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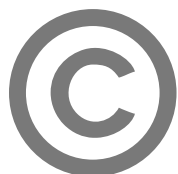
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PREFACE

The Ecology & Environment subject is an important component of the Civil Services Examination conducted by the Union Public Service Commission (UPSC). Aspirants who are preparing for this prestigious examination need to have a strong understanding of Ecology & Environment subject.

This book of UPSC Power Bank of Ecology & Environment subject has been designed keeping in mind the needs of aspirants who are preparing for the Civil Services Examination. The book covers all the important topics of Ecology & Environment including Biodiversity, Ecology, Act & Policies, Environmental Organization, Environmental issues & Pollution.

The questions in this book are comprehensive and have been curated after extensive research to ensure that they cover all the aspects of Ecology & Environment subject. Each question is accompanied by a detailed answer that not only explains the correct option but also provides additional information related to the question. This will help aspirants to build a strong foundation in Ecology & Environment subject and understand the subject in greater depth.

The objective of this book is:

1. **Assessing Knowledge:** by testing the candidates' understanding and knowledge of these topics.
2. **Testing Critical Thinking Skills:** to apply it in new and different contexts, analyse and evaluate information, and draw conclusions.
3. **Providing Practice:** by making them familiar with the format and style of UPSC questions.
4. **Preparing for the Exam:** by covering the same types of questions and difficulty levels as the actual exam.
5. **Identifying Knowledge Gaps:** By using the question bank, candidates can identify areas where they need to improve their knowledge or skills, and focus their study efforts accordingly.
6. **Improving Time Management:** This question bank provides a variety of questions that test different aspects of knowledge and skills, so that candidates can learn to manage their time effectively during the actual exam.
7. **Encouraging Self-Assessment:** By detailed explanations and solutions to each question, candidates can assess their own performance and identify areas for improvement.

We hope that this book will prove to be a valuable resource for aspirants preparing for the UPSC Civil Services Examination and help them achieve their goals. We wish all the aspirants the very best for their preparation and future endeavours.

We also express our gratitude to **Ms. Geeta Rani** who have contributed to the book, for her experience and knowledge. Her contributions will help our readers gain valuable insights and knowledge and secure a high rank in the UPSC examination.

We wish the readers great success ahead!

All the best!
Team Oswaal

Study Approach for Ecology & Environment for UPSC Prelims

Environment and Ecology play a pivotal role in the UPSC Prelims exams, with numerous questions being asked annually. Understanding these subjects is crucial as they encompass vital topics like biodiversity, climate change, and conservation. Candidates must focus on mastering these areas to enhance their chances of success in the examination. Here are certain guideline which will surely help you in your preparations.

- **Understand the Syllabus:** Start by thoroughly understanding the UPSC syllabus for the prelims exam. The environment section generally covers topics like ecology, biodiversity, climate change, environmental conservation, and sustainable development.
- **Study Material:** Some recommended books for the environment section include NCERT textbooks on biology and geography (especially the 12th-grade biology and 11th and 12th-grade geography books).
- **Current Affairs:** Stay updated with current environmental issues and policies by reading newspapers, magazines, and reliable online sources. Focus on national and international environmental news, government initiatives, environmental agreements, and important environmental reports. Make notes of key points and statistics for quick revision.
- **Study Fundamentals:** Develop a strong foundation in environmental concepts. Understand topics like ecosystem, biodiversity, climate change, pollution, environmental laws, and sustainable development. Refer to the NCERT textbooks to grasp the fundamental concepts.
- **Make Notes:** While studying, make concise notes on important topics, keywords, definitions, and key points. Organise your notes in a systematic manner, which will help you during revision.
- **Revise Regularly:** Plan a revision schedule to ensure regular and systematic revision of the environment topics. Revise your notes, practice MCQs, and focus on areas where you feel less confident. Allocate sufficient time for revision before the exam to reinforce your understanding.
- **Analyse the Questions:** Analyse previous year's question papers to understand the type of questions asked in the exam. You will get an idea of the important topics and the areas that require more focus.
- **Practice MCQs:** Practice multiple-choice questions (MCQs) of Other UPSC exams such as CDS, CAPF, NDA, UPSC IES. This will help you to assess your understanding of the subject and also familiarise you with the exam pattern.
- **Stay Updated:** Continuously update your knowledge of current environmental issues, policies, and scientific advancements. Follow reputable sources, attend webinars or seminars, and join relevant online forums to stay connected with experts and fellow aspirants.

Remember, while preparing for the environment section, integrate your understanding of environmental concepts with their practical applications, policy implications, and current affairs. Develop a holistic approach to tackle questions effectively in the exam.

Best of luck for your UPSC prelims!

Aashirvad Kumar
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3 UPSC Interviews



Positive Affirmations

I realize what I cannot Control and let the good things flow

I courageously move in the direction of my dreams

I am Supported fully by the universe

I am wrapped in the loving energy of the universe

I allow my desires to flow to me now

All of my thoughts are aligned with my desires

Affirmations for the new "YOU"

I effortlessly attract my desires

// Accept yourself, love yourself, and keep moving forward. If you want to fly, you have to give up what weighs you down.

I am open to new experiences and welcome abundance into my life

When I let go, I create space for something better.

// I have the power to shift my mindset and see the good in everything.

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Flash Facts

Unit-1: Ecosystem

1. Ecology: Components and Functions

- **Ecology:** The term was coined by the German biologist Ernst Haeckel in 1869.
 - It may be defined as the scientific study of the relationship among the living organisms and with their environment.
- **Environment:** The conditions or surroundings in which an organism operates or lives.
 - It includes both biotic (living) and abiotic (non-living) components.
- **Ecological Hierarchy:** The formation of grouping of organisms due to the synergy of organisms with their environment.
- **Individual:** The Individual organism is the first level of ecological hierarchy.
- **Population:** A group of individuals that live in a definite area, interact with each other and belong to the same species.
- **Community:** A group of organisms that live in an area, that interacts with each other and containing several different species.
- **Ecosystem:** A collection or group of organisms and their environment, interacting with each as one of the ecological unit.
- **Biosphere:** A relatively thin life supporting stratum of the surface of the Earth that extends from the deep sea vents in the ocean to a few kilometres into the atmosphere.
- **Biome:** Group of similar ecosystems with the same general type of environment anywhere in the world.
- **Habitat:** It is the physical space in which the animal resides and which includes its environment.
- **Niche:** The role played by an organism in a community. The niche of an species describes how it fits within its environment.
- **Species:** It is a group of organism capable of inter-breeding and producing fertile offsprings.
 - Every species has a specific set of genetic characteristics that distinguishes it from other species.
- **Species Diversity:** The different kinds of organisms present in a community represents the diversity of species.
- **Amensalism:** One species harms or limits the existence of the other species without being harmed or adversely affected.
 - It is a negative relationship between the two species.
- **Predation:** Predator catches, kills and consumes a prey animal of a different species. Prey suffers but the predator profits from this kind of relationship.
- **Parasitism:** One species suffers while the other profits. It includes a parasite which lives on other living species known as the host.
- **Competition:** Both the species gets adversely affected when both need a vital resource which is in short supply.
 - It can be intra-specific or inter-specific.
- **Commensalism:** One species (the host) is neither harmed nor inhibited while the other species (commensal) benefits.
- **Mutualism:** That kind of biotic interaction in which both species gets benefited.
- **Neutralism:** A kind of relationship between the two organisms in which there appears to be no influence each other.
- **Gross Primary Productivity (GPP):** The rate of production of an organic matter during photosynthesis.
- **Net Primary Productivity (NPP):** It is the biomass which is available for the consumption by the heterotrophs (decomposers and the herbivores).
 - Gross Primary Productivity (GPP) minus the respiration losses (R) is equal to the NPP.
- **Ecological Efficiency (Lindeman's Efficiency):** The ratio between the amount of energy acquired from lower trophic level and that transferred from the higher trophic level.
 - It follows a 10% rule.
- **10 per cent Rule:** If 100 cal is produced by the autotrophs, the herbivores will store only 10 cal and the carnivores will store only 1 cal.
- **Trophic Level:** A particular position of an organism in a food chain based on the source of their nutrition or food.
- **Food Web:** In an ecosystem, the trophic levels do not always follow a linear relationship.
 - They are linked together and form a food web.
 - It is a matrix of the inter-connected food chains.
- **Ecological Pyramids:** These are the graphic illustrations of the trophic levels. The base of pyramids are made up of producers.
- **Bio-accumulation:** The mechanism of increasing within the body of a specific organism the concentration of toxic elements as compared to the external environment like water, air, etc.
- **Bio-magnification:** There is an increase in the concentration of a pollutant from one trophic level to the another trophic level.
- **Nutrient/Biogeochemical Cycles:** The movement of the nutrient elements through the various ecosystem components. In a perfect nutrient cycle, the replacement of the nutrients is at the same rate as they are used.

- Examples of these cycles include Water Cycle, Carbon Cycle, Nitrogen Cycle, Phosphorus Cycle, etc.
- **Ecological Succession:** It is the mechanism through which animal and plant species, in a given region, are replaced or transformed into another over time.
- **Pioneer Community:** The community which initially inhabits the bare area. After some time, this community gets replaced by another community and the process continues.
- **Climax Community:** The community which forms the final or terminal stage of succession.
- **Sere:** The complete sequence of communities in each area succeeding each other during the succession.
- **Homeostasis:** It refers to the ecosystems ability to self-regulate. The ability to control the function and structure of their own organisms.
- Scientists have estimated that there are around 8.7 million species of animals and plants on Earth.
- **Biodiversity Levels:** The levels in which the biodiversity is mainly found to exist.
- **Genetic Diversity:** The variety of genes present within species of animals, plants and micro-organisms.
 - Genetic diversity permits the species which are present, to adapt to different environments.
- **Species Diversity:** Different variety of species within a geographical area.
 - There is difference in between the species, mainly in the genetic makeup and they do not inter-breed in nature.
- **Species Richness:** The count of various species in a given area. Further, it can be classified into alpha, beta and gamma diversity.

2. Types of Ecosystems

Terrestrial Ecosystem:

- **Forest Terrestrial Ecosystem:** A forest ecosystem is made up of several plants, especially trees, animals, and microorganisms that coexist with the environment's abiotic factors. Forests help in keeping up with the temperature of the earth and are the significant carbon sink.
- **Tundra Ecosystem:** The tundra is a type of ecosystem that lacks trees and is typically located in cold climates or areas with low rainfall, resulting in most of the year being covered in snow. It can be found in the Arctic or on mountain tops.
- **Grassland Ecosystem:** In a grassland ecosystem, the vegetation is dominated by grasses and herbs. Temperate grasslands and tropical or savanna grasslands are examples of grassland ecosystems.
- **Desert Ecosystem:** Deserts are found throughout the world. These are regions with little rainfall and scarce vegetation. The days are hot, and the nights are cold.
- **Natural Ecosystem:** It is a collection of living and non living entities that naturally exists and inside which each of the components interact as a single unit through physical, chemical and biological processes.
- **Artificial Ecosystem:** These are also termed as the man-engineered or man-made ecosystems. Examples include the croplands.
- **Aquaculture:** Practice of raising aquatic plants or animals in a managed environment.
- **Species Abundance:** It implies the relative numbers among different species. For an instance, the number of animal species, plant and other micro-organisms might be more in an area than that in the other area.
- **Taxonomic Diversity:** It implies the genetic relationships between various species.
 - When the taxonomically unrelated species are present in an area, the area exhibits higher species diversity as compared to an area represented by the related species.
- **Ecosystem Diversity:** It refers to the presence of the different types of ecosystems.
 - For example, compared to the desert ecosystem, which has quite less number of animal and plant species, the tropical southern India has rich species diversity with different structure.

Aquatic Ecosystem

- **Freshwater Ecosystem:** The freshwater ecosystem is an aquatic ecosystem that includes lakes, ponds, rivers, streams and wetlands. These have no salt content in contrast with the marine ecosystem.
- **Marine Ecosystem:** The marine ecosystem includes seas and oceans. These have a more substantial salt content and greater biodiversity in comparison to the freshwater ecosystem.
- **The Evil Quartet:** Four major causes for loss of biodiversity are Habitat loss and fragmentation, Over exploitation, Co-extinctions and Alien species invasions.
- **Ways in which Biodiversity Loss can be caused:**
 - **Direct Ways:** Hunting, deforestation and commercial exploitation.
 - **Indirect Ways:** Introduction of the exotic species, loss of the natural habitats, pollution, etc.
 - **Natural Causes:** Natural disaster, climate change, etc.

Unit-2: Biodiversity

1. Biodiversity Levels

- **Biodiversity or Biological Diversity:** It is described as the huge variety of life on Earth. It applies to all of the organisms in a single ecosystem.
- **Sixth Mass Extinction:** It is considered different from the previous five mass extinction episodes as in the present mass extinction the species extinction rates are estimated to be about 100-1000 times faster than the pre human times.

- **Ecosystem Services:** Protection of natural resources like water, recycle and storage of nutrients, pollution breakdown, climate stability, recovery from unpredictable events, etc.
- **Biological Services:** Food production, medicinal resources and pharmaceutical drugs, wood products, ornamental plants, breeding, etc.
- **Social Services:** Research, education and monitoring, recreation activities and tourism.
- **Facts about Biodiversity:**
 - The species density, in general, is greater in the Southern Hemisphere.
 - Only 12 countries, Brazil, China, Colombia, Costa Rica, the Democratic Republic of the Congo, Ecuador, India, Indonesia, Madagascar, Mexico, and Peru, are home to 70% of the world's species.
 - There are 25,000 plant species in the Hindu Kush-Himalayan region as a whole, which accounts for 10% of the world's flora.
 - Two-thirds of the estimated 250,000 plant species are found in tropical regions.
 - In a 52-hectare plot in Lambir Hills National Park, Sarawak (Malaysian Borneo), 1,200 species of trees have been documented as the highest tree diversity to date .
 - About 50 to 90 percent of all species are thought to be contained in tropical rainforests.
 - About 2,600 bird species, or 30% of all bird species, depend on tropical forests.

2. Biodiversity Hotspots

- Biodiversity hotspots refer to regions that exhibit an exceptional concentration of endemic species and are currently experiencing a significant loss of habitat. These regions are characterized by high species richness and a high degree of endemism.
- The concept of biodiversity hotspots was introduced by Norman Myers in 1988 when he observed a decline in plant species and habitat in tropical forests.
- The Red Data Book, which is prepared by the IUCN, is an important resource for tracking threatened species. Biodiversity hotspots are crucial to human survival because biodiversity is fundamental to all life on Earth, providing air, food, and water, among other essentials. Hotspots, which contain the highest levels of biodiversity and are under the greatest threat, are particularly important.

Biodiversity hotspots in India

There are major four biodiversity hotspots in India:

- **Himalaya:** Includes the entire Indian Himalayan region (and that falling in Pakistan, Tibet, Nepal, Bhutan, China, and Myanmar).
- **Indo-Burma:** Includes entire North-eastern India, except Assam and Andaman group of Islands (and Myanmar, Thailand, Vietnam, Laos, Cambodia, and southern China).
- **Western Ghats and Sri Lanka:** Includes entire Western Ghats (and Sri Lanka).
- **Sundalands:** Includes Nicobar group of Islands (and Indonesia, Malaysia, Singapore, Brunei, Philippines).

Unit-3 : Protected Area Network

- **Biodiversity Conservation:** The proper management of natural resources to retain the balance in nature and diversity.
 - It includes the rational use of natural resources.
- **In-situ Conservation:** Protection of animals and plants within their natural or protected areas.
- **Ex-situ Conservation:** Conservation of animals and plants outside their natural habitats.
 - Examples include zoos, botanical gardens, gene banks, seed banks, cryopreservation and tissue culture.
- **National Parks:** IUCN in 1975 defined National Park as a relatively large area where several or one ecosystem is not altered by human occupation or exploitation.
 - State governments declares the National Parks under the Wildlife (Protection) Act of 1972.
- **Wildlife Sanctuaries:** Conservation inside these sanctuaries is species-oriented, and its boundary is not limited by state legislation.
 - Under the Wildlife (Protection) Act of 1972 the State Government declares an area as the Wildlife Sanctuaries.
- **Biosphere Reserves:** Natural areas which are undisturbed and are dedicated to conservation of biological diversity and genetic integrity of animals, micro-organisms and plants in their totality.
- Traditionally, the biosphere reserves are grouped into three inter-related zones:
 - **Core Area:** Natural area of the biosphere reserve that is fully protected and least disturbed by human activities.
 - **Buffer Zone:** It surrounds the core zone and is managed to provide some room for a greater variety of resource-use strategies, educational activities and researches.
 - **Transition Zone:** The outer-most part of the biosphere reserve which is an area of active engagement between the locals and the reserve management.
- Other activities like cropping, settlements, recreation, forestry, etc. are carried out in harmony with the conservation goals.
- **The main functions of Biosphere Reserves are:**
 - **Conservation:** Conservation of the biodiversity and ecosystems around the world.
 - **Development:** Associating the environment with the development.
 - **Education, Monitoring and Scientific Research:** International network of research and monitoring.
- **Conservation Reserves:** Area under the State Government besides the National Parks and Sanctuaries for protecting the seascape, landscape and the habitats of animals and the plants.
 - Conservation Reserve Management Committee manages these reserves.

- **Community Reserve:** A community land or a private land may be notified by the State Government as a community reserve with an aim of protecting the flora and fauna of the reserve and also to improve the socio-economic conditions of the people living in that particular areas.
- **Sacred Forests:** Protected by the local communities because of their beliefs and rituals that runs through several generations. These areas are free from all disturbances.
- **Sacred lakes:** Several water bodies have been declared sacred by the local people leading to protection of aquatic flora and fauna.
- **Critical Tiger Habitat (CTH):** These are also referred to as the core areas of the tiger reserves.
 - These are identified under the Wildlife Protection Act of 1972.
 - State government in consultation with the expert committee notifies an area as the CTH.
- **Marine Protected Areas (MPAs):** As defined by the IUCN, it is an area of the inter-tidal or the sub-tidal terrain together with its overlaying water and related fauna, flora, cultural as well as historical features and has been reserved by law to protect the enclosed environment. Primarily, the MPAs in India are classified into following three categories:
 - Category-I: It covers Sanctuaries and the National Parks and has entire areas in sub-tidal/inter-tidal or mangroves, creeks, coral reefs, algal beds, seagrass beds, lagoons and estuaries.
 - Category-II: This category includes that islands, the major portion of which comes under marine ecosystems and some parts in terrestrial ecosystems.
 - Category-IIIa: It includes the sandy beaches beyond the inter-tidal line but occasionally interacting with the seawater.
 - Category-IIIb: This category has evergreen or semi-evergreen forests of lands.
- **Botanical Garden:** The scientifically planned collection of living shrubs, trees, climbers, herbs and other plants from various parts of the world.
- **Gene Banks:** Preservation and ex-situ collection of the genetic resources is carried out in these banks.
- **Cryopreservation:** Storage of the materials at the ultra-low temperatures of liquid nitrogen and it essentially involves suspension of all metabolic activities.
- **Biodiversity Hotspots:** This concept was introduced in 1988 by Norman Myers.
 - It refers to that bio-geographic region which contains in it the significant levels of biodiversity which is threatened by the human habitation.
- **Biodiversity Hotspots in India:**
 - The Eastern Himalayas
 - Indo-Burma
 - Western Ghats and Srilanka
 - Sundalands
- **Man and Biosphere Programme (MAB):** It is an inter-governmental scientific programme, launched in 1971 by UNESCO, that aims to establish a scientific basis for improving the relationship between people and their environments.
 - It combines the natural and social sciences with a view to improving human livelihoods and safeguarding natural and managed ecosystems, thus promoting innovative approaches to economic development that are socially and culturally appropriate and environmentally sustainable.
 - Currently, the World Network of Biosphere Reserves has 738 sites located in 134 countries around the globe.
- **IUCN's Red List of Threatened Species:** It was formed in 1964 to become the world's most comprehensive information source about the global conservation status of fungi, animal and plant species. It has few categories:
 - **Extinct (EX):** A taxon is considered as extinct when there is no doubt that the last individual has passed.
 - **Extinct in the Wild (EW):** When the exhaustive and extensive surveys in the known or expected habitats have failed to record even a single individual.
 - **Critically Endangered (CR):** When a taxon has been facing high risk of extinction in the wild in the immediate future.
 - **Endangered (EN):** When the taxon in question is not critically endangered but it is facing a very high risk of extinction in the wild in near future.
 - **Vulnerable (VU):** When the taxon is not critically endangered or endangered but it is facing a high risk of extinction in the wild in medium term future.
 - **Lower Risk:** When the taxon has been evaluated and does not seem to be falling in the categories such as CR, EN or VU, then it is considered to be at lower risk of extinction.
 - **Data Deficient:** When there is inadequate availability of information about a taxon to make any direct or indirect assessment of its risk of extinction.
 - **Not Evaluated:** The taxon is not put to any evaluation when it has not been assessed as per the above mentioned criterias.
- **Colour Codes in the List according to the risk of extinction:**
 - Pink Pages: Critically Endangered (CR) species.
 - Green Pages: It contains those species which were once considered endangered and are now no longer considered threatened.
- **Red List Index:** It measures the trends in the overall extinction risk of the set of species as an indicator of trends in the biodiversity status.
 - It helps the governments in tracking the progress in achieving targets that reduce the biodiversity loss.
- **This index is available for five taxonomic groups:**
 - Birds
 - Mammals
 - Amphibians
 - Cycads
 - Corals
- **Red List Index = 1:** All species qualifying as Least Concern (LC).

- **Red List Index = 0:** All species have gone Extinct.
- **National Conservation Efforts:** Initially, there was no provision in the Indian Constitution to protect or to promote the environment. In 1977, the 42nd Amendment added some key clauses to entrust the Government with the duty of maintaining a well-protected and safe environment.
- **Constitutional Provisions:** After the UN Conference on Human Environment held in Stockholm in 1972, which is also known as Stockholm Conference, the Indian Constitution was amended to include protection of the environment as a Constitutional mandate.
 - **Article 51A (g):** It made it a fundamental duty of every Indian to protect and improve the natural environment. "It shall be the duty of every citizen in India to protect and improve the natural environment including forests, lakes, rivers, and wildlife and have compassion for living creatures."
 - **Article 48A (DPSP):** "The States shall endeavour to protect and improve the environment and to safeguard the forests and the wildlife of the country."
- **Project Tiger:** It is a Centrally Sponsored Scheme launched by the Ministry of Environment, Forests and Climate Change (MoEFCC). India is having 50 reserves which are all run under the Project Tiger.
 - **Launched:** 1973
 - **Aim:** To protect the Bengal tigers from extinction and maintaining a stable population in their habitats.
 - **Number of Tigers:** Madhya Pradesh > Karnataka > Uttarakhand
 - **Tiger Census:** The NTCA conducts this census across India every four years.
 - **Conservation Status of Tigers:**
- **IUCN Red List:** Endangered
- **CITES:** Appendix I
- **Wildlife (Protection) Act, 1972:** Schedule I
- **Project Elephant:** It is a Centrally-Sponsored Scheme which offers a financial and technical help to States.
 - **Launched:** 1992
 - **Implemented In:** 16 States
 - **Corridors Set-up:** 88
 - **Programmes:** MIKE (Monitoring of Illegal Killing of Elephants), 'Haathi Mere Saathi' by MoEFCC and wildlife trust of India.
 - **Conservation Status of Elephants:**
- **IUCN Red List:** Endangered
- **CITES:** Appendix I
- **Wildlife (Protection) Act, 1972:** Schedule I
- **Indian Rhino Vision 2020:** It was launched with a view to increase rhino population from 2000 to 3000 by 2020 in seven protected areas of Assam:
 - Kaziranga National Park
 - Pobitora National Park
 - Orang National Park
 - Manas National Park
 - Burachapori Wildlife Sanctuary
 - Laokhowa Wildlife Sanctuary
 - Dibru-Saikhowa Wildlife Sanctuary
- **Project Snow Leopard:**
 - **Launched:** 2009
 - **Aim:** To strengthen wildlife conservation in Himalayan High altitudes.
 - **Found:** In Central Asian and Himalayan mountains
 - **In Western and Trans Himalayas:** Conservation above 3000 metres
 - **In Eastern Himalayas:** Above 4000 metres
 - **Conservation Status:**
- **IUCN Red List:** Vulnerable (VU)
- **CITES:** Appendix I
- **Wildlife Protection Act, 1972:** Schedule I
- **Sea-Turtle Project:** Olive Ridley Turtle visits Indian coasts for hatching during winters.
 - **Launched:** 1999
 - **Started By:** Environment Ministry in collaboration with UNDP
 - **Implementing agency:** Wildlife Institute of India (WII), Dehradun
 - **IUCN Status:** Vulnerable (VU)

Unit-4: Environmental Issues

1. Climate Change and Forests

- **Climate change** refers to long-term shifts in the Earth's climate system, including changes in temperature, precipitation, and weather patterns, that are primarily caused by human activities, such as burning fossil fuels and deforestation. These activities release large amounts of greenhouse gases, such as carbon dioxide, into the atmosphere, trapping heat and causing the Earth's average temperature to rise. Climate change also includes the impacts of these changes, such as rising sea levels, increased frequency and severity of natural disasters, and changes in ecosystems and biodiversity.
- **Deforestation:** It includes the issues like tree felling, lopping, grazing, browsing, trampling of seedlings and clearing of the forest debris.
 - Removal or damage of vegetation in a forest to the extent that the forest's natural flora and fauna is no longer supported.
- **Causes of Deforestation:** Agriculture, Overgrazing, Urbanisation and developmental projects, fuel (firewood) requirements, raw material requirements, etc.
- **Consequences of Deforestation:**
 - Soil Erosion and Flash Floods
 - Climatic Change and Forests Destruction
 - Loss of Biodiversity
- **Shifting Cultivation:** It is also known as Jhoom Farming or the Slash and Burn farming. In this method, the wild and forested land is cleared and any remaining vegetation burned.
 - This type of farming is often intended to meet the on-site demands or needs.

2. India State of Forest Report

- **India State of Forest Report (ISFR):** It is a biennial publication by the Forest Survey of India, which is a part of the Ministry of Environment, Forests and Climate Change (MoEF&CC).

- It assesses the country's land and tree inventory, including wall to wall forest cover mapping.
- **Forest Area:** As per the Government records, the legal status of the land as forest.
- **Forest Cover:** It implies the presence of trees over any land.
- **Key Findings of the ISFR 2021:**
 - Increase in the Forest and the Tree Area: Countrywide, there is an increasing forest and tree cover. Over the last two years, there has been a rise in cover of 1,540 square kilometres.
- India's forest cover has increased to 7,13,789 square kilometres (21.71% of the country's geographical area).
- The term "tree cover" refers to all tree patches less than one hectare in size that occur outside the recorded forest area. This applies to all tree formations, including scattered trees.
 - Increase or Decrease in Forests:
- The highest increase in forest cover have been shown by Telangana (3.07%).
- Loss of Forest cover have been shown by five states in the North-East, viz. Arunachal Pradesh, Manipur, Meghalaya, Mizoram and Nagaland.
 - States with Highest Forest Area/Cover:
- **Area-wise:** Madhya Pradesh > Arunachal Pradesh > Chhattisgarh
- **Percentage of Total Geographical Area:** Mizoram > Arunachal > Meghalaya
 - Mangroves: With an increase of 17 sq. km, India's total mangrove cover touched 4992 sq. km.
- **Top 3 states with increase:** Odisha > Maharashtra > Karnataka
 - Forest Prone to Fire: Forest cover prone to forest fire is around 46%.
- **Extremely Prone:** 81%
- **Very Highly Prone:** 7.85%
- **Highly Prone:** 11.51%
 - Total Carbon Stock: The amount of carbon that has been removed from the atmosphere and stored in the forest ecosystem is known as the forest carbon stock.
- The majority of this carbon is stored in living biomass and soil, with a smaller amount in deadwood and litter.
- The country's forests are thought to contain 7,204 million tonnes of carbon overall, an increase of 79.4 million tonnes since 2019.
 - Bamboo Forests: Registered a growth from 13882 million culms in 2019 to 53336 million culms in 2021.
- **Desertification:** The destruction or reduction of the biological capacity of a land, which can eventually lead to desert-like conditions. It is resulted by excessive felling of trees.
 - Human-induced desertification has affected about 76.15% of the total Indian desert.
 - 19.5% of the total area is de-certified in some form.
- **Control Measures against Desertification:** India is one of the signatory to the United Nations Convention to Combat Desertification (UNCCD).
 - In order to take appropriate action in resolving desertification issues, the National Action Plan for Combating Desertification commenced in 2001.
 - National Afforestation Programme
 - Integrated Watershed Management Programme
 - National Mission for Green India
 - The Mahatma Gandhi National Rural Employment Guarantee Scheme
 - Soil Conservation in the Catchment of River Valley Project and Flood Prone River
 - National Watershed Development Project for Rainfed Areas
 - Desert Development Programme
 - Fodder and Feed Development Scheme
- **Natural Desertification:** In the Asia-Pacific region, an area of approximately 4.361 lakhs hectare has resulted from the natural desertification.
- **Classification of Natural Deserts:**
 - Sub-tropical Deserts
 - Cold Deserts (Gobi Desert, Ladakh region, etc.)
 - Coastal Deserts
 - Rain-Shadow Deserts
 - Interior Continental Deserts

3. Coral Bleaching

- **Coral Bleaching:** When the corals are subjected to stressful conditions by changes in temperature, light, or nutrients, they throw out the symbiotic algae living in their tissues, causing the corals to turn white completely.
 - The Zooxanthellae and the Coral lives in a symbiotic relationship which helps each other in their survival.
- **Causes of Coral Bleaching:**
 - Increased temperature in the ocean which is the result of Climate Change is the most common trigger for Coral bleaching.
 - Storm Run-off and Pollution are damaging for the corals.
 - High Solar-irradiance caused by the over-exposure to sunlight bleaches the shallow water corals.
 - Increased Sedimentation
 - Ocean Acidification
 - Infectious Diseases
 - Chemical Pollution
 - Sub-aerial Exposure
- **Protection Measures for Corals:**
 - The Ministry of Environment, Forests and Climate Change (MoEF&CC) provides the financial support to UTs/Coastal States for Coral Reef and Mangrove protection and management.
 - The Coral reef has been granted the highest level of protection under the Schedule I of the Wildlife (Protection) Act, 1972.
 - Protected Areas have been developed across the country to preserve the Marine life, including Coral Reefs, under the provisions of the Wildlife (Protection) Act, 1972.

- The Wildlife Crime Control Bureau was formed to improve the law enforcement in the fight against illegal wildlife trade and poaching activities.
- **Ocean Acidification:** The acidity of the ocean water increases due to the absorption of more carbon dioxide which eventually inhibits the ability of the corals to produce the calcareous skeletons, which is essential for their survival.
- **Eutrophication:** It is that condition of a water body which gets enriched with nutrients.
 - This excessive enrichment with nutrients facilitates the growth of water hyacinth, algae, phytoplankton and other aquatic plants.
- **Oligotrophication:** The process of nutrient reduction or depletion in rates of cycling of nutrients in the aquatic ecosystems.
 - It is considered as the partial reduction of the eutrophication process.
- **Red Tide:** It is a phenomenon where a particular phytoplankton species containing pigments and which bloom and the human eye perceives the water to get discoloured.
- **Biological Oxygen Demand (BOD):** The term “biochemical oxygen demand” (BOD) refers to how much oxygen is used by bacteria and other microorganisms during the aerobic (oxygen-containing) decomposition of organic matter at a specific temperature.
 - Decrease in the dissolved oxygen (DO) causes a large number of aquatic species to die abruptly which releases an unpleasant odour eventually rendering the water unfit for human consumption.
 - Algal Blooms or water blooms are effected by the explosive growth of algae and phytoplankton, which gives water a green colour.
- It covers the surface layer and prevents the sunlight from entering and gas from the atmosphere to diffuse.
- **Harmful Algal Blooms (HABs):** Phytoplankton blooms that are harmful or toxic. When colonies of algae grow out of control and have toxic or harmful effects on people, fish, shellfish, marine mammals, and birds, this is known as a hazardous algal bloom, or HAB.
 - Scientists prefer the term “harmful algal bloom” even though many people refer to these blooms as “red tides”.
 - Nearly every summer, the Florida Gulf Coast experiences one of the most well-known HABs in the US.
- A dinoflagellate species called *Karenia brevis* is the agent for this type of bloom.
 - The most common causes of blooms in freshwater lakes and reservoirs is blue-green algae (also known as cyanobacteria).
- Run-off from agriculture and urban areas is directly related to blue-green algae blooms.
 - Cyanobacterial development is promoted by nutrient pollution.

Unit-5: Environmental Pollution

1. Classification of Pollutants

- **Acid Rain:** A precipitation that is unusually acidic containing high levels of hydrogen ions. It usually has a pH levels between 4.2 and 4.4.
 - Sulphur dioxide and Nitrogen oxide emissions when react with water molecules in the atmosphere to form the acids which results in the acid rain.
- **Air Pollution:** A composition of any gaseous, liquid or solid substances in the atmosphere in concentrations that are considered harmful to humans, other living organisms, plants, property, that usually interferes with normal environmental processes.
- **Photochemical Smog:** Air pollution that occurs when volatile organic compounds (VOCs) react to sunlight creating a brown haze above cities.
- **Primary Pollutant:** Air pollutant that is emitted directly from the source. Example includes nitrogen oxides, VOCs, etc.
- **Secondary Pollutant:** Pollutant which is formed when the other primary pollutants reacts in the atmosphere.
 - Example includes Ozone, Peroxyacetyl nitrate (PAN), etc.
- **Volatile Organic Compounds (VOCs):** These are formed by the evaporation of naturally occurring compounds like terpenes and the incompletely burned fossil fuels.
- **Non-Attainment Cities:** Those cities which are marked by Central Pollution Control Board (CPCB) for falling short of the National Ambient Air Quality Standards (NAAQS) for NO₂ and PM10 over 5 years.

2. Types of Pollution

- **Air pollution**
 - Air pollution is a mixture of solid particles and gases in the air.
 - Car emissions, chemicals from factories, dust, and pollen and mold spores may be suspended as particles.
 - Common gaseous pollutants include carbon monoxide, sulfur dioxide, chlorofluorocarbons (CFCs) and nitrogen oxides produced by industry and motor vehicles
- **Water pollution**
 - Water pollution occurs when toxic substances enter water bodies such as lakes, rivers, oceans and so on, getting dissolved in them, lying suspended in the water or depositing on the bed.
 - Common pollutants include discharges of untreated sewage, and chemical contaminants, release of waste and contaminants into surface runoff flowing to surface waters, groundwater pollution from waste disposal and leaching into the ground.
- **Soil pollution**
 - It is the presence of toxic chemicals (pollutants or contaminants) in soil, in high enough concentrations to pose a risk to human health and/or the ecosystem.

- The contaminants include metals, inorganic ions and salts (e.g. phosphates, carbonates, sulfates, nitrates), and many organic compounds (such as lipids, proteins, DNA, fatty acids, hydrocarbons, PAHs, alcohols, etc.).
- **Thermal pollution**
 - Thermal pollution, sometimes called “thermal enrichment,” is the degradation of water quality by any process that changes ambient water temperature.
 - A common cause of thermal pollution is the use of water as a coolant by power plants and industrial manufacturers.
 - Deforestation eliminates shade, which exposes the water to sunlight.
 - Water on hot paved surfaces gets hot, and then runs off into nearby bodies of water, raising the water temperature.
 - Retention ponds can also be a source of thermal shock because the relatively small and shallow bodies of water can absorb quite a bit of heat energy from the sun.
- **Noise pollution**
 - Noise pollution happens when the sound coming from planes, industry or other sources reaches harmful levels.
 - WHO Noise Environmental Burden on Disease working group found that noise pollution may contribute to hundreds of thousands of deaths per year by increasing the rates of coronary heart disease.
 - Underwater noise pollution coming from ships has been shown to upset whales’ navigation systems and kill other species that depend on the natural underwater world
- **Light pollution**
 - Light pollution is the excess amount of light in the night sky.
 - Light pollution, also called photo-pollution, is almost always found in urban areas.
 - Light pollution can disrupt ecosystems by confusing the distinction between night and day.
- **Land Pollution**
 - This involves the decline in the quality of the earth’s land surfaces in terms of use, landscape, and ability to support life forms.
 - Land pollution takes place when waste and garbage is not disposed of in the right manner thus, introducing toxins and chemicals on the land.
 - Also, Mineral exploitation equally leads to a decline in the quality of the earth’s land surfaces.
- **Point-Source Pollution:** It is said to occur when pollutants gets discharged from a particular location such as a drain pipe containing the effluents from industries and discharge directly into the water body.
- **Non-Point Source Pollution:** When waste discharges from the diffused sources or from a broader area such as from a farm field, pasture land, building site, abandoned mines and dumps, and streets and roads.

3. Pollution Control Measures

- **For Air Pollution:** Afforestation or planting more trees should be encouraged to maintain a balance in the ecosystem and manage the effect caused by the rising greenhouse gases. The government also took initiatives to control air pollution, including the National ambient air quality standards (NAAQS) and the National air quality monitoring program (NAMP).
- **For Water Pollution:** Water consumption must be minimized or reduced by revising the strategies involved in controlling the environmental pollution of water. Wastewater should be treated well to be reused.
- **For Soil Pollution:** To control the environmental pollution of soil, we must stop plastic usage. The use of plastic should be reduced to prevent soil pollution, and sewage should be appropriately treated before its utilization as fertilizer on cultivated grounds.
- **For Thermal Pollution:** Thermal environmental pollution can be prevented using a few scientific approaches, like cooling ponds or buildings and constructing artificial lakes. These lakes are man-made water sources that provide a possible alternative for cooling power plants.
- **For Noise Pollution:** Noise pollution can be decreased by properly maintaining roadside vehicles and using soundproof equipment in noisy places. Horns should be used minimally on roads. Automobiles and industrial equipment must be fitted with silencers to avoid excessive noise.
- **For Light Pollution:** Lights should be turned off whenever unused, especially at night. The over utilization of indoor lights should be minimized.
- Lights should be pointed towards the ground whenever you are going outside your home.
- **For Land Pollution:** Organic fertilizers, an incorporated pest management technique, and crop rotation can all be used by farmers.
- The 3 R’s should be embraced by all households – reduce, reuse, and recycle, to generate less waste.
- People should use products as much as possible to generate less waste individually.
- We should pick materials that can be easily recycled, for instance, paper, glass, plastics, and electronic items, and transform them into new products.

4. Ozone Depletion

- **Ozone Depletion:** The thinning of the atmosphere’s protective ozone layer is referred to as ozone layer depletion.
 - This occurs when certain chemicals interact with ozone and destroy it.
- **Ozone Hole:** It defines a region of the stratosphere where, during specific months, ozone concentrations drop to exceedingly low levels.
- **Polar Stratospheric Clouds:** Clouds present at an altitude of 12-22 kms containing water, nitric acid and sulphuric acid. They are formed generally during winter.

5. Waste Management

- **Bioremediation:** The usage of natural or genetically engineered micro-organisms (bacteria or fungi) to downgrade environmental pollutants into relatively less harmful types.
- **Bioventing:** Air and nutrients are supplied to contaminated soil via wells to stimulate the development of local bacteria.
 - It can be applied if contamination is found deeply below the surface and is employed for simple hydrocarbons.
- **Biosparging:** An in-situ remediation technique called biosparging employs indigenous micro-organisms to break down organic constituents in the saturated zone.
 - In order to boost the biological activity of the indigenous microorganisms, air (or oxygen) and nutrients (if needed) are injected into the saturated zone during biosparging.
- **Bioaugmentation:** Adding cultured microorganisms to the subsurface with the purpose of biodegrading certain contaminants in the soil and groundwater is known as bioaugmentation.
- **Oil Zapper:** Oil zapping is the new term for the technique of cleaning up an oil spill using bacteria.
 - Oil zapping is a bio-remediation technique that employs microorganisms that “zap” oil.
- **Landfarming:** It is an ex-situ waste treatment method that is carried out in biotreatment cells or the upper soil zone.
 - Transported to the land farming site, contaminated soils, sediments, or sludge are mixed into the soil surface and periodically turned over to aerate the mixture.
- **Bioreactors:** A bioreactor is a vessel in which raw materials are transformed into products under controlled conditions by living cells (microorganisms, mammalian, plant cells, algae, and stem cells) or by cellular components like enzymes.
- **Composting:** The natural process of recycling organic matter, such as leaves and food scraps, into a valuable fertiliser that can enrich soil and plants is known as composting.
- **Phytoaccumulation:** When the contaminants accumulate in the above ground shoots or leaves and roots of plants.
- **Phytoremediation:** When the plants are employed to extract toxins from the soil and water, the process is termed as phytoremediation.
- **Coagulation:** When alum is introduced in the untreated water, the dirt particles in the water stick together or coagulates.
- **Flocculation:** Following the coagulation, the clusters of dirt particles clump together and forms the larger particles called the flocs, which proves to be easier to extract by filtration or by settling.
- **Electronic Waste or E-Waste:** These are generally the discarded electrical or electronic equipments.
- **Extended Producer Responsibility (EPR):** Under the EPR principle, the manufacturers are bound to collect a certain percentage of e-waste produced by their products till the time they reach their end of life.
- **Solid waste:** Those materials that have been discarded or are called the waste-like.
- **Vermiculture:** In this process, the earthworms are added to the compost, which break down the waste and the excrement of these worms enriches the compost with nutrients.
- **Sanitary Land Filling:** Garbage is spread out in thin layers, compacted, and covered with clay or plastic foam in a sanitary landfill. The bottom of modern landfills is lined with an impermeable liner, which is usually made up of several layers of clay, thick plastic, and sand. The liner prevents leachate from percolating into the groundwater, contaminating it.
- The bottom leachate is pumped and sent for treatment. To prevent water seepage, the landfill is covered with clay, sand, gravel, and top soil once it is full. Several wells near the landfill site are being drilled to see if any leakage is contaminating ground water. Anaerobic decomposition produces methane, which is collected and burned to generate electricity or heat.
- **Incineration:** The term incinerates refers to the act of burning something until it is reduced to ashes. An incinerator is a device or facility that burns trash and other waste until it turns to ash. An incinerator is made of heavy, well-insulated materials to avoid releasing excessive amounts of heat into the environment.
- **Pyrolysis:** Pyrolysis is a type of incineration in which organic materials are chemically decomposed by heat in the absence of oxygen. Pyrolysis occurs most commonly under pressure and at temperatures above 430°C (800°F).

Unit-6: Climate Change

1. Global Warming & Greenhouse Effect

- **Climate:** The long-term average of the weather events of a place is termed as climate. Due to natural forces like ice age glaciations, sunspots, etc. the world has shifted several times over billions of years.
- **Climate Change:** Change of climate directly or indirectly due to human activities that changes the composition of the atmosphere and which is in addition to the natural climate variability observed over comparable period of time.
 - A change in long term weather trends is known as climate change.
- **Global Warming:** Increase in the temperature of the atmosphere near the surface of the Earth and in the troposphere which affects the climate patterns around the world.
 - It can be caused by both natural and man-made factors.
 - Generally, it is caused due to increased emissions of greenhouse gases from anthropogenic activities.
- **Greenhouse Effect:** The naturally-occurring phenomena that blankets the earth's lower atmosphere and warms it, holding it at a temperature suitable for life.

- **Greenhouse Gases:** Water Vapour, Carbon Dioxide, Methane, Nitrous Oxide, Fluorinated gases, Black carbon, Brown Carbon, etc.
- **Global warming Potential (GWP):** The heat that any greenhouse gas in the atmosphere absorbs, expressed as a multiple of the heat that the same mass of carbon dioxide would absorb, is known as its global warming potential.
 - For CO₂, the GWP is 1. According to the gas and the time period, it varies for various gases.
 - From GWP, carbon dioxide equivalent is calculated.
- **Polar Vortex:** It is an area of low pressure arctic air which is normally centred around the North pole.
 - It is held in its place by a jet stream passing around 65° N, 25000 to 30000 feet above ground and divides the cold air and warm air.
 - The Jet stream is pushed in a wavy manner by a high pressure and a low pressure system, which leads the polar vortex much southwards than normal.
 - Arctic Invasion: When a portion of the vortex is brought into North America and causes the temperatures in the mid-west and the eastern United States to dive below zero.

2. Impacts of Climate Change

- Agriculture and Food security
- Sea Levels, Oceans and Coastal Areas
- Water Stress and Water Insecurity
- Biological Diversity Affected
- Health Issues encountered
- **Social Cost of Carbon:** Under this calculation, it is generally tried to add-up all the quantifiable costs and benefits of emitting one additional tonne of CO₂ in monetary terms.
 - This value can then be used to weigh the advantages of reduced warming against the costs of cutting emissions.
 - It is generally estimated as the net present value of the impacts of the climate change over the next 100 years of one additional tonne of carbon emitted to the atmosphere today.
 - It is marginal damage cost of carbon emissions.
 - Objective: To assist the policy-makers in assessing whether a policy designed to curb climate change is justified or not.

3. Climate Change Mitigation Strategies

- Lowering the amount of Green House Gas (GHG) emissions that contribute to global warming
- Retrofitting buildings to make them more energy-efficient
- Embracing the various renewable energy sources such as solar, wind and small hydro
- Assisting communities in creating more sustainable transportation solutions, such as electric cars, bus rapid transit and bio-fuels
- Promoting more sustainable use of forests and land
- **Carbon Sequestration:** The process of capturing CO₂ gas in the atmosphere. It is also termed so when the

CO₂ is captured from the existing and new power plants and the factories before they are released into the atmosphere.

- Once the Carbon dioxide gas has been contained it is placed in to long term storage.
- Carbon Sequestration is aimed at eliminating harmful human-introduced carbon from our atmosphere by disrupting the carbon cycle.
- **Types of Carbon Sequestration:**
 - Terrestrial Sequestration: The plants and trees store CO₂ in their roots and in their bodies.
 - Geologic Sequestration: Carbon dioxide gas is buried thousand feet underground.
- **Carbon Sink:** Anything that absorbs more carbon than it releases in the form of carbon dioxide.
 - These sinks are essential for controlling atmospheric carbon dioxide levels.
 - Common carbon sinks include undisturbed soils and forests, the ocean, untapped fossil fuel sources, and terrestrial plant photosynthesis.
- **Carbon Credit:** Permits that allow the owner to emit a specific amount of carbon dioxide or other greenhouse gases are known as carbon credits, commonly referred to as carbon offsets.
 - One carbon dioxide credit, or its equivalent in other greenhouse gases, allows for the emission of one tonne of carbon dioxide.
 - The carbon credit is half of a so-called cap-and-trade programme.
 - Companies that pollute are given credits that allow them to do so up to a limit that is periodically reduced.
 - In the meantime, the company may sell any credits it doesn't require to another company that needs them.
 - In order to reduce greenhouse gas emissions, carbon credits were devised.
 - Companies are given a set number of credits, which decrease with time. Any extra credits can be sold to another company.
 - Companies have a monetary incentive to cut their carbon emissions attributable to carbon credits. Those that find it difficult to cut emissions can still operate, although at a higher cost.
 - The cap-and-trade model, which was employed in the 1990s to reduce sulphur pollution, is the basis for carbon credits.
 - The creation of a global carbon credit offset trading market was decided upon by negotiators in the Glasgow COP26 climate change summit in November 2021.
- **Carbon Offsetting:** Through carbon offset programmes, individuals and companies can make investments in environmental projects all over the world to offset their own carbon footprints.
 - Carbon offset programmes assist in the fight against global warming while also supporting local communities.
 - These projects frequently provide underdeveloped communities with much-needed jobs, health improvements, biodiversity, reforestation, and broad social benefits.

- **Carbon Tax:** A tax on burning fuels containing carbon is known as a carbon tax (coal, oil, gas).
 - It is thought to be the main policy for reducing and ultimately eliminating the use of fossil fuels, the burning of which is degrading and destabilising our climate.
 - Emission trading, which entails setting a maximum quantity of permissible effluents from industries and permitting those with low emissions to sell their extra space, is another method of pricing carbon.
 - Economic activities such as the usage of coal can be subject to a carbon tax, as is the case in Canada and Sweden.
- **Geo-Engineering:** It is the large scale intervention in the Earth system to counteract the human-led climate change. There are two basic techniques to intervene:
- **Carbon Dioxide Removal:** Under this, the carbon dioxide is removed from the atmosphere and stored for a long time. Techniques included are:
 - Ocean Fertilization
 - Afforestation
 - Air Capture
- **Solar Radiation Management:** By reflecting some sunlight back to space the global warming is counteracted. Techniques included are:
 - Desert Surface Albedo
 - Stratospheric Aerosol
 - Space Reflector

4. Global Response to Climate Change

- **United Nation Framework Convention on Climate Change (UNFCCC):**
 - In Force: 1994
 - Secretariat: Bonn, Germany
 - Ratified by: 197 countries
 - Convention: Legally non-binding
 - Aim: To stabilize GHG concentrations in the atmosphere.
 - Annex-I Countries: Industrialized Nations and economies in transition.
 - Annex-II Countries: Developed countries which pay for costs of the developing countries.
 - Non-Annex Countries: Developing countries.
- **Kyoto Protocol:**
 - Adopted: 1997
 - In Force: 2005
 - Parties: 192
 - Task: It sets the binding goals for the Annex-I countries.
 - Aim: To combat global warming it aims to reduce the greenhouse gas emissions.
 - Concept for Protocol: Common but Differentiated Responsibilities.
 - GHGs included in Protocol:
 - Methane
 - Carbon Dioxide
 - Sulphur Hexafluoride
 - Nitrous Oxide
- **UN-REDD:** REDD stands for Reducing Emissions from Deforestation in Developing Countries.
 - Formed: 2008
 - HQ: Geneva
- Membership: 64 Countries
- Type: Multi-lateral collaborative programme of the FAO, UNDP and UNEP
- Objective: Partners with the developing countries to support them in creating the technical capacities needed to implement REDD+ and meet UNFCCC requirements for REDD+ results based payments.
- **Global Environment Facility (GEF):** The Global Environment Facility (GEF) was created to offer fresh grants and additional concessional funding to meet the additional costs associated with transforming a project with national benefits into one with global environmental benefits.
 - The GEF unites 180 member nations in collaboration with global organisations, non-governmental organizations, and the private sector.
- **Green Climate Fund (GCF):** The GCF was established in 2010 as part of the UNFCCC's financial mechanism to provide funding from developed countries to developing countries so they can both combat climate change and adapt to its effects.
 - The Green Climate Fund will use thematic funding windows to support projects, programmes, policies, and other activities in developing country Parties.
- **Intergovernmental Panel on Climate Change (IPCC):**
 - Formed: 1988
 - By: WMO and UNEP
 - Objective: To provide policymakers with regular assessments of the scientific basis of climate change, its future risks and impacts and options for adaptation and mitigation.
 - The United Nations Framework Convention on Climate Change (UNFCCC) negotiations are based on IPCC assessments, which give governments of all levels a scientific basis for developing climate-related policies.
- **Paris Agreement: An international agreement to address climate change is known as the Paris Agreement.**
 - The governments of 195 countries met in Paris, France, from November 30 to December 11, 2015, to examine the possibility of a new global climate change agreement that would reduce greenhouse gas emissions worldwide and reduce the threat of dangerous climate change.
 - The 32-page Paris Agreement, which consists of 29 articles, is widely considered to be an important deal to prevent global warming.
 - Aim(s):
 - Limit the increase in the global temperature this century to no more than 2 degrees Celsius over the pre-industrial level.
 - Attempt to limit the temperature rise to 1.5 degrees Celsius or less.
 - Bolster ability of the countries to deal with the effects of climate change.

5. Indian Initiatives

- **National Action Plan on Climate Change (NAPCC):** The Prime Minister's Council on Climate Change launched the National Action Plan on Climate Change (NAPCC) in 2008.

- It aims to create awareness of the threat posed by climate change and the steps to counter it among representatives of the public, different government agencies, scientists, industry, and communities.
- The NAPCC is comprised of eight national missions, which together offer multi-pronged, long-term, integrated strategies for attaining key climate change goals. These are:
 - National Solar Mission
 - National Mission for Enhanced Energy Efficiency (NMEEE)
 - National Mission on Sustainable Habitat
 - National Water Mission
 - National Mission for Sustaining the Himalayan Ecosystem
 - National Mission for a Green India
 - National Mission for Sustainable Agriculture
 - National Mission on Strategic Knowledge for Climate Change.
- **Intended Nationally Determined Contribution (INDC):** Intended Nationally Determined Contributions, or INDCs, are declarations made by individual countries indicating the climate actions they expect to undertake after 2020 as part of a new international agreement.
 - With the aim of reducing greenhouse gas emissions enough to keep global temperature rise under 2 degrees Celsius, the INDCs combine the top-down system of a United Nations climate agreement with bottom-up system-in elements, allowing countries to present their agreements in light of their own national circumstances, capabilities, and priorities.
 - India's Proposed Targets:
 - Reduce the GDP's emissions intensity by 33 to 35% by 2030 compared to 2005 levels.
 - With the help of technology transfer and low-cost international finance, achieve an installed capacity of non-fossil fuel-based energy resources equal to about 40% of the total by 2030.
 - By 2030, create additional 2.5 to 3 billion tonnes of CO₂ equivalent of forest and tree cover to serve as a carbon sink.
- **Green Building:** A "green" building is one that reduces or eliminates negative effects on our climate and natural environment during design, construction, or operation. It can also have positive impacts.
 - Green buildings preserve precious natural resources and raise our quality of life.
 - Green building is the process of creating and constructing structures while employing processes that are resource-efficient and environmentally responsible at every stage of a building's life cycle, from siting to design to construction to operation to maintenance to renovation to deconstruction.
- **Green Rating for Integrated Habitat Assessment (GRIHA):** It is India's official national rating system for finished buildings.
 - In India's Intended Nationally Determined Contributions (INDC) presented to the United Nations Framework Convention on Climate

Change, GRIHA is recognized as the country's own green building rating system (UNFCCC).

- The Energy and Resources Institute (TERI) came up with the concept and the Ministry of New and Renewable Energy worked jointly with TERI to create it.
- **BSE-GREENEX:** The first environmentally friendly equity index, "BSE-Greenex," was launched by the country's premier stock exchange, BSE Ltd.
 - It would allow investors make better informed decisions in India's green theme.
 - The BSE has created BSE-Greenex in association with gTrade (supported by GIZ promoted by Germany, Observer Research Foundation, and IIM Ahmedabad), with the goal of promoting green investing while placing an emphasis on financial performance and long-term viability of companies.
 - To assess carbon performance, it is based purely on quantitative and objective performance signals.

Unit-7: Sustainable Development

1. Definition

- **Sustainable Development:** Development that meets present needs without compromising the ability of future generation to meet their own needs.
 - The Brundtland Commission provided this most widely accepted definition of sustainable development in its report 'Our Common Future' (1987).
 - In order to create an inclusive, sustainable, and resilient future for people and the planet, sustainable development (SD) calls for coordinated efforts.
- **Core Elements of Sustainable Development:**
 - Economic growth, social inclusion, and environment protection are the three pillars of sustainable development. It is essential to bring them together.
 - Sustainable development emphasises living in harmony with nature, achieving sustainable livelihoods, and using the appropriate technologies.

2. UN-SDGs

- **United Nations-Sustainable Development Goals (UN-SDGs):** The Sustainable Development Goals (SDGs), also known as the 'Global Goals', were adopted by the United Nations in 2015 as a universal call to action to end poverty, protect the planet and ensure that by 2030 all people enjoy peace and prosperity.
 - The 17 SDGs are integrated, they recognise that action in one area will affect outcomes in others and that development must balance social, economic and environmental sustainability.
 - Countries have committed to prioritize progress for those who're furthest behind. The SDGs are designed to end poverty, hunger, AIDS, and discrimination against women and girls.

■ The 17 UN-SDGs are listed below:

- **SDG 1:** No Poverty
- **SDG 2:** Zero Hunger
- **SDG 3:** Good Health and Well being
- **SDG 4:** Quality Education
- **SDG 5:** Gender Equality
- **SDG 6:** Clean Water and Sanitation
- **SDG 7:** Affordable and Clean Energy
- **SDG 8:** Decent Work and Economic Growth
- **SDG 9:** Industry, Innovation and Infrastructure
- **SDG 10:** Reduced Inequalities
- **SDG 11:** Sustainable Cities and Communities
- **SDG 12:** Responsible Consumption and Production
- **SDG 13:** Climate Action
- **SDG 14:** Life below Water
- **SDG 15:** Life on Land
- **SDG 16:** Peace, Justice and Strong Institutions
- **SDG 17:** Partnerships for the Goals
- **Efforts at the Individual Level:**
 - Conserve Fossil Fuels
 - Conserve Water
 - Save Trees
 - Keep the Air Clean
 - Reduce Garbage
 - Spread Awareness

3. NITI Aayog's SDG Index

- **NITI Aayog's Sustainable Development Goal India Index (SDG India Index):** SDG India Index look to provide a holistic view on the Social, Economic and Environmental status of the country and its States. The SDG India Index provides a State's or UT's present situation on each of the indicators taken into account, and later versions will reflect incremental change. This Index spans across 13 out of 17 SDGs not taking into its fold the goals 12, 13, 14 and 17.
- **Developed By:** Ministry of Statistics & Programme Implementation, NITI Aayog, United Nations-India and Global Green Growth Institute.
- **Classification Criteria:**
 - Aspirant: 0-49
 - Performer: 50-64
 - Front-Runner: 65-99
 - Achiever: 100
- **SDG India Index 2.0:** This version of SDGs covers around 16 out of total 17 SDGs, which means it is more comprehensive in its coverage as compared to the SDG India Index 1.0.

Unit-8: Environmental Organisations

1. United Nations Environment Programme (UNEP)

- **United Nations Environment Programme (UNEP):**
 - Established: 1972 (as an outcome of the Stockholm Conference)
 - HQ: Kenya (Nairobi)
 - Achievements:
- One of the several implementing agencies for the Global Environmental facility (GEF).
- International Cyanide Management Code was developed under its auspices.

- Contributed to the creation of treaties and recommendations on topics such as Contamination of International Waterways, International Trade in potentially hazardous substance, etc.

2. World Meteorological Organisation (WMO)

- **World Meteorological Organization (WMO):**
 - Formed: 1950
 - HQ: Geneva, Switzerland
 - Type: Inter-governmental organisation
 - Membership: 191 states and territories
 - Importance: Provides an international forum for co-operation in meteorology.

3. World Wide Fund for Nature

- **World Wide Fund for Nature (WWF):**
 - Formed: 1986
 - Mission: To halt and reverse the destruction of our environment.
 - Type: International Non-Governmental Organisation
 - Tasked with: Wilderness preservation and reducing the human's footprint on the environment.
 - It is a type of charity with around 60% of its funding coming from the voluntary donations by private individuals.

International Union for Conservation of Nature (IUCN)

- **International Union for Conservation of Nature (IUCN):**
 - Formed: 1948
 - HQ: Switzerland
 - Type: Membership union comprising both Governments and Civil Society Organisations.
 - IUCN Red List of Threatened Species: It is the most comprehensive inventory of the global conservation status of animal and plant species.
- It assesses the likelihood of species extinction using a set of quantitative criteria. All species and geographical regions around the world find these criteria as relevant.
- The extinction risk of a species is defined by the IUCN Red List Categories. The range of nine categories comprises NE (Not Evaluated) to EX (Extinct).
- Species that are deemed to be at risk of extinction include those that are Critically Endangered (CR), Endangered (EN), and Vulnerable (VU).
- **Global Tiger Forum:** The GTF is the only inter-governmental international body created with members from willing nations to launch a global campaign to preserve the tiger.
 - Formed: 1993
 - HQ: New Delhi
- **International Whaling Commission (IWC):** It is an international organisation created in accordance with the International Convention for the Regulation of Whaling (ICRW).
 - HQ: England
 - Functions: The ICRW governs the 59 member nations' commercial, scientific, and subsistence whaling practices.

- It enacted a moratorium on commercial whaling in 1986. This ban is still in effect.
- **International Solar Alliance (ISA):** It is an action oriented, member-driven, collaborative platform to increase deployment of solar energy based technologies. It was conceived as a joint effort by France and India to mobilize efforts against climate change through employment of solar energy solutions.
 - **Aim:** To facilitate energy access, ensure energy security, and drive energy transition in its member countries.
 - **Vision:** 'Let us together make the sun brighter'.
 - **Mission:** 'Every home, no matter how far away, will have a light at home'.
 - **Headquarters:** India (Gurugram)
 - **Member Nations:** 106 countries (Out of 106 nations, 86 have signed and ratified the ISA Framework Agreement)
 - **Eligibility:** All member states of the United Nations are eligible to join the ISA.

Unit-9: Miscellaneous

1. Important Acts related to Environment

- **Wildlife (Protection) Act, 1972:** The Act was passed in order to save various plant and animal species. Except for the State of Jammu & Kashmir, it covers the entirety of India. India only had five recognised national parks prior to the passage of this legislation.
 - **Authorities Appointed Under the Act:**
- **By Central Government:** The Director of Wildlife Preservation
- **By State Governments:** The Chief Wildlife Warden (CWLW)
 - **Schedules Under the Act:** The WPA of 1972 has divided the protection status of various animals and plants under the below-mentioned six categories:
 - Schedule-I
 - Schedule-II
 - Schedule-III
 - Schedule-IV
 - Schedule-V
 - Schedule-VI
- **Environmental Protection Act 1986:** It was enacted by the Government of India after the Bhopal Gas Tragedy.
 - It establishes the framework for studying, planning, and putting into practise long-term environmental safety requirements as well as prescribing a system of timely and appropriate reaction to environmental hazards.
 - The EPA Act was passed in accordance with Article 253 of the Indian Constitution, which provides for the enactment of legislation to implement international agreements.
 - The EPA grants the Central Government the power to establish authorities tasked with preventing environmental pollution in all of its forms and addressing particular environmental problems that are peculiar to various regions of the country.

2. Coastal Regulation Zone (CRZ)

- **Coastal Regulation Zone (CRZ):** The land between the low tide line (LTL) and the high tide line, as well as the coastal areas including seas, bays, creeks, rivers, and backwaters that are exposed to tides up to 500 metres from the high tide line (HTL), have been designated as coastal regulation zone (CRZ) from 1991.
 - The Ministry of Environment, Forest, and Climate Change has established the coastal regulation zones in accordance with the Environment Protection Act of 1986.
 - The state governments' Coastal Zone Management Authorities are responsible for ensuring that the CRZ Rules are implemented, even though the Union Environment Ministry creates them.
 - Classification of Coastal Zones under CRZ Notification 2011:
 - CRZ-I: Ecologically Sensitive Areas.
 - CRZ-II: Shore Line Areas.
 - CRZ-III: Undisturbed Areas
 - CRZ-IV: Territorial Area

3. Organizations

Animal Welfare Board of India (AWBI)

- **Established in 1962 + HQ:** Ballabgarh in Haryana (earlier based at Chennai).
- **Key person:** Rukmini Devi Arundale (also the 1st Chairperson of AWBI).
- AWBI is a statutory advisory body under The Prevention of Cruelty to Animals Act, 1960 under the Ministry of Fisheries, Animal Husbandry and Dairying.
- **Functions:** Its advices governments on the matters related to Animal welfare + Provides grants to Animal Welfare Organizations.

Central Zoo Authority (CZA)

- Established in 1992 (HQ: New Delhi)
- CZA is a statutory body + under 1991 Amendment to Wildlife (Protection) Act 1972 + under MoEF&CC.
- **Objectives:** To complement the national effort in conservation of wild life + To maintain Indian Zoos on par with International standards + Exchange of animals between Indian and foreign zoos.
- The Authority consists: Chairman: Minister of Environment + 10 members & a member Secretary.

Forest Survey of India (FSI)

- Established in 1981 + HQ: Dehradun in Uttarakhand + under MoEF&CC.
- It started as 'Pre-Investment Survey of Forest Resources (PISFR)' in 1965 before re-organized as FSI in 1981.
- **Objective:** to conduct survey and assessment of forest resources.
- **Forest Survey Report:** Released by FSI since 1987, biennially (once in two years).

Botanical Survey of India (BSI)

- Established in 1890 (under the direction of Sir George King) + HQ: Kolkata + under MoEF&CC.
- BSI is the apex taxonomic research organization of the country.

- **Mandate:** biosystematics research, floristic studies, documentation of flora, digitization of herbarium specimens, & advisory services etc.,
- BSI publishes 'Red Data Book of Indian Plants'.

Zoological Survey of India (ZSI)

- Established in 1916 + HQ: Kolkata + under MoEF&CC
- **Objective:** to promote the survey, exploration and research of the fauna.
- The history of ZSI goes back to Asiatic Society of Bengal founded by Sir William Jones in 1784.

National Biodiversity Authority (NBA)

- Established in 2003 + HQ: Chennai + under MoEF&CC
- NBA is a statutory body under Biological Diversity Act, 2002.
- The act was enacted to give effect to the Convention on Biological Diversity (CBD) (India signed it in 1992)
- **Mandate:** to perform regulatory & advisory functions for the GoI on issues of conservation, sustainable use of biological resources.
- NBA supports creation of State Biodiversity Boards (SBBs).
- **Biodiversity Heritage Sites:** Notified by State Governments in consultation with local bodies.

Wildlife Crime Control Bureau (WCCB)

- Established in 2006 + HQ: New Delhi + under MoEF&CC
- WCCB is a statutory body constituted under the Wildlife (Protection) Act 1972 (WPA 2006, Amendment).
- Have five regional offices at Delhi, Kolkata, Mumbai, Chennai & Jabalpur.
- **Objective:** to combat organized wildlife crime
- Additional Director General (Wild Life) is the ex-officio director of the WCCB.
- WCCB is the nodal point for SAWEN (South Asia Wildlife Enforcement Network) in India.
- **WCCB has conducted:** Operation Save Kurma, Thunder Bird, Wild-Net, Lesknow, Birbil, Clean Art
- It also assists & advises the Customs authorities in inspection of the consignments of flora & fauna as per the provisions of WPA, CITES & EXIM Policy.
- UNEP has awarded WCCB with 'Asia Environment Enforcement Awards' in 2018.

National Plan for Conservation of Aquatic Eco-Systems (NPCA)

- NPCA was launched in 2013 by merging National Lake Conservation Plan (NLCP) and National Wetlands Conservation Programme (NWCP)
- **Objective:** Holistic conservation & restoration of lakes, wetlands to enhance water quality besides improving biodiversity and the ecosystem.
- NPCA is presently operational on cost sharing between Central and respective state governments.

National Ganga River Basin Authority

- Established in 2009 + HQ: New Delhi + under Ministry of Jal Shakti
- Mandate: Abatement of pollution & conservation of the river Ganga.
- The NGRBA is chaired by the Prime Minister
- Members include: Union Ministers concerned, the Chief Ministers of the States through which Ganga flows.

National Board for Wildlife (NBWL)

- Established in 2003 + HQ: New Delhi + under MoEF&CC
- It replaced the 'Indian Board for Wildlife', which was formed in 1952 as an advisory board.
- NBWL is a statutory body constituted under the WPA, 1972.
- NBWL Composition: Chair Person: the Prime Minister | Vice-Chair: Minister of Environment | 45 other members including 19 ex-officio members, 3 MPs (2 from LS & 1 from RS), 5 NGOs.
- **Objective:** To promote the conservation and development of wildlife and forests.
- It has power to review all wildlife-related matters and approve projects in and around national parks and sanctuaries.
- No alternation of boundaries in National Parks and Wildlife Sanctuaries can be done without approval of the NBWL

National Tiger Conservation Authority (NTCA)

- Established in 2006 + HQ: New Delhi + under MoEF&CC
- NTCA is a statutory body constituted under the WPA, 1972 (Amendment Act, 2006).
- **Chairperson:** Minister of Environment.
- It provides statutory authority to Project Tiger.

4. Environmental Impact Assessment (EIA)

- **Environmental Impact Assessment (EIA):** According to the UNEP (United Nations Environment Programme) EIA is a tool used to identify the environmental, social and economic impacts of a project prior to decision-making.
 - Aim: 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.
 - Process:
- **1st Stage-Screening:** It tells us whether the proposed project requires an EIA and if it does then the level of assessment required.
- **2nd Stage-Scoping:** This stage identifies the key impacts and issues that should be further investigated further. It also explains the boundary and time-limit of the study.
- **3rd Stage-Impact analysis:** Identifies and predicts the likely social and environmental impact of the proposed project and evaluates the importance.
- **4th Stage-Mitigation:** Recommends the steps to reduce and avoid the potential adverse consequences on the environment of the development activities.
- **5th Stage-Reporting:** Presents the result of EIA through a report to the decision-making body and other parties.
- **6th Stage-Public hearing:** On completion of the EIA report, environmental and public groups living close to project site may be informed and then consulted.
- **7th Stage-Review of EIA:** It examines the effectiveness and adequacy of the EIA report and provides the necessary information for the decision-making process.

- **8th Stage-Decision-making:** It decides whether the concerned project is approved, rejected or needs any further changes.
- **9th Stage-Post monitoring:** This stage comes into picture when the project is commissioned. It checks to confirm that the impacts of the project does not exceed the legal standards and implementation of the mitigation measures are in the way described in the report.

5. Agriculture

- Agriculture is the science, art and practice of cultivating plants and livestock. Agriculture was the key development in the rise of sedentary human civilization, whereby farming of domesticated species created food surpluses that enabled people to live in cities.

Salient Features of An Indian Agriculture

- Subsistence type of agriculture.
- Dependent on unreliable and erratic monsoon (about 60 percent)
- India's vast relief, varying climate and soil conditions produce a variety of crops.
- All tropical, subtropical and temperate crops are grown across geographical areas.
- Predominance of food crop → about 2/3rd of total cropped area.
- Backbone of rural economy.
- Plays critical role in ensuring food security.
- Poor electricity, storage, water, credit & marketing infrastructure.
- Supports allied sectors and activities – cattle, poultry etc.
- Major involvement of women in Indian agriculture sector.
- Characterized by poor mechanization, inadequate Agricultural research and extension services.
- Fragmented nature of agricultural holding.

Productivity of Agriculture

- Productivity of Agriculture is defined as the number of crops produced per unit land.
- Productivity levels in Indian agriculture are very low as compared to the productivity levels of other countries – China, USA etc.
- Like in 2018, average productivity in India was 3075 Kg/ha while world average was 3200kg/ha.
- Fertiliser use, irrigation and rainfall cause significant variation in productivity.
- Productivity in the regions of Green revolution are certainly higher than other areas. Other high productivity regions are Tamil Nadu, Kerala, West Bengal and Maharashtra.
- The productivity in Gangetic plain is reducing because of Land bifurcation leading to reduced size of land holdings.
- Key issues affecting agricultural productivity include the decreasing sizes of agricultural land holdings, continued dependence on the monsoon, inadequate

access to irrigation, imbalanced use of soil nutrients resulting in loss of fertility of soil, uneven access to modern technology in different parts of the country, lack of access to formal agricultural credit, limited procurement of food grains by government agencies, and failure to provide remunerative prices to farmers.

Cropping Intensity

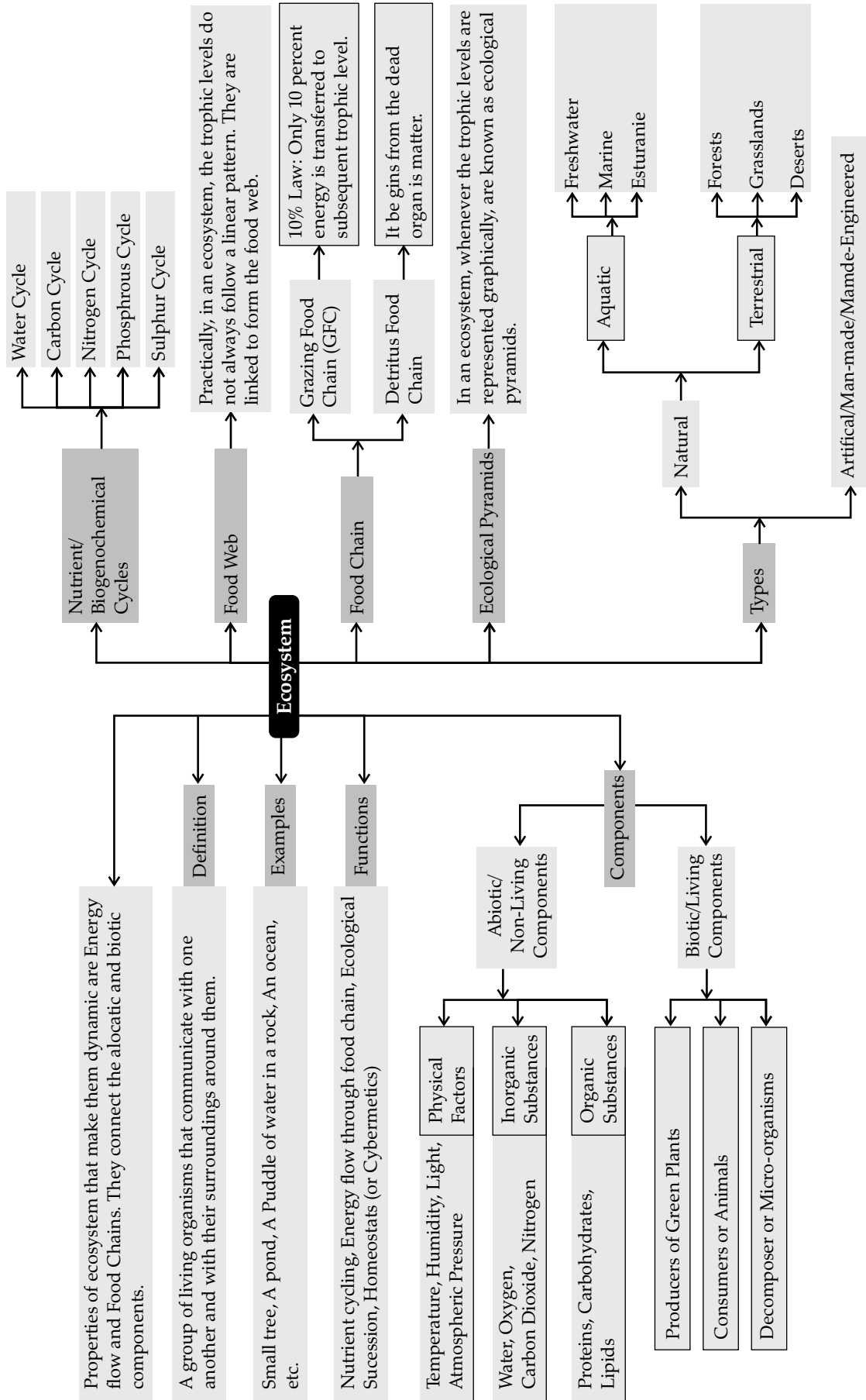
- The ratio of the gross cropped area to the net sown area.
- As the land is cropped multiple times, the cropping intensity increases.
- It depends on factors like climate, demand of crops, availability of irrigation and other inputs etc.

6. Renewable Energy Sources

- **Solar Energy:** Solar energy is the most plentiful energy source available and may be used in cloudy conditions. The Earth absorbs solar energy at a pace that is around 10,000 times greater than the rate at which people use.
- The quantity of solar energy that reaches the surface of the globe in a single hour exceeds the planet's whole annual energy.
- **Wind Energy:** Wind energy is the process of harnessing the kinetic energy of moving air by means of massive wind turbines that are installed on land (onshore), in salt water, or in freshwater (offshore). Despite the fact that wind energy has been used for thousands of years, onshore and offshore wind energy technology has lately progressed to maximize the quantity of electricity produced, with higher turbines and larger rotor diameters.
- **Hydro-Power Energy:** The largest renewable energy source in the electricity sector at the moment is hydro-power. It is dependent on typically consistent rainfall patterns. The energy of water flowing from higher elevations to lower elevations is captured by hydro-power.
- **Ocean Energy/ Tidal Energy:** Tidal energy is now at the research and development (R&D) stage in India, according to the Ministry of New and Renewable Energy. Low to moderate tidal wave power is predicted for the Gulf of Khambat, Gulf of Kutch, southern Gujarat, Palk Bay and Mannar Channel in Tamil Nadu, Hooghly River, South Haldia, and the Sunderbans in West Bengal.
- **Geothermal Energy:** Geothermal energy uses the thermal energy that exists within the Earth's interior. Warming geothermal reservoirs can be accomplished using wells and other methods.
- **Biomass Energy:** Bioenergy is made from various organic resources, known as biomass, including wood, charcoal, dung, and other manures for the production of heat and power, as well as agricultural crops for the creation of liquid biofuels. The majority of biomass is used for cooking, lighting, and space heating by the poorest people in developing countries rural areas.

Unit 1

Ecosystem



Chapter-1

Ecosystem: Components and Functions**1. Consider the following statements:**

- Deep Carbon Observatory conducts field observations of deep microbial ecosystem.
- Deep Carbon Observatory is a global research programme to outreach the role of carbon on earth.
- Blue-green algae does not help in the growth of plants.

How many of the above statements are correct?

- (a) Only one (b) Only two
(c) All three (d) None

2. In an ecosystem, the amount of energy during the transfer from one trophic level to other:

- (a) Remains constant
(b) Decreases
(c) Increases
(d) May increase or decrease

3. Match the following:

List-I		List- II	
A.	Acacia	1.	Equatorial
B.	Epiphytes	2.	Mediterranean
C.	Cedars	3.	Savanna
D.	Baobab	4.	Sahara

How many of the above pairs are correctly matched?

- (a) Only one pair (b) Only two pairs
(c) All four pairs (d) None of the pairs

4. Consider the following statements:

- Phasing out the use of mercury and the mercury-based products is the aim of the Minamata Convention.
- Coal-based power plants do not emit Mercury into the Environment.

Which of the statement(s) given above is/are correct?

- (a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

5. Consider the following statements about the Coral Formation:

- They are often referred to as the 'rainforests of the sea'.
- It is not found in the Gulf of Cambay region.

Which of the statement(s) given above is/are correct?

- (a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

6. With reference to the Ecosystem Productivity, consider the following statements:

- The amount of inorganic substances left in the plant by the end of its own metabolism is known as Gross Primary Productivity (GPP).
- Net Primary Productivity (NPP) is referred to as total amount of solar energy stored and captured in the form of organic substances by plants.

- In the sub-tropical rainforest regions of the terrestrial environments, the highest value of Net Primary productivity occurs.

How many of the above statements are correct?

- (a) Only one (b) Only two
(c) All three (d) None

7. With reference to the growth of Coral Reefs consider the following statements:

- Sea water of tropics in a temperature range of 20°C to 21°C.
- Sediment-free water.
- Photic conditions
- 10% salinity of seawater.

How many of the above conditions favours the growth of corals?

- (a) Only one (b) Only two
(c) Only three (d) All four

8. With reference to Dugong, consider the following statements:

- Kerala government has established India's first conservation reserve for Dugong in the Gulf of Mannar.
- Dugong has been listed as "Vulnerable" under the IUCN's Red List of Threatened Species.
- It is the only existing species of herbivorous mammal that lives exclusively in the sea.

How many of the above statements are correct?

- (a) Only one (b) Only two
(c) All three (d) None

9. Consider the following statements about 'Project Dolphin':

- It is one of the activities planned under the Namami Gange Programme.
- It will be implemented by the Ministry of Environment, Forest & Climate Change (MoEF&CC).
- It was an initiative to focus on only sea Dolphins.

How many of the above statements are correct?

- (a) Only one (b) Only two
(c) All three (d) None

10. Consider the following statements:

- Saprotrophs obtain the energy they need by consuming dead organic matter.
- Decomposition does not involves fragmentation as a process.

Which of the statement(s) given above is/are correct?

- (a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

11. Consider the statements about 'Single-Use Plastics':

- Plastic Waste Management Amendment Rules, 2011 prohibits specific single-use plastic items which have "low utility and high littering potential" by 2022.
- The ban is applicable to all types of plastic without any exception.

Select the correct answer using the codes given below:

- (a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

12. '*Minervarya Pentali*' was sometimes in the news, is referred to:

- (a) A Frog species (b) A Bat
(c) A Satellite (d) An Exoplanet

13. With reference to 'slender loris' consider the following statements:

1. It is protected under schedule II of the Wildlife (Protection) Act of India, 1972.
2. They are found in tropical rainforests, shrub forests, semi-deciduous forest, and swamps.
3. They are genus of Loris native to India and Srilanka.

How many of the above statements are correct?

- (a) Only one (b) Only two
(c) All three (d) None

14. '*Acetabularia Jalakanyakae*' was sometimes in news is:

- (a) An algal species with an umbrella head.
(b) It is named after an imaginary sea mermaid.
(c) Both (a) and (b)
(d) None of the above

15. Consider the following statements about 'Great Indian Bustard(GIB)':

1. It is the state bird of Rajasthan and Gujarat.
2. Its population is confined to Rajasthan and Gujarat only.
3. It is designated as Critically Endangered in the IUCN Red List.

How many of the above statements are correct?

- (a) Only one (b) Only two
(c) All three (d) None

16. Consider the following statements about the 'Ken-Betwa Inter-Linking Project':

1. The project involves the transferring of water from the Ken to the Betwa River.
2. Paricha, Rajghat and Matatila dams are over the Ken River.
3. National Inter-linking of Rivers Authority is the implementing agency for the project.

How many of the above statements are incorrect?

- (a) Only one (b) Only two
(c) All three (d) None

17. Consider the following statements:

1. Only the biotic components are included in the lake ecosystem.
2. The littoral zone is the near shore area where the sunlight penetrates all the way to sediment and allows aquatic plants to grow.
3. The closed water area where the lights are generally not penetrating to reach the bottom is limnetic.

How many of the above statements are correct?

- (a) Only one (b) Only two
(c) All three (d) None

18. With reference to 'Indian Pangolin' consider the following statements:

1. It is protected under Schedule-I of the Wildlife Protection Act, 1972.
2. It is adaptable to a wide range of habitats.
3. Its population is steadily increasing from last few years.

How many of the above statements are correct?

- (a) Only one (b) Only two
(c) All three (d) None

19. Consider the following statements regarding Bomb cyclones:

1. Bomb cyclone is an intense, large and mid-latitude storm that has low pressure at its centre.
2. Bomb cyclones generally occur during colder months because cyclones occur due to cold and warm air meetings.

Select the correct answer using the codes given below:

- (a) 1 only (b) 2 only
(c) Both 1 and 2 (d) None of the above

20. 'Razzaza Lake' is located in which country?

- (a) Iran (b) Egypt
(c) Oman (d) Iraq

21. Consider the following statements with respect to the 'Ecological Niche':

1. For a species every niche is unique.
2. Two species from the same habitat can have identical niches.

Which of the statements given above is/are correct?

- (a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

22. With reference to 'Biome' consider the following statements:

1. Aquatic systems are also called biomes.
2. The climate has an effect on determining the boundary of the biome.
3. No two biomes can be alike.

How many of the above statements are correct?

- (a) Only one (b) Only two
(c) All three (d) None

23. Consider the following statements:

1. Seasonally the food preferences of the organisms can change.
2. Food web is only a part of the energy and food.
3. There will be no overall effect on the food web when any of the intermediate food chain is removed.

How many of the above statements are correct?

- (a) Only one (b) Only two
(c) All three (d) None

24. Consider the following statements:

1. Shifts and differences in climatic patterns are not caused by altitudinal and latitudinal variations.
2. Study of the interrelation between organisms and the environment on land is called terrestrial ecology.

Which of the statements given above is/are correct?

- (a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

25. With reference to 'Bio-geochemical cycles' consider the following:

1. Phosphorous cycle 2. Oxygen cycle
3. Nitrogen cycle 4. Sulphur cycle

How many the above has been included in the sedimentary cycle of the bio-geochemical cycle?

- (a) Only one (b) Only two
(c) Only three (d) All four

26. Consider the following statements in the context of wetlands:

1. Macrophytes are the dominant producers in case of wetlands.
2. Compared to lakes, the biodiversity is generally high in the case of wetlands.

Which of the above statements is/are correct?

- (a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

27. With reference to the 'Green India Mission' of the Government of India, consider the following statements:

1. Launching the second green revolution to increase agricultural productivity and provide future food security for all.
2. Introducing "Green Accounting" by including environmental benefits and costs in the State and Union Budgets.
3. Enhancing and restoring the forest cover while taking both adaptation and mitigation measures in response to climate change.

How many of the above statements are correct?

- (a) Only one (b) Only two
(c) All three (d) None

Chapter-2

Types of Ecosystems

1. Consider the following statements:

1. Homeostatic capacity of ecosystem is usually unlimited.
2. Homeostasis is the capacity of an ecosystem to self-regulate.

Which of the statement(s) given above is/are correct?

- (a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

2. Consider the following statements:

1. In the aphotic zone no respiration takes place.
2. For the aquatic ecosystem oxygen acts as an important limiting factor.
3. Photic zone is the upper-most layer of the aquatic ecosystem up to which the sunlight penetrates and where both respiration and photosynthesis takes place.

How many of the above statements are correct?

- (a) Only one (b) Only two
(c) All three (d) None

3. With reference to Ecological Pyramid consider the following statements:

1. The size variation of the organisms counted at each trophic level is not taken into account by the pyramid of numbers.
2. The trophic structure of an ecosystem is completely defined by the pyramid of numbers.

Which of the statement(s) given above is/are correct?

- (a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

4. With reference to the Planktons, consider the following statements:

1. Unlimited growth of phytoplanktons signifies the presence of the algal bloom.
2. Chlorophyll is not present in the Phytoplanktons.
3. These are considered as the primary producers of the ocean.

How many of the above statements are correct?

- (a) Only one (b) Only two
(c) All three (d) None

5. With reference to 'The Economics of Ecosystems and Biodiversity (TEEB)', consider the following statements:

1. Drawing attention to the economic benefits of the biodiversity is the main focus of this global initiative.
2. IMF, UNEP and World Economic Forum have hosted this initiative.
3. This initiative has the potential to help the decision-makers in recognizing, demonstrating and to capturing the value of Biodiversity and ecosystems.

How many of the above statements are correct?

- (a) Only one (b) Only two
(c) All three (d) None

6. Which of the following is related to the Brazzaville Declaration?

- (a) In Latin America and Caribbean to strengthen the international protection of refugees, displaced and stateless persons.
(b) Committed to climate risk transparency it is the world's first Insurance market.
(c) It was signed to protect the world's largest tropical peatland.
(d) By 2022 the reduction in the number of road accidents.

7. Arrange the following ecosystems in the correct sequence of the albedo value in decreasing order:

1. Taiga 2. Tundra
3. Tropical Deciduous 4. Tropical Evergreen

Select the correct answer using the codes given below:

- (a) 1, 4, 3, 2 (b) 2, 1, 3, 4
(c) 1, 3, 2, 4 (d) 4, 3, 2, 1

8. With reference to *Eutrophication*, consider the following statements:

1. Eutrophication is identified by excessive algal and plant growth.
2. Increase in photosynthetic activities indicates the occurrence of Eutrophication.
3. The excess algae and plant matter eventually decompose, producing large amounts of sulphur dioxide.

How many of the above statements are correct?

- (a) Only one (b) Only two
(c) All three (d) None

9. Consider the following statements:

1. Corals have been found to have a parasitic relationship with the zooxanthellae.
2. Zooxanthellae's only function is to provide beautiful and unique colours to corals.

Which of the statement(s) given above is/are correct?

- (a) 1 only (b) 2 only
(c) Both 1 and 2 (d) None of these

10. With reference to plankton consider the following statements:

1. They are usually found near the surface of the water.
2. Zooplankton populations can be quickly affected by the abundance of phytoplanktons.
3. They are considered marine drifters.

How many of the above statements are correct?

- (a) Only one (b) Only two
(c) All three (d) None

11. Consider the following pairs:

	Wildlife	Naturally found in
1.	Rusty-spotted Cat	Eastern Ghats
2.	Blue-finned Mahseer	Cauvery river
3.	Irrawaddy Dolphin	Betwa River

How many of the pairs given above is/are correctly matched?

- (a) Only one pair (b) Only two pairs
(c) All three pairs (d) None

12. Consider the following statements:

1. Habitat rights for Primitive and Vulnerable Tribal Groups in any part of India are officially decided and declared by the Union Ministry of Environment, Forest and Climate Change (MoEF&CC).
2. The Forest Rights Act of 2006 incorporates the definition of "Critical Wildlife Habitat" within its provisions.

Which of the statement(s) given above is/are correct?

- (a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

13. With reference to 'Birdlife International', consider the following statements?

1. It's a global partnership between conservation organisations.

2. This organisation led the concept of 'biodiversity hotspot'.

3. It identifies sites referred to as the 'Important Bird and Biodiversity Areas'.

How many of the above statements are correct?

- (a) Only one (b) Only two
(c) All three (d) None

14. Consider the following statements with respect to the 'Red Sanders':

1. In the tropical dry deciduous forest areas of South India, it is one of the most important trees.

2. It is a tree species found only in Karnataka.

Which of the statement(s) given above is/are correct?

- (a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

15. For the propagation of plants and animals the Germplasm is required, which of the given below makes up Germplasm?

1. Egg and sperm repository

2. Genetic Resource

3. Tissue or seed for breeding

- (a) Only one (b) Only two
(c) All three (d) None

16. With reference to Dugong, consider the following statements:

1. Under schedule I of the Wildlife Protection Act, 1972 it is given legal protection.

2. It is a herbivorous animal.

3. It is found along the entire coast of India.

How many of the above statements are correct?

- (a) Only one (b) Only two
(c) All three (d) None

17. From the pairs of species mentioned below, a small quantity of the fine quality of wool is obtained in India from?

(a) Pashmina rabbits and Angora goats

(b) Pashmina rabbits and Angora sheep

(c) Pashmina goats and Angora sheep

(d) Pashmina goats and Angora rabbits

18. Consider the following list of animals:

1. Salt-water crocodile 2. Snow Leopard

3. Jaguar

How many of the above is/are naturally found in India?

- (a) Only one (b) Only two
(c) All three (d) None

19. Consider the following species:

1. Emperor Penguin 2. Adjutant stork

3. Rattlesnake

How many of the above is/are naturally found in India?

- (a) Only one (b) Only two
(c) All three (d) None

20. Consider the following statements:

1. Only different species of microscopic algae are the producers in the aquatic ecosystem.