by Rachel Carson, centered around environmental issues (e.g., impact of pesticides).
- The Land Ethic: Concept developed by Aldo Leopold, introduced in "A Sand County Almanac."
- Global Environmental Events & Organizations:
- Earth Hour: Global event organized by the World Wide Fund for Nature (WWF).
- World Environment Day (June 5): Marks the anniversary of the Stockholm Conference on Human Environment (1972).
- First U.N. International Conference on Environment: Held at Stockholm in 1972.
- World Watch Institute: In its Jan. 1996 annual report, suggested levying an Environment Tax instead of Income Tax.
- Environmental Awards:
- Global-500 Award: Given for rare achievement in environment conservation.
- Goldman Environmental Prize (Goldman Awards): Given for the protection of the environment.
- Major Environmental Movements & Leaders (India):
- Narmada Bachao Andolan: Led by Medha Patkar; addresses both sociological and ecological issues, particularly related to the Sardar Sarovar Dam.
- Chipko Movement: An environmental movement, known for its slogan "Ecology is permanent economy." Prominent leader: Sunderlal Bahuguna.
- Appiko Movement: Associated with nature conservation, led by Pandurang Hegde (also associated with Appu and Mamtha).
- People for Animals: An organization associated with Maneka Gandhi.
- Resurrection of Kali Bein Rivulet: A conservation effort associated with Balbir Singh Seechewal.
- Chilka Bachao Andolan: Addresses both sociological and ecological issues.
- Key Personalities & Contributions (Environmental/Scientific):
- Medha Patkar: Leader of the Narmada Bachao Andolan.
- M. S. Swaminathan: Known for Rice Research and Biodiversity Conservation (pioneer of the Green Revolution in India).
- Anil Agarwal: Associated with the Centre for Environment Science (Centre for Science and Environment).
- Salim Ali: Renowned ornithologist and for Biodiversity Conservation ("Birdman of India").
- Balbir Singh Seechewal: Associated with the Resurrection of Kali Bein Rivulet.
- Maneka Gandhi: Associated with People for Animals.
- Pandurang Hegde: Leader of the Appiko Movement.
- Rachel Carson: Author of "Silent Spring."
- Mahatma Gandhi: Authored the quote on human needs versus greed.
- Sunderlal Bahuguna: A prominent leader of the Chipko Movement.
- Specific Environmental Initiatives/Facts:
- Bangalore Vertical Organic Garden: India's first, located on a pillar of the Hosur Road Electronics City Flyover, a project by NGO Jeevan.
- Aluminum as "Green Metal": Considered green because it provides a replacement for wood, thereby contributing to saving forests.
- Uttarakhand Specific (Regional Context):
- 'Kham' system: An administrative system implemented by the British in the Rawain area of Uttarakhand.
- 'Uttar Vrindavan Ashram' (Mithola, Almora): Its founder was Ronald Henry Nixon (later known as Swami Krishna Prem).