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CIVIL SERVICES ACHIEVERS' POINT

A ONE STOP SOLUTION FOR UPSC/APSC/SSC & BANKING

UPSC PRELIMS

PREVIOUS YEAR QUESTIONS

(1995-2018)

ENVIRONMENT

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CONTENTS

I. BASIC CONCEPTS AND TERMINOLOGY PART 1

QUESTION 1

Q. Which one of the following is the best description of the term 'ecosystem'? [2015]

(a) A community of organisms interacting with one another.

(b) That part of the Earth which is inhabited by living organisms.

(c) A community of organisms together with the environment in which they live.

(d) The flora and fauna of a geographical area.

Answer : c

EXPLANATION

ENVIRONMENT AND ITS COMPONENT

Environment

• Environment: It is everything that surrounds or affect an organism which comprises of both living (biotic) and non-living (abiotic) components.

• In biological sense, environment constitute the physical (nutrients, water, air etc.) and biological factors (biomolecules, organisms) along with their chemical interactions (chemical cycles –carbon cycle, nitrogen cycle etc.).

• Environment is not static and the two components continuously interact with each other to define and specify the habitat (where an organism live) and ecosystem of an organism.

• The scientific study of the interactions between the organisms living in an environment and the environment itself is called Ecology.

ENVIRONMENTAL COMPONENTS

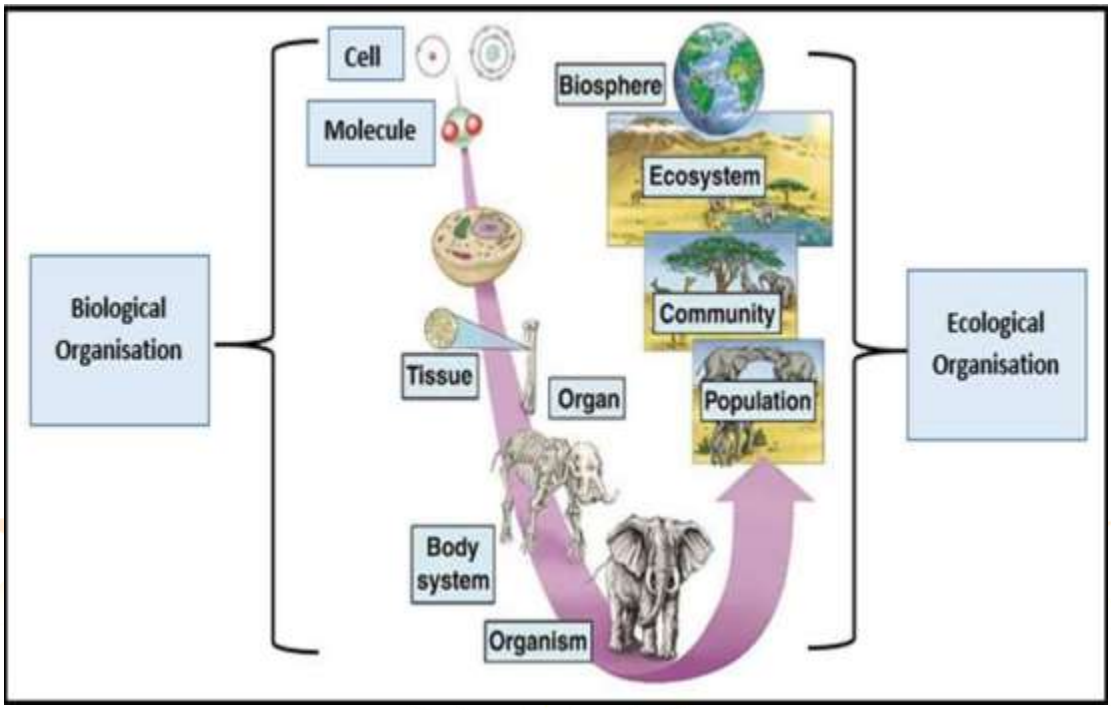
Abiotic Components	Biotic Components
• Energy	• Micro-organisms
• Radiation	• Green Plants
• Temperature & heat flow	• Non-green plants
• Soil	• Parasites
• Water	• Man
• Atmospheric gases and wind	• Animals

• Ecology is the branch which studies the interactions among organisms and their environment. Objects of study include interactions of organisms with each other and with abiotic components of their environment.

• The term ecology was coined in 1866 by the German biologist, Ernst Haeckel from the Greek oikos meaning "house" or "dwelling", and logos meaning "science" or "study". Thus, ecology is the "study of the household or nature".

• Ecology encompasses study of individual, organisms, population, community, ecosystem, biome and biosphere which form the various levels of ecological organization.

Levels of Organisation



Levels of Ecological Organisation

INDIVIDUAL

✓ A living being that has the ability to act or function independently.

POPULATION

✓ It is a group of organisms usually of same species, occupying a defined area during a specific time.

✓ Population growth rate is the percentage variation between the numbers of individuals in a population at two different times. It can be positive due to birth and/or immigration or negative due to death and/or emigration.

✓ The main limiting factors for the growth of population are biotic and abiotic components.

✓ The number of individuals per unit area at a given time is termed as population density.

COMMUNITY

✓ Biotic community is a result of interdependence and interactions amongst population of different species in a habitat. This is an assemblage of populations of plants, animals, bacteria and fungi that live in an area and interact with each other.

✓ Communities in most instances are named after the dominant plant form (species). For example: A grassland community is dominated by grasses, though it may contain herbs, shrubs, and trees, along with associated insects and animals of different species.

✓ On the basis of size and degree of relative independence communities may be divided into two types:

Major Communities and Minor Communities.

• Major Communities: These are large sized and relatively independent. They depend only on the sun's energy from outside. For example: Tropical evergreen forests.

• Minor Communities: These are dependent on neighbouring communities and are often called societies. They are secondary aggregations within a major community. For example: A mat of lichen on a cow dung pad.

ECOSYSTEM

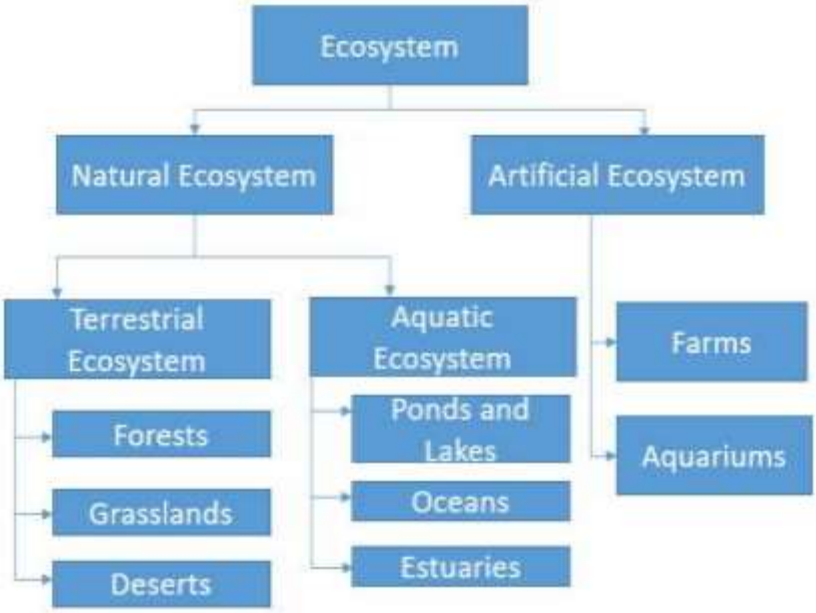
✓ Ecosystem is a community of organisms interacting with each other and with their environment such that energy is exchanged with help of system-level processes, such as the cycling of elements.

✓ It is structural and functional unit of biosphere.

✓ The components of ecosystem and environment are same i.e. Biotic and abiotic components.

✓ Abiotic components/factors: They are the inorganic and non- living part of world. They are the most important determinants of where and how well an organism exists in an organism. It includes factors like: energy, rainfall, temperature, atmosphere, soil, latitude and altitude.

✓ Biotic components/factors are the living components.



BIOME

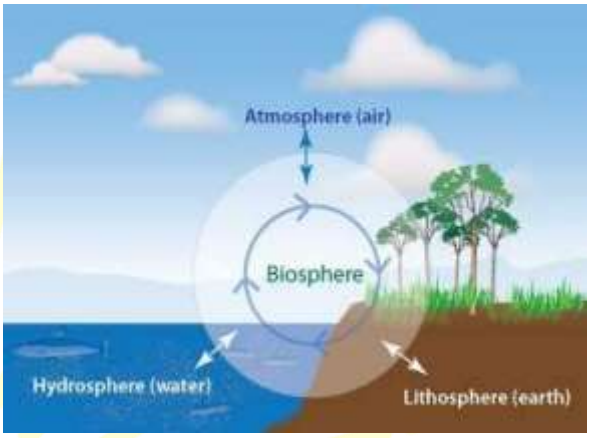
✓ Biome is a large naturally occurring community of flora and fauna occupying a major habitat.

✓ They are characterised by climate, vegetation, soil, fauna, etc. The climatic factors generally determine boundaries of biome.

✓ E.g. Rainforest biome is restricted mainly in equatorial region have evergreen forests with abundant fauna, while tundra biome is found in upper latitudes are devoid of trees and contain mainly lichen, mosses, etc. which can survive low temperatures.

✓ Plants and animals in a biome have common characteristics due to similar climates and can be found over a range of continents.

BIOSPHERE

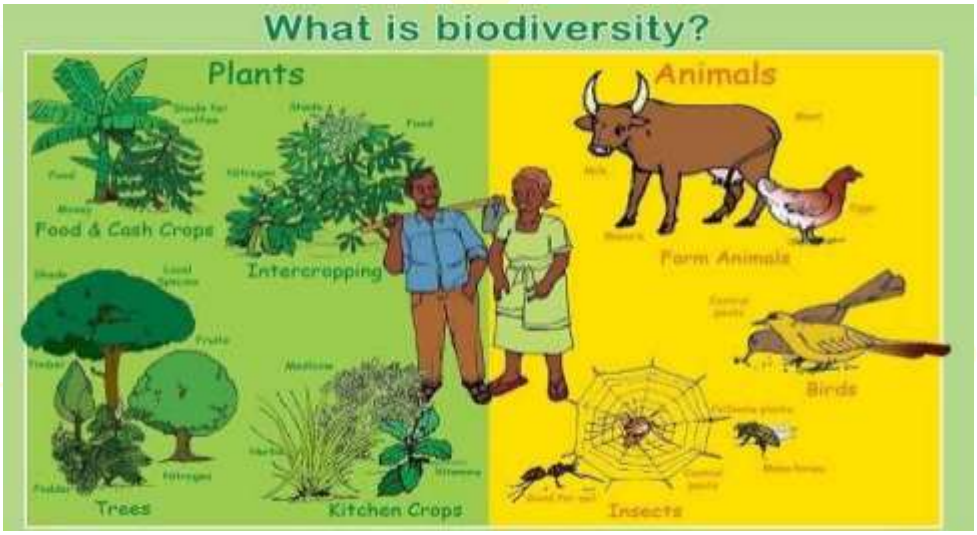


✓ The biosphere is the biological component of earth which includes the lithosphere, hydrosphere and atmosphere.

✓ The biosphere includes all living organisms on earth, together with the dead organic matter produced by them. Thus, it is that part of the earth which is inhabited by living organisms.

✓ The energy required for life in biosphere mainly comes from sun. Since, the energy is not uniformly distributed across biosphere distribution of life also varies.

Biodiversity: - : It is the variety of plant (flora) and animal species (fauna) found in the world or in a particular habitat or a geographical area.



QUESTION 2

Q. Which one of the following terms describes not only the physical space occupied by an organism, but also its functional role in the community of organisms? [2013]

(a) Ecotone

(b) Ecological niche

(c) Habitat

(d) Home range

Answer : b

EXPLANATION

HABITAT OF AN ORGANISM

• Habitat is the physical environment in which an organism lives (it corresponds to address of an organism)

• Habitat is only the physical part of environment and hence, the two should not be confused. The habitat for a fish may be a particular river but its environment composes of other things as well like sun, air, other aquatic animals, etc.

• An organism is not restricted to its home or habitat but has greater geographical area of coverage and interaction i.e. home range is wider.

• In nature, many species occupy the same habitat but they perform different functions or role and thus, have a unique ecological niche.

HOME RANGE

• A home range is the area in which an animal lives and moves on a daily or periodic basis.

• It is a little bigger than its habitat.

• As humans our home range will generally include the area from:

Home → Office → Market → Home.

ECOLOGICAL NICHE

• Niche refers to the unique functional role and position of a species in its habitat or ecosystem.

• Habitat of a species is like its 'address' (i.e. where it lives) whereas niche is its "profession" (i.e. activities and responses specific to the species).

• A niche is unique for a species while many species share the habitat. No two species in a habitat can have the same niche. This is because of the competition with one another until one is displaced. For example, a large number of different species of insects may be pests of the same plant but they can co-exist as they feed on different parts of the same plant.

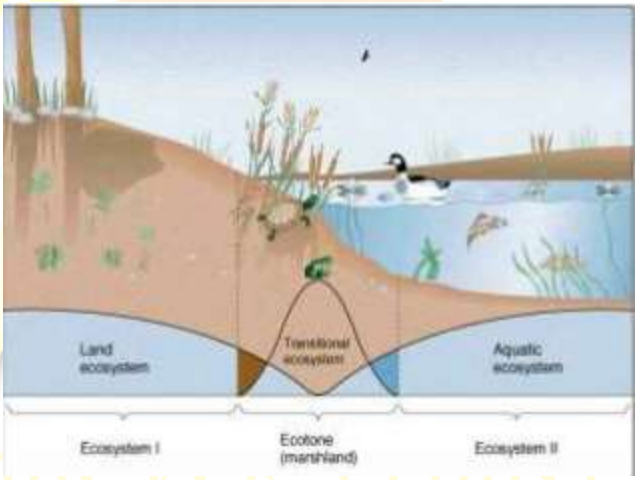
• Niche plays an important role in conservation of organisms.

ECOSYSTEM

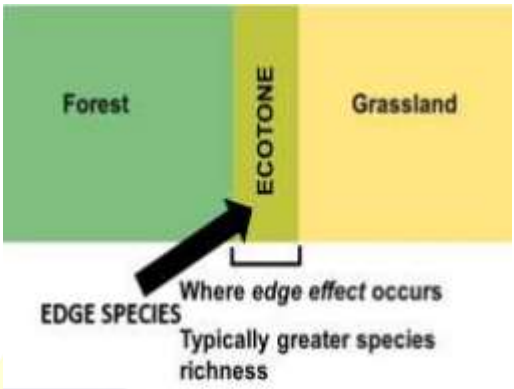
• Ecosystem is a community of organisms interacting with each other and with their environment.

• Ecotone: An ecotone is a zone of junction or a transition area between two diverse ecosystems. It is where communities of ecosystems meet and integrate.

• For e.g. the mangrove forests represent an ecotone between marine and terrestrial ecosystem. Other examples are grassland (between forest and desert), estuary (between fresh water and salt water) and river bank or marsh land (between dry and wet).



CHARACTERISTICS OF ECOTONE



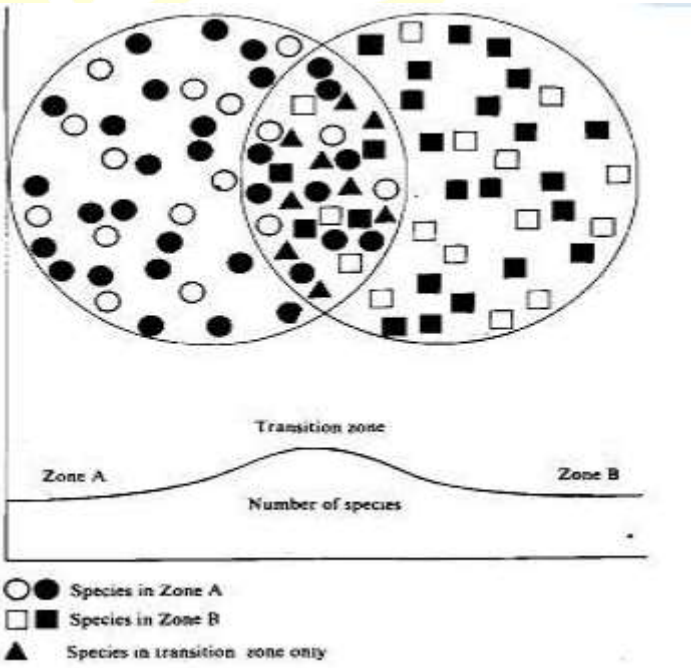
• Ecotone may be narrow (between grassland and forest) or wide (between forest and desert).

• As it is a zone of transition, it has conditions intermediate to the adjacent ecosystems. Hence it is a zone of tension.

• Usually, the number and the population density of the species of an outgoing community decreases as we move away from community or ecosystem.

• A well-developed ecotones contain some organisms which are entirely different from that of the adjoining communities and shows Edge effect.

ECOTONE AND EDGE EFFECT



• Edge effects: It refer to the change in population of species that occur at the boundary of two habitats or at ecotone. The number of species and the population density of some of the species in the ecotone is much greater than in either ecosystem. This is called edge effect.

• The organisms which occur primarily in this zone are known as edge species.

• In the terrestrial ecosystems edge effect is especially applicable to birds. For example the density of birds is greater in the mixed habitat of the ecotone between the forest and the grassland.

QUESTION 3

Q. The Millennium Ecosystem Assessment describes the following major categories of ecosystem services provisioning, supporting, regulating, preserving and cultural. Which one of the following is supporting service? [2012]

(a) Production of food and water

(b) Control of climate and disease

(c) Nutrient cycling and crop pollination

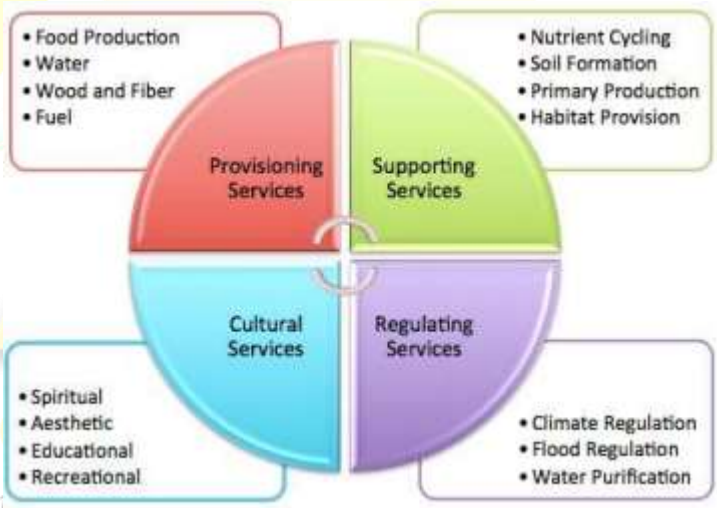
(d) Maintenance of diversity

Answer: c

EXPLANATION

SERVICES OF AN ECOSYSTEM

An ecosystem is a group or community composed of living and non-living things and their interactions with each other. We as humans are an integral part of an ecosystem. The numerous benefits we obtain from the ecosystem are known by the term ecosystem services. Life and biodiversity on earth depend on these services. Ecosystem services are classified into four services:



✓ Provisioning Services
✓ Supporting Services
✓ Regulating Services
✓ Cultural services and Preserving services

QUESTION 4

Q. Within biological communities, some species are important in determining the ability of a large number of other species to persist in the community. Such species are called _____ [2000]

(a) Keystone species

(b) Allopatric species

(c) Sympatric species

(d) Threatened species

Answer : a

EXPLANATION

SPECIES

Species are a group of living organisms consisting of similar individuals capable of exchanging genes or of interbreeding, considered as the basic unit of taxonomy.

SPECIATION

Specification is the evolutionary process by which populations evolve to become distinct species. The biologist Orator F. Cook coined the term in 1906.

METHODS OF SPECIATION

• Parapatric speciation: It is when speciation occurs in subpopulations of the same species that are mostly isolated from each other, but have a narrow area where their ranges overlap. Such species are called Parapatric species.

• Peripatric speciation: It occurs when members of a population on the border of that population's habitat separate off from the main group and evolve over many generations to become a different species. Such species are called Parapatric species.

• Allopatric Speciation: It is when one species is separated into different groups due to geographic isolation of species restricting gene flow due to events like creation of mountain barrier. Such species are called Allopatric species.

• Sympatric speciation: It is speciation that occurs when two groups of the same species live in the same geographic location, but they evolve differently until they can no longer interbreed and are considered different species. Such species are called Sympatric species.

IMPORTANT DEFINITIONS

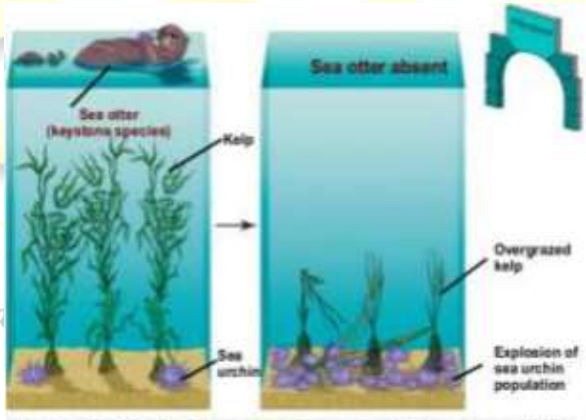
Keystone species

• A keystone species is a species that plays an essential role in the structure, functioning or productivity of a habitat or ecosystem at a defined level (habitat, soil, seed dispersal, etc.).

• Disappearance of such species may lead to significant and disproportionate effect on ecosystem as compared to other species.

• Examples bats and insects which act as pollinating agents and are a keystone species in terrestrial ecosystem. Similarly, corals act as keystone species of marine ecosystem.

• By focussing on keystone species, conservation actions for that species may help to preserve the structure and function of a wide range of habitats which are linked with that species during its life cycle.

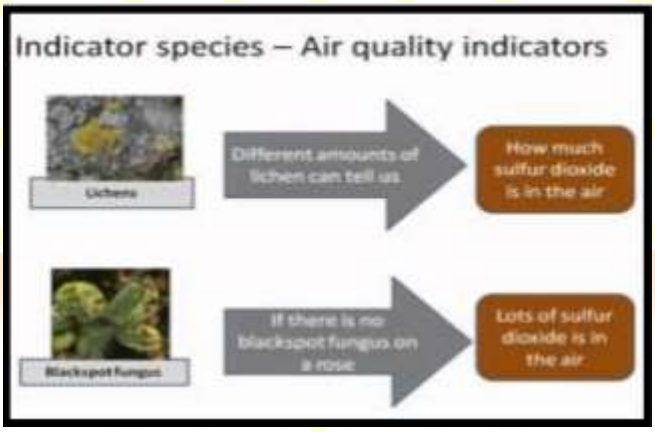


Removal of the keystone sea otter : sea urchins overgraze kelp and destroy the kelp forest community.

Indicator species

• An indicator species is a species or group of species chosen as an indicator of, or proxy for, the state of an ecosystem or of a certain process within that ecosystem.

• Examples include crayfish as indicators of freshwater quality; corals as indicators of marine processes such as siltation, seawater rise and sea temperature fluctuation; or native plants as indicators for the presence and impact of alien species.



Umbrella species

• Umbrella species are species selected for making conservation-related decisions, typically because protecting these species indirectly protects the many other species that make up the ecological community of its habitat.

• Umbrella species can be used to help select the locations of potential reserves, find the minimum size of these conservation areas or reserves, and to determine the composition, structure and processes of ecosystems.

Flagship species

• Flagship species is a species selected to act as an ambassador, icon or symbol for a defined habitat, issue, campaign or environmental cause. By focusing on, and achieving conservation of that species, the status of many other species which share its habitat – or are vulnerable to the same threats - may also be improved.

• Flagship species are usually relatively large, and considered to be 'charismatic' in western cultures.

• Flagship species may or may not be keystone species and may or may not be good indicators of biological process.

Priority species

• Priority species is a term used by World Wildlife Fund (WWF) solely for the purposes of planning and simple communication.

• It is reflective of a key threat across that region - such that conservation of the species will contribute significantly to a broader threat mitigation outcome.

• It is often crucial to the economic and/or spiritual wellbeing of peoples within that region.

• Threatened species are any species (including animals, plants, fungi, etc.) which are vulnerable to endangerment in the near future. International Union for Conservation of Nature (IUCN) is the foremost authority which regularly releases an IUCN Red list of threatened species.

QUESTION 5

Q. Which one of the following is the correct sequence of ecosystems in the order of decreasing productivity? [2013]

(a) Oceans, lakes, grasslands, mangroves

(b) Mangroves, oceans, grasslands, lakes

(c) Mangroves, grasslands, lakes, oceans

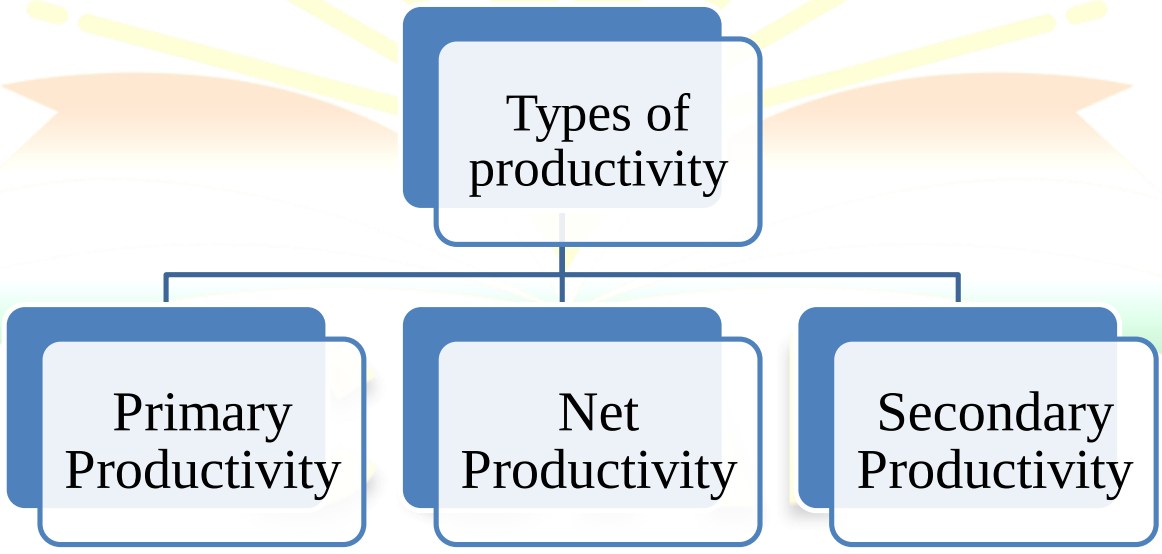
(d) Oceans, mangroves, lakes, grasslands

Answer : c

EXPLANATION

ECOSYSTEM PRODUCTIVITY

In ecology, productivity of an ecosystem refers to the rate of production of biomass, i.e., the amount of organic matter accumulated in any unit time. It is usually expressed in units of mass per unit surface (or volume) per unit time. The mass unit may relate to dry matter or to the mass of carbon generated.



Types of productivity

PRIMARY PRODUCTIVITY

• Primary productivity is defined as the rate of which radiant energy is stored by the producers, most of which are photosynthetic, and to a much lesser extent the chemosynthetic microorganisms. Primary productivity is of two types: Gross Primary Productivity and Net Primary Productivity.

• Plants typically capture and convert about 1.3 - 1.6% of the solar energy that reaches Earth's Surface and use about a quarter of the captured energy for metabolism and maintenance.

GROSS PRIMARY PRODUCTIVITY

• Gross Primary Productivity refers to the total rate of photosynthesis including the organic matter used up in respiration during the measurement period. It depends on the chlorophyll content. The rate of primary productivity are estimated in terms of either chlorophyll content as chl/g dry weight/unit area, or photosynthetic number, i.e., amount of CO2 fixed/g chl/hour.

NET PRIMARY PRODUCTIVITY

• Net Primary Productivity refers to the rate of storage of organic matter in plant tissues in excess of the respiratory utilisation by plants during the measurement period. It is also known as apparent photosynthesis or net assimilation.

• Around 1% of the solar energy reaching Earth's surface (per unit area and time) ends up as net primary productivity.

• This can be mathematically stated as:

Net Primary Productivity = Gross Primary Productity − Organic Matter used in respiration

SECONDARY PRODUCTIVITY

Secondary Productivity is the rate of energy storage at consumer's levels-herbivores, carnivores and decomposers. Consumers tend to utilise already produced food materials in their respiration and also converts the food matter to different tissues by an overall process. It actually remains mobile (i.e., keeps on moving from one organism to another) and does not live in situ like the primary productivity.

NET PRODUCTIVITY

Net Productivity refers to the rate of storage of organic matter not used by the heterotrophs or consumers, i.e., equivalent to net primary production minus consumption by the heterotrophs during the unit period, as a season or year etc. It is thus the rate of increase of biomass of the primary producers which has been left over by the consumers.

Net Productivity = Net Primary Productivity − Consumption by Heterotrophs/Consumers

THE ORDER OF PRODUCTIVITY OF ECOSYSTEMS

• Tropical rain forests are among the most productive terrestrial ecosystems.

• Estuaries and coral reefs are most productive among aquatic ecosystem. Similarly, mangroves also have a high productivity comparable to corals, estuaries, etc.

• Grassland has lesser productivity than mangroves.

• The average ocean productivity is about 50 grams carbon per square meter per year. The average land productivity is 160 grams carbon per square meter per year. The productivity of lakes is comparable to ocean but slightly higher as it contains greater biomass per unit area due to small area but more organic matter.

• The open ocean has a relatively low production per unit area comparable to deserts.

• So, the correct sequence is:

Mangroves > *Grassland* > *Lakes* > *Oceans*

DO IT YOURSELF

QUESTION 6

Q. Among living organisms, which one of the following is the most responsible factor for bringing about the origin of a new species? [2002]

(a) Isolation

(b) Mutation

(c) Natural Selection

(d) Sexual reproduction

QUESTION 7

Q. Read about the following organisations and find out the nature of these organisations, their headquarters and about their objectives.

- IUCN: International Union for Conservation of Nature
- WWF: World Wide Fund for Nature
- Conservation International
- Birdlife International

II. BASIC CONCEPTS AND TERMINOLOGY PART 2

QUESTION 1

Q. With reference to food chains in ecosystems, consider the following statements : [2013]

1. A food chain illustrates the order in which a chain of organisms feed upon each other.

2. Food chains are found within the populations of a species.

3. A food chain illustrates the numbers of each organism which are eaten by others

Which of the statements given above is/are correct?

(a) 1 only

(b) 1 and 2 only

(c) 1, 2 and 3

(d) None

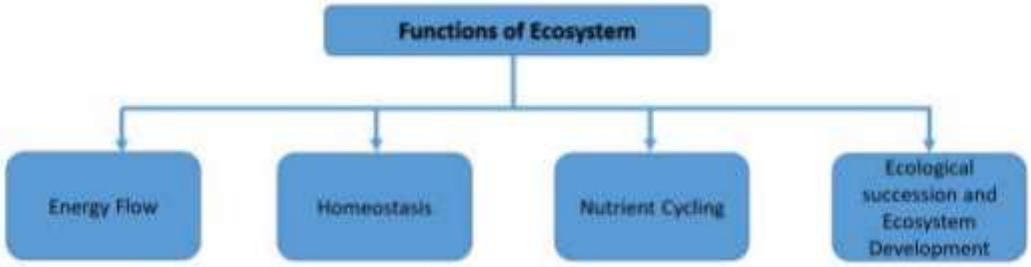
Answer : a

EXPLANATION

FUNCTION OF ECOSYSTEM

• It is the basic structural and functional unit of nature.

• Ecosystem is not a static entity. There is a continuous interactions that takes place between its various components which helps in not only survival of ecosystem but also maintenance of life on earth.



Energy Flow

• Continuous supply and flow of energy is required for the existence of an ecosystem.

• In an ecosystem, the flow of energy which takes place from producers to top consumers is unidirectional.

• To understand this flow, we first need to know the interactions taking place at various trophic levels.

TROPHIC LEVEL

• The trophic level of an organism is the position it occupies in a food chain.

• Trophic level is the representation of energy flow in an ecosystem.

• Trophic level interaction deals with how the members of an ecosystem are connected based on nutritional needs.

• Energy level decreases from the first trophic level onwards due to loss of energy in the form of heat at each trophic level. Only 10% of energy is generally available at each successive level. This is known as 10% rule.

• Trophic level interactions can be shown as:

✓ Ecological Pyramids

✓ Food web

✓ Food chain

MAJOR TROPHIC LEVELS

Trophic Level	Source of Energy	Examples
Producers	Solar energy	Green plants, photosynthetic protists and bacteria
Herbivores	Producers	Grasshoppers, water fleas, antelope, termites
Primary carnivores	Herbivores	Wolves, spiders, some snakes, warblers
Secondary carnivores	Primary carnivores	Killer whales, tuna, falcons
Omnivores	Several trophic levels	Human, rats, opossums, bears, raccoons, crabs
Detritivores and Decomposers	Waste and dead bodies of other organisms	Fungi, many bacteria, earthworms, vultures

FOOD CHAIN

• Transfer of food energy from green plants (producers) through a series of organisms with repeated eating and being eaten link is called a food chain.

• Each step in the food chain is called trophic level. A food chain starts with producers and ends with top carnivores.

• The trophic level of an organism is the position it occupies in a food chain.

• There are two main types of food chain on the basis of the type of organism that starts food chain:

✓ Grazing food chain

✓ Detritus food chain

GRAZING FOOD CHAIN

• The primary consumers in the food chain, utilizes the plant or plant part as their food i.e. autotrophs or producers, constitute the grazing food chain. This food chain begins from green plants at the base and the primary consumer is herbivore.

• Here, green plant are the base and herbivores are primary consumers.

• For example, in terrestrial ecosystem, grass is eaten by caterpillar, which is eaten by lizard and lizard is eaten by snake.

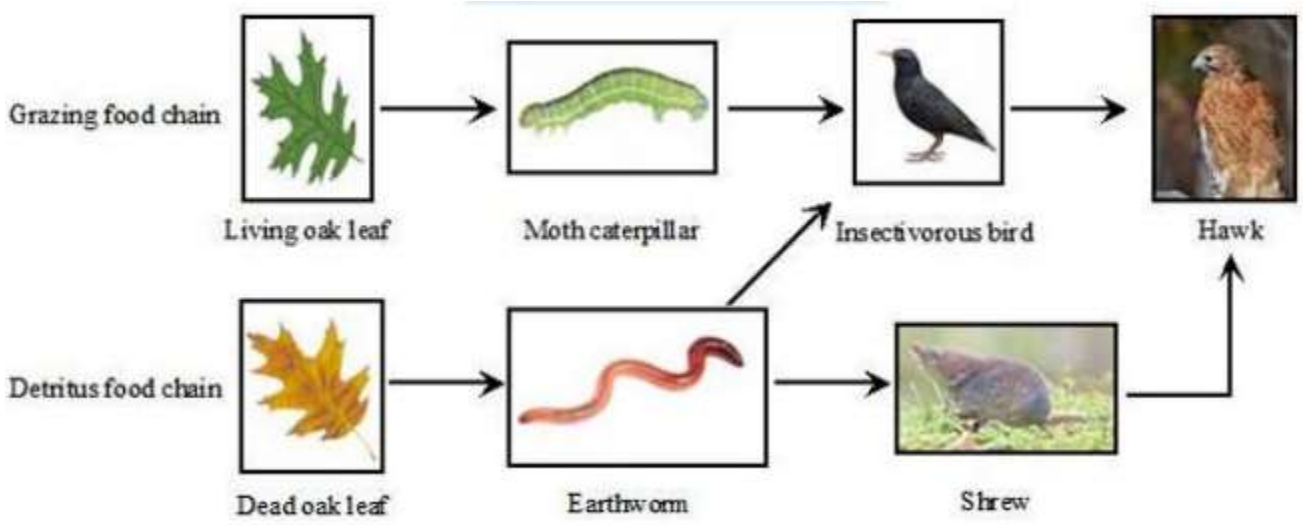
• In Aquatic ecosystem phytoplankton (primary producers) are eaten by zoo planktons which are eaten by small fishes and fishes are eaten by pelicans or larger fishes.

DETRITUS FOOD CHAIN

• This type of food chain starts from dead organic matter of decaying animals and plant bodies.

• Dead organic matter or detritus feeding organisms are called detrivores. The detrivores are eaten by predators.

• In an aquatic ecosystem, grazing food chain is the major conduit for energy flow. As against this, in a terrestrial ecosystem, a much larger fraction of energy flows through the detritus food chain than through the grazing food chain.



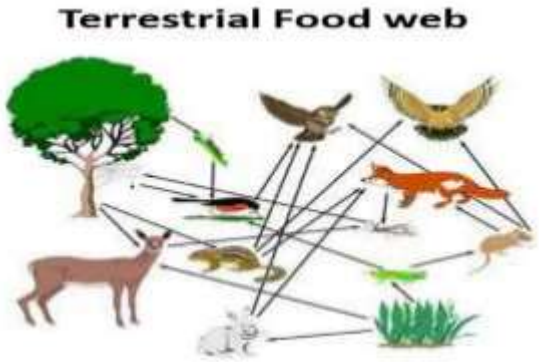
• The two food chains are linked. The initial energy source for detritus food chain is the waste materials and dead organic matter from the grazing food chain.

Food web

• Multiple interlinked food chains make a food web. Food web represents all the possible paths of energy flow in an ecosystem.

• If any of the intermediate food chain is removed, the succeeding links of the chain will be affected largely.

• The food web provides more than one alternative for food to most of the organisms in an ecosystem and therefore increases their chance of survival.



Ecological Pyramids

• The pyramidal representation of trophic levels of different organisms based on their ecological position is called as an ecological pyramid.

• The producer forms the base of the pyramid and the top carnivore forms the tip. Other consumer trophic levels are in between.

• The pyramid consists of a number of horizontal bars depicting specific trophic levels. The length of each bar represents the total number of individuals or biomass or energy at each trophic level in an ecosystem.

• The ecological pyramids are of three categories.

✓ Pyramid of numbers

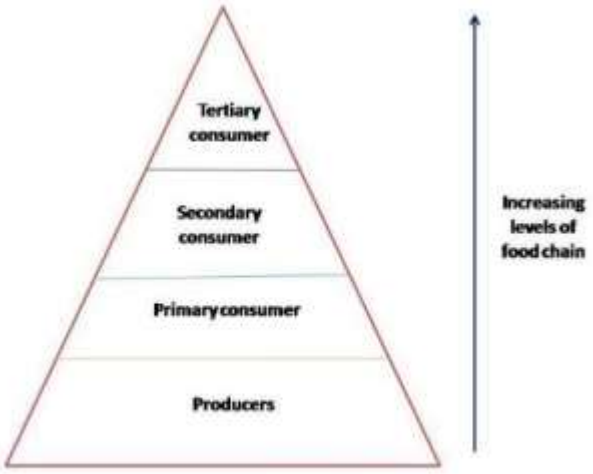
✓ Pyramid of biomass

✓ Pyramid of energy or productivity

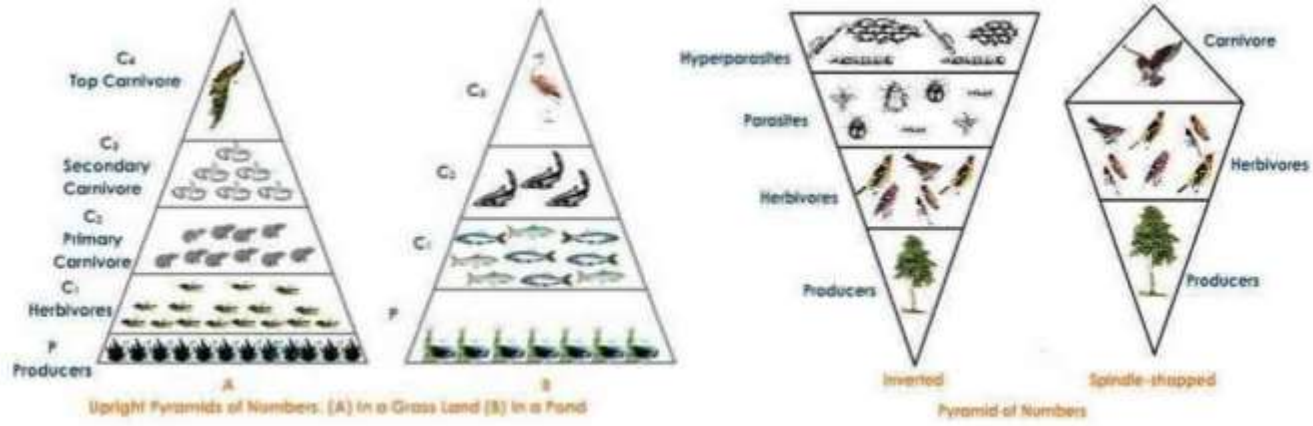
PYRAMID OF NUMBERS

• Pyramid of numbers represents the total number of individuals of different species (population) at each trophic level.

• Depending upon the size, the pyramid of numbers may not always be upright, and may even be completely inverted.



Ecological pyramid definition



PYRAMID OF BIOMASS

• Pyramid of biomass is usually determined by collecting all organisms occupying each trophic level separately and measuring their dry weight.

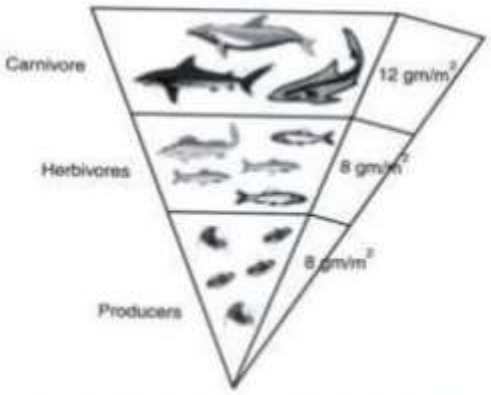
• This overcomes the size difference problem because all kinds of organisms at a trophic level are weighed. Biomass is measured in g/m^2.

• Each trophic level has a certain mass of living material at a particular time called as the standing crop.

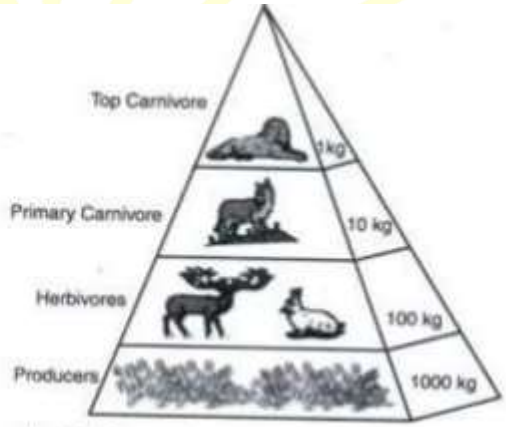
• The standing crop is measured as the mass of living organisms (biomass) or the number in a unit area.

• For terrestrial ecosystems, the pyramid of biomass is upright as has a large base of primary producers with a smaller trophic level perched on top.

• For aquatic ecosystems, the pyramid of biomass may assume an inverted form. [Pyramid of numbers for aquatic ecosystem is upright].

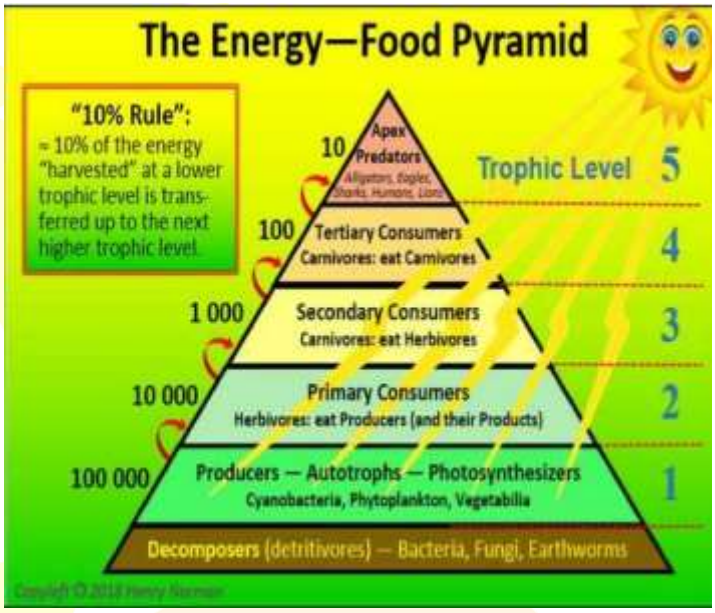


Inverted Pyramid of Biomass in Aquatic Ecosystem



Upright Pyramid of Biomass for Grassland Ecosystem

PYRAMID OF ENERGY



• An energy pyramid represents the amount of energy at each trophic level and loss of energy at each transfer to another trophic level. Hence the pyramid is always upward, with a large energy base at the bottom.

Limitations of Ecological Pyramids

• It does not take into account the same species belonging to two or more trophic levels.

• It assumes a simple food chain, something that almost never exists in nature; it does not accommodate a food web.

• Moreover, saprophytes (plant, fungus, or microorganism that lives on decaying matter) are not given any place in ecological pyramids even though they play a vital role in the ecosystem.

QUESTION 2

Q. With reference to the food chains in ecosystems, which of the following kinds of organism is/are known as decomposer organism/organisms? [2013]

1. Virus

2. Fungi

3. Bacteria

Select the correct answer using the codes given below.

(a) 1 only

(b) 2 and 3 only

(c) 1 and 3 only

(d) 1, 2 and 3

Answer : b

EXPLANATION

DECOMPOSERS

• Decomposers are organisms that break down dead or decaying organisms, and in doing so, they carry out the natural process of decomposition.

• Decomposers are very important for any ecosystem. If they weren't in the ecosystem, the plants would not get essential nutrients, and dead matter and waste would pile up.

• They are heterotrophic in nutrition.

• While the terms decomposer and detritivore are often interchangeably used, detritivores must ingest and digest dead matter via internal processes while decomposers can directly absorb nutrients through chemical and biological processes hence breaking down matter without ingesting it. Thus, invertebrates such as earthworms or some predators like hawks are technically detritivores, not decomposers, since they must ingest nutrients and are unable to absorb them externally.

• There are two main types of decomposers:

✓ Fungi

✓ Bacteria

QUESTION 3

Q. Which one of the following is the correct sequence of a food chain? [2014]

(a) Diatoms-Crustaceans-Herrings

(b) Crustaceans-Diatoms-Herrings

(c) Diatoms-Herrings-Crustaceans

(d) Crustaceans-Herrings-Diatoms
Answer : a

EXPLANATION

AQUATIC FOOD WEB

• The food chain which occurs in aquatic water is called aquatic food chain. Combination of such food chain refer to an aquatic food web. E.g. Algae →

Protozoa → Small Insects → Large aquatic Insects → Small fish → Large fish

• Phytoplankton are the primary producers in the oceans. They include:

• Diatoms (unicellular algae),

• Coccolithophores (unicellular, eukaryotic protist), Cyanobacteria (Bluegreen algae): synechococcus, prochlorococcus, nostoc, spirogyra etc.

• Dinoflagellates.

• Crustacean: They form a large, diverse arthropod taxon which includes such familiar animals as crabs, lobsters, crayfish, shrimp, krill, woodlice, and barnacles.

• Herring: It refers to a small fish.

QUESTION 4

Q. A pesticide which is a chlorinated hydrocarbon is sprayed on a food crop. The food chain is:

Food crop ⇒ Rat ⇒ Snake ⇒ Hawk.

In this food chain, the highest concentration of the pesticide would accumulate in which one of the following? [2010]

(a) Food crop

(b) Rat

(c) Snake

(d) Hawk

Answer : d

EXPLANATION

POLLUTANTS AND TROPHIC LEVEL

• Pollutants, especially non-degradable ones move through the various trophic levels in an ecosystem. Non-degradable pollutants mean materials, which cannot be metabolized by the living organisms. Example: Chlorinated Hydrocarbons.

• Chlorinated Hydrocarbons or Organochloride or CHC are hydrocarbons whose some or most hydrogen atoms have been replaced by chlorine E.g. DDT, endosulfan etc. are non-biodegradable.

• Source of these pollutants:

✓ Pesticides and insecticides such as DDT, heptachlor, and endosulfan. They are absorbed by soil and plants and hence enter the food chain.

✓ Solvents and cleansing agents: Chloroform, dichloromethane, di-chloro-ethane, and tri-chloroethane are useful solvents. These solvents are immiscible with water and effective in cleaning applications such

as degreasing and dry cleaning.

✓ Plastics and micro plastics: The plastics can enter the digestive system of organisms with other food and hence become part of food chain.

• Movement of these pollutants involves two main processes:

✓ Bioaccumulation.

✓ Bio magnification.

Bio-accumulation

• Bio-accumulation occurs within a trophic level and is increase in concentration of a substance in our bodies through food and environment.

• It refers to how pollutant enters a food chain.

Bio-magnification

• Bio-magnification refers to the tendency of pollutants to concentrate as they move from one trophic level to the next.

• It refers to movement of pollutant across trophic levels.

• If a pollutant is short-lived, it will be broken down before it can become dangerous.

• If it is not mobile, it will stay in one place and is unlikely to be taken up by organisms.

• If the pollutant is soluble in water, it will be excreted by the organism.

• Pollutants that dissolve in fats, however, may be retained for a long time

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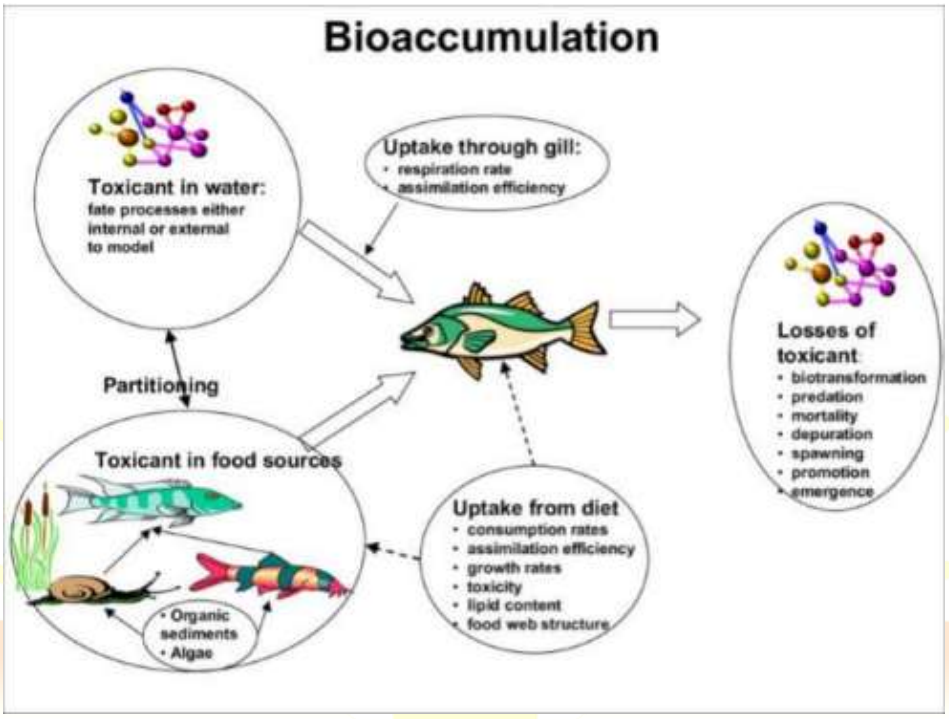
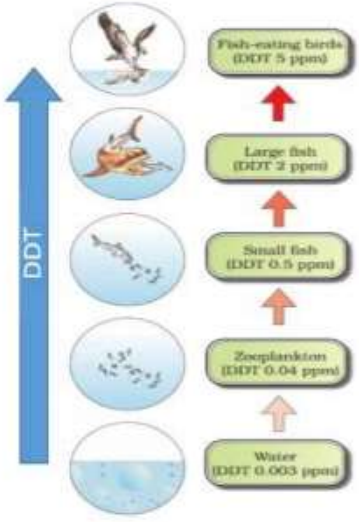
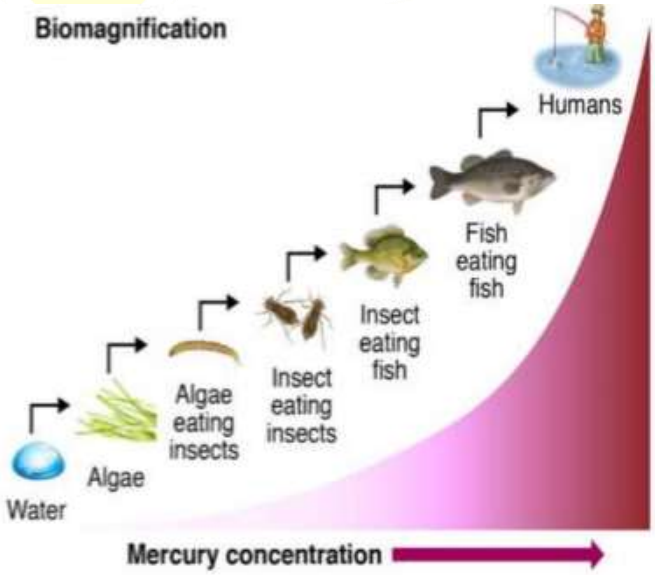






Bio-concentration: Bio-concentration occurs within a trophic level through absorption from water.

Bio-dilution: Bio-dilution means decrease in the concentration of a substance with increase in trophic level. This occurs if nutrient has decays faster than the rate by which it's added.

QUESTION 5

Q. What would happen if phytoplankton of an ocean is completely destroyed for some reason? [2012]

1. The ocean as a carbon sink would be adversely affected.

2. The food chains in the ocean would be adversely affected.

3. The density of ocean water would drastically decrease.

Select the correct answer using the codes given below:

(a) 1 and 2 only

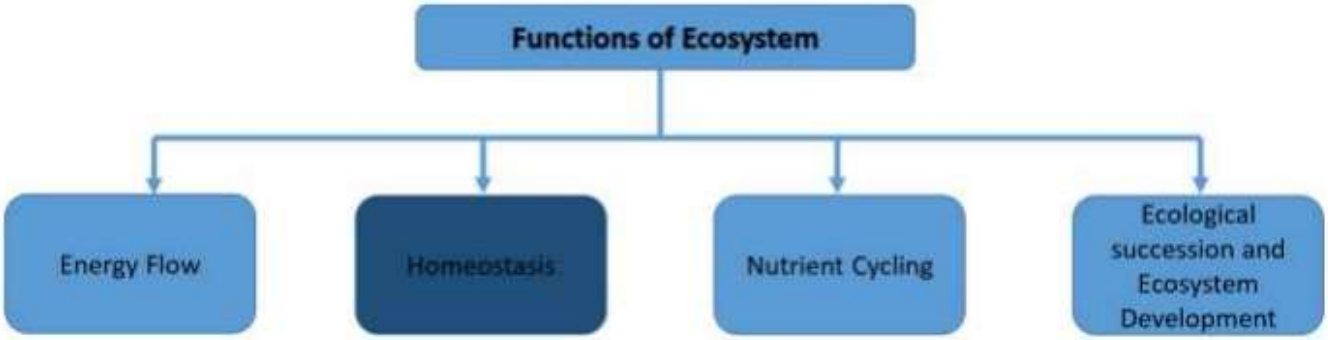
(b) 2 only

(c) 3 only

(d) 1, 2 and 3

Answer: a

EXPLANATION



HOMEOSTASIS

• Ecosystems are capable of maintaining their state of equilibrium.

• The process by which ecosystem regulates its own species structure and functional processes is known as homeostasis.

• For example, in a pond ecosystem, if the population of zooplankton increased, they would consume large number of the phytoplankton and as a result food would become scarce for zooplankton as well as other small fishes. This will lead to decrease in their number due to food scarcity.

• When the number zooplankton is reduced because of starvation, phytoplankton population start increasing. After some time the population size of zooplankton also increases and this process continues at all the trophic levels of the food chain.

• However, homeostatic capacity of ecosystems is not unlimited as well as not everything in an ecosystem is always well regulated. Humans are the greatest source of disturbance to ecosystems.

• So, in case a species is completely wiped out, homeostasis will fail and food chain will be severely affected. This is because energy flow cannot take place and will finally lead to death or extinction of the other dependent species.

ROLE OF PHYTO-PLANKTONS

• They act as a base of marine ecosystem. They are the primary producers of their environment, meaning they are the first organisms to produce energy, which they create from light sources, such as the Sun.

• Plankton are an important food source for organisms in an aquatic environment. They exist in oceans, lakes, rivers, and streams. Algae floating in water is a common and easily found example of plankton.

• They have low biomass and do not add much too mass of oceans, but are high in number.

• They play an important role in carbon sequestration as the single-celled organisms dissolves CO_2 into the sea from the atmosphere, via photosynthesis.

CARBON SEQUESTRATION AND CARBON SINK

• Carbon sink: A carbon sink is a natural or artificial reservoir that accumulates and stores some carbon containing chemical compound for an indefinite period. The process by which carbon sinks remove carbon dioxide (CO_2) from the atmosphere is known as carbon sequestration.

• Carbon sequestration is the process of capturing and storing atmospheric carbon dioxide from air to a sink.

• The world ocean is the major natural sink for carbon dioxide and is estimated to contain more than 90% of the inventory. The sequestration occurs with help of photosynthesis by phyto-planktons and calcification to form shells.

DO IT YOURSELF

QUESTION 6

Q. Which one of the following organisms is likely to show the highest concentration of DDT, once it has been introduced into the ecosystem? [1997]]

(a) Grasshopper

(b) Toad

(c) Snake

(d) Cattle

QUESTION 7

Q. Read about the following organizations and find out the nature of these organizations, who is head of these organizations, their headquarters and their working goals.

NTCA: National Tiger Conservation Authority
CPCB: Central pollution Control Board
Animal Welfare Board of India

III. BASIC CONCEPTS AND TERMINOLOGY PART 3

QUESTION 1

Q. Consider the following: [2011, 2014]

1. Photosynthesis

2. Respiration.

3. Decay of organic matter

4. Volcanic action.

Which of the above add carbon dioxide to the carbon cycle on earth?

(a) 1 and 4 only

(b) 2 and 3 only

(c) 2, 3 and 4 only

(d) 1 and 4

Answer: c

QUESTION 2

Q Which of the following adds / add nitrogen to the soil? [2013]

1. Excretion of urea by animals

2. Burning of coal by man

3. Death of vegetation

Select the correct answer using the codes given below.

(a) 1 only

(b) 2 and 3 only

(c) 1 and 3 only

(d) 1, 2 and 3

Answer: d

EXPLANATION

NUTRIENT

• A Nutrient is a substance used by an organism to survive, grow, and reproduce.

NUTRIENT CYCLING

• Nutrients of food matter never get used up. They can be recycled again and again indefinitely.

• Carbon, hydrogen, oxygen, nitrogen and phosphorus as elements and compounds make up 97% of the mass of our bodies and are more than 95% of the mass of all living organisms.

• These elements or mineral nutrients are always in circulation moving from non-living to living and then back to the non-living components of the ecosystem in a more or less circular fashion. This circular fashion is known as biogeochemical cycling. These cycles are largely energized by solar insolation.

TYPES OF NUTRIENT CYCLE

• Based on the replacement period, a nutrient cycle is referred to as Perfect or Imperfect cycle.

✓ A perfect cycle is one in which nutrients are replaced as fast as they are utilized. Most gaseous cycles are generally considered as perfect cycles.

✓ In imperfect cycles some nutrients are lost from the cycle or are not immediately available for replacement. Sedimentary cycles are imperfect as nutrients gets stored as sediments and are not available for cycling.

• Based on the nature of the reservoir, there are two types of cycles namely-

✓ Gaseous Cycle: Here, the reservoir of nutrient is the atmosphere or the hydrosphere. Such cycles include water cycle, carbon cycle, nitrogen cycle, etc.

✓ Sedimentary Cycle: Here, the reservoir is the soil and rocks in earth's crust. Such cycles include phosphorous cycle, sulphur cycle, calcium cycle, magnesium cycle etc.

Gaseous cycle

CARBON CYCLE

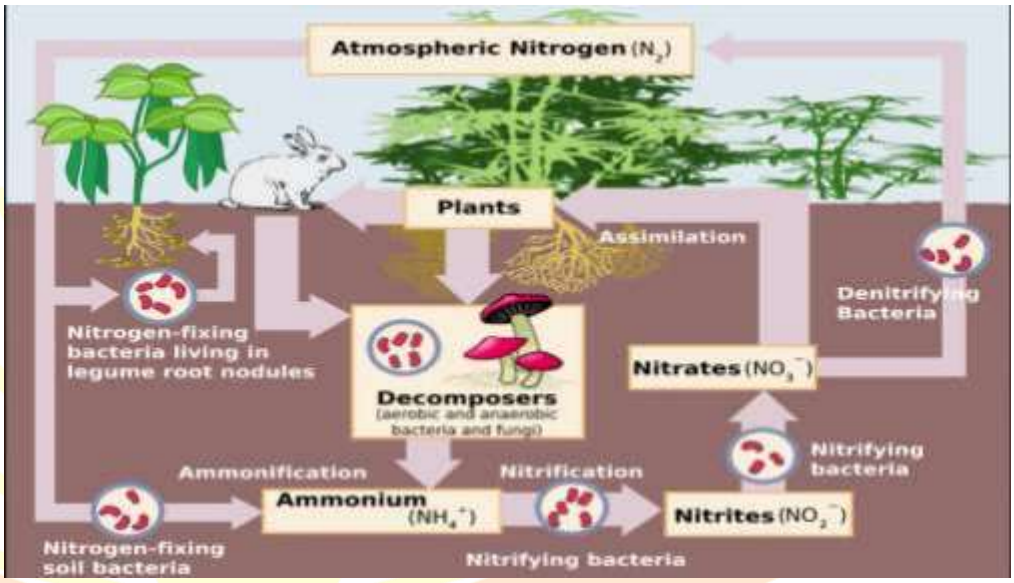
• The carbon cycle is the biogeochemical cycle by which carbon is exchanged among the biosphere, hydrosphere, lithosphere and atmosphere of the Earth.

• All living things are made of carbon. Carbon is also a part of the ocean, air, and even rocks. Because the Earth is a dynamic place, carbon does not stay still and continuously moves in earth.

• The carbon cycle was discovered by Joseph Priestley and Antoine Lavoisier, and popularized by Humphry Davy.

Figure 2: CARBON CYCLE

NITROGEN CYCLE



• The nitrogen cycle is the biogeochemical cycle by which nitrogen is converted into multiple chemical forms as it circulates among atmosphere, terrestrial, and marine ecosystems.

• The conversion of nitrogen can be carried out through both biological and physical processes

• Nitrogen is both the most abundant element in the atmosphere. It is a building block of proteins and nucleic acids such as DNA, and a crucially important component of all biological life.

• It is released back to soil and environment by process of excretion in form of excreta like urea, urine, etc. from our bodies or through decomposition by decomposers. The burning of fossil fuelsadd nitrogen to atmosphere.

• This occurs in various stages:

✓ Nitrogen Fixation

✓ Nitrification

✓ Assimilation

✓ Ammonification

✓ Denitrification

PROCESSES IN NITROGEN CYCLE

NITROGEN FIXATION

• Nitrogen fixation is a process by which nitrogen in the air is converted into ammonia (NH_3) or related nitrogenous compounds. It can be through biological processes or non-biological.

• Non- Biological Fixation: It can be through industrial processes like Haber-Bosch process or by atmospheric process of lightening.

• Biological Fixation: Biological nitrogen fixation was discovered by the German agronomist Hermann Hellriegel and Dutch microbiologist Martinus Beijerinck Biological nitrogen fixation (BNF) occurs when atmospheric nitrogen is converted to ammonia by an enzyme called a nitrogenase released by nitrogen fixing bacteria like azotobacter.

• Plants that contribute to nitrogen fixation include those of the legume family which includes pulses and others like Frankia. They contain symbiotic bacteria called rhizobia within nodules in their root systems, producing nitrogen compounds that help the plant to grow and compete with other plants. When the plant dies, the fixed nitrogen is released, making it available to other plants; this helps to fertilize the soil.

ASSIMILATION

• The nitrogen compounds in various forms, such as nitrate, nitrite, ammonia, and ammonium are taken up from soils by plants which are then used in the formation of plant and animal proteins. This is called assimilation.

AMMONIFICATION

• Ammonification is the process by which the organically bound nitrogen of microbial, plant, and animal biomass is recycled after their death. Ammonification is carried out by a diverse array of microorganisms that perform ecological decay services, and its product is ammonia or ammonium ion.

NITRIFICATION

• Nitrification is the biological oxidation of ammonia or ammonium to nitrite followed by the oxidation of the nitrite to nitrate. The transformation of ammonia to nitrite is usually the rate limiting step of nitrification. Nitrification is an aerobic process performed by small groups of autotrophic bacteria most commonly Nitrosomonas and Nitrosococcus.

DENITRIFICATION

• Denitrification is a microbially facilitated process where nitrate ($NO3^-$) is reduced and ultimately produces molecular nitrogen (N_2) through a series of intermediate gaseous nitrogen oxide products. Facultative anaerobic bacteria perform denitrification as a type of respiration that reduces oxidized forms of nitrogen in response to the oxidation to free nitrogen.

• Denitrification can leak N2O, which is an ozone-depleting substance and a greenhouse gas that can have a considerable influence on global warming.

• The process is performed primarily by heterotrophic bacteria (such as Paracoccus denitrificans and various pseudomonads).

WATER CYCLE/ HYDROLOGICAL CYCLE

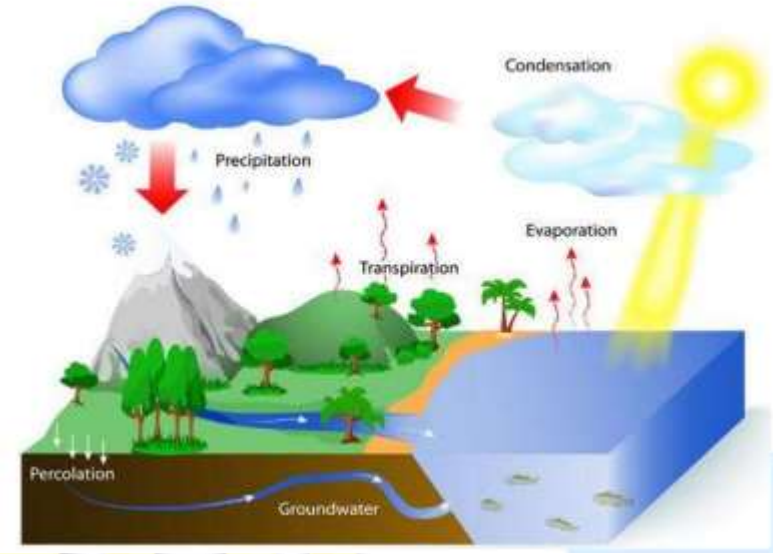
• It involves the continuous circulation of water in the Earth-atmosphere system. Of the many processes involved in the water cycle, the most important are evaporation, transpiration, condensation, and precipitation. Although the total amount of water within the cycle remains essentially constant, its distribution among the various processes is continually changing.

• Despite a vast amount of water on earth only a small quantity is available for our use. This is because around 99% is not suitable for consumption.

Reservoir	Percentage of the total
Oceans	97.25
Ice caps and glaciers	2.05
Ground water	0.68
Lakes	0.01
Soil moisture	0.005
Atmosphere	0.01
Streams and Rivers	0.0001
Biosphere	0.00004

PROCESS OF WATER CYCLE

• Evaporation, one of the major processes in the cycle, is the transfer of water from the surface of the Earth to the atmosphere. By evaporation, water in the liquid state is transferred to the gaseous, or vapour, state. The main factors affecting evaporation are temperature, humidity, wind speed, and solar radiation. The principal source of water vapour is the oceans, but evaporation also occurs in soils, snow, and ice.



• Transpiration is the evaporation of water through minute pores, or stomata, in the leaves of plants.

• The transition process from the vapour state to the liquid state is called condensation. Condensation may take place as soon as the air contains more water vapour than it can receive from a free water surface through evaporation at the prevailing temperature. This condition occurs as the consequence of either cooling or the mixing of air masses of different temperatures. By condensation, water vapour in the atmosphere is released to form precipitation. This can be in form of rainfall, sleet, snowfall, etc.

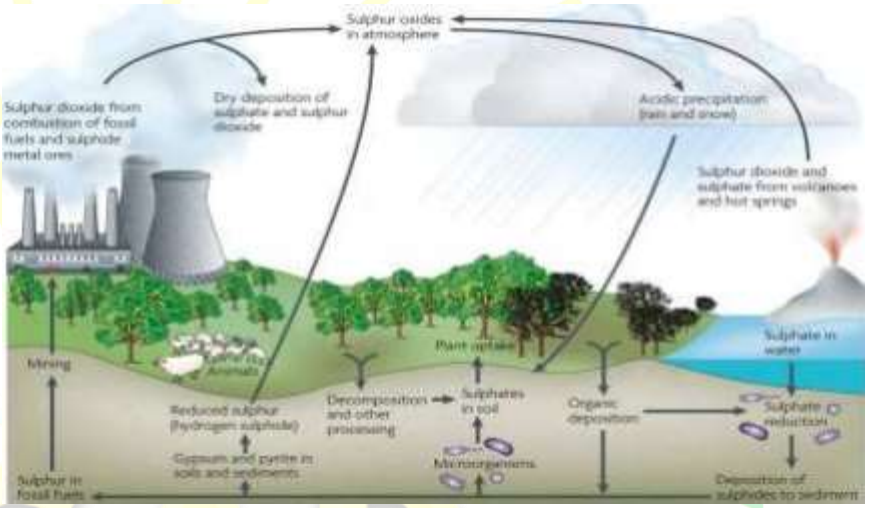
Sedimentary cycle

SULPHUR CYCLE

• The sulphur cycle is mostly sedimentary except two of its compounds – hydrogen sulphide (H2S) and sulphur dioxide (SO2) which add a gaseous component.

• Sulphur enters the atmosphere from several sources like volcanic eruptions, combustion of fossil fuels (coal, diesel etc.), from surface of ocean and from gases released by decomposition. Atmospheric hydrogen sulphide also gets oxidized into sulphur dioxide.

• Atmospheric sulphur dioxide is carried back to the earth after being dissolved in rainwater as weak sulphuric acid. Whatever the source, sulphur in the form of sulphates is take up by plants and incorporated through a series of metabolic processes into sulphur bearing amino acid which is incorporated in the proteins of autotroph tissues. It then passes through the grazing food chain.

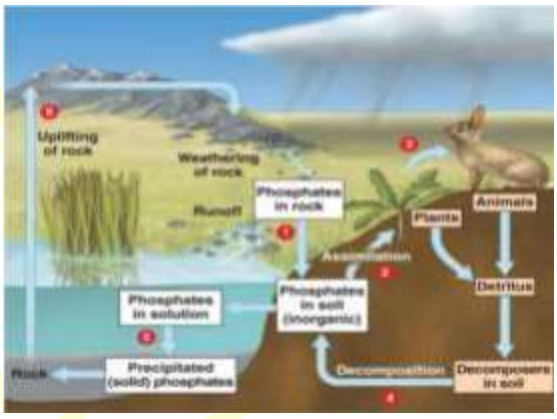


• Sulphur bound in living organism is carried back to the soil, to the bottom of ponds and lakes and seas through excretion and decomposition of dead organic material.

• The sulphur in the soil and sediments is locked in organic (coal, oil and peat) and inorganic deposits (pyrite rock and sulphur rock) in the form of sulphates, sulphides and organic sulphur.

• It is released by weathering of rocks, erosional runoff and decomposition of organic matter and is carried to terrestrial and aquatic ecosystems in salt solution.

PHOSPHORUS CYCLE



• Unlike carbon and nitrogen, which come primarily from the atmosphere, phosphorus occurs in large amounts as a mineral in phosphate rocks and enters the cycle from erosion and mining activities.

• The main storage for phosphorus is in the earth's crust. On land phosphorus is usually found in the form of phosphates.

• The other major reservoir of phosphorus is living organisms themselves. It is a part of DNA-molecules, of molecules that store energy (ATP and ADP) and of fats of cell membranes. Phosphorus is also a building block of certain parts of the human and animal body, such as the bones and teeth.

• Decomposition of dead and decaying matter release phosphorus in soil as phosphates.

• By the process of weathering and erosion phosphates enter rivers and streams that transport them to the ocean and circulates in nature.

• In the ocean phosphorus accumulates on continental shelves in the form of insoluble deposits.Let us now try to solve some questions based on the facts that we have just learnt.

QUESTION 3

Q. In the grasslands, trees do not replace the grasses as a part of an ecological succession because of [2013]

(a) insects and fungi

(b) limited sunlight and paucity of nutrients

(c) water limits and fire

(d) None of the above

Answer: c

QUESTION 4

Q. Lichens, which are capable of initiating ecological succession even on a bare rock, are actually a symbiotic association of [2014]

(a) algae and bacteria

(b) algae and fungi

(c) bacteria and fungi

(d) fungi and mosses

Answer: b

QUESTION 5

Q. Which one of the following is a useful functional association between fungi and the roots of higher plants? [1999]

(a) Bio fertilizer

(b) Coralloid root

(c) Lichen

(d) Mycorrhiza

Answer: d

QUESTION 6

Q. If you walk through countryside, you are likely to see some birds stalking alongside the cattle to seize the insects disturbed by their movement through grasses. [2014]

Which of the following is/are such bird/birds?

1. Painted Stork

2. Common Myna

3. Black-necked Crane

Select the correct answer using the code given below.

(a) 1 and 2

(b) 2 only

(c) 2 and 3

(d) 3 only

Answer: b

EXPLANATION

ECOLOGICAL SUCCESSION AND ECOSYSTEM DEVELOPMENT

• Biotic communities are dynamic in nature and change over a period of time. The process by which communities of plant and animal species in an area are replaced or changed into another over a period of time is known as ecological succession.

• Succession is a universal process of directional change in vegetation on an ecological time scale. It occurs when a series of communities are replaced by other due to large scale destruction or change in environmental conditions.

• Succession is characterized by the following: increased productivity, the shift of nutrients from' the reservoirs, increased diversity of organisms with increased niche development, and a gradual increase in the complexity of food webs.

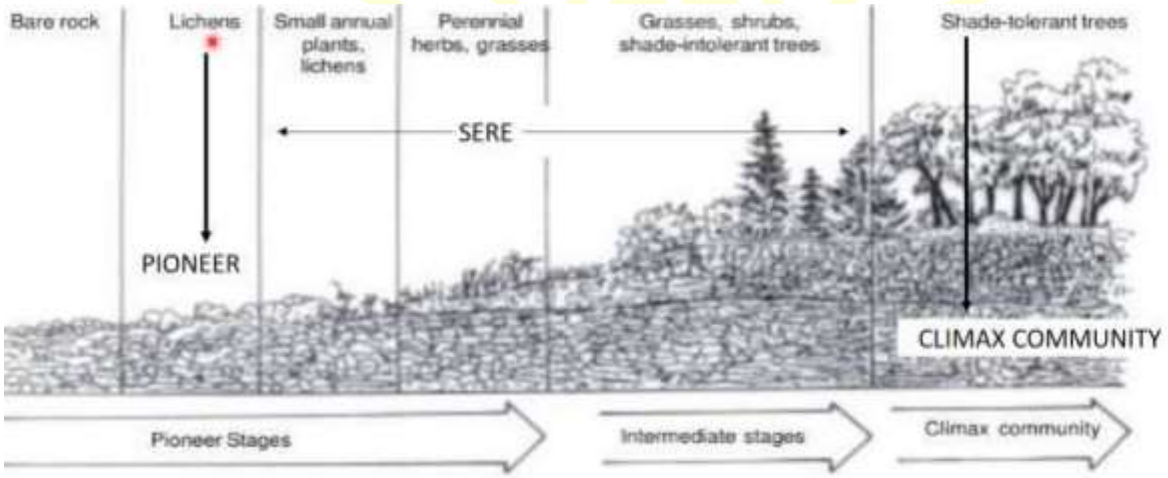
• Succession is a progressive series of changes which leads to the establishment of a relatively stable climax community. This occurs in various stages.

STAGES OF ECOLOGICAL SUCCESSION

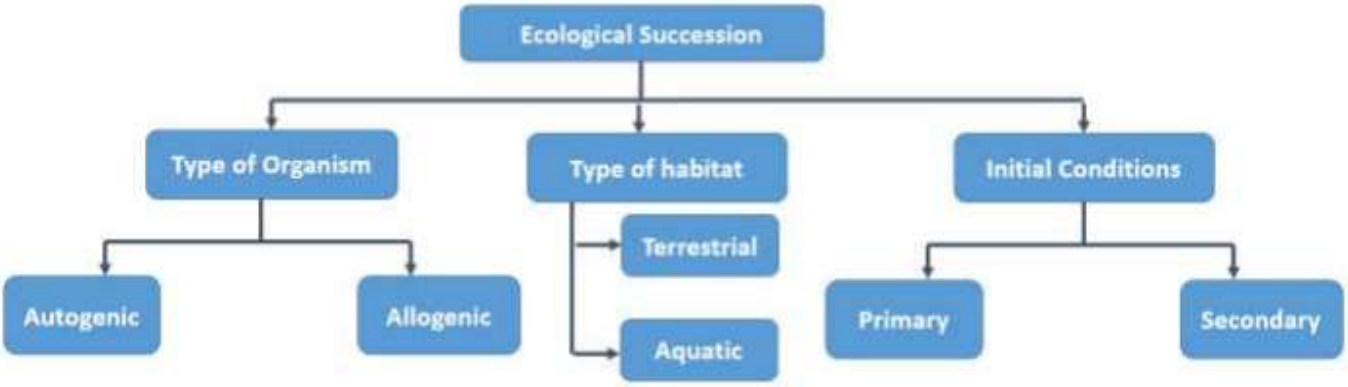
• The first plant to colonize an area is called the pioneer community. The final stage of succession is called the climax community. Each transitional (temporary) community that is formed and replaced during succession is called a stage in succession or a seral community.

• The terminal (final) stage of succession forms the community which is called as climax community. A climax community is stable, mature, more complex and long lasting.

• The entire sequence of communities in a given area, succeeding each other, during the course of succession is termed sere. The stage leading to the climax community are called successional stages which include seral communities.



Types of Ecological Succession



PRIMARY SUCCESSION

• Primary succession takes place an over a bare or unoccupied areas such as rocks outcrop, newly formed deltas and sand dunes, emerging volcano islands and lava flows as well as glacial moraines (muddy area exposed by a retreating glacier) where no community has existed previously.

• In primary succession on a terrestrial site the new site is first colonized by a few hardy pioneer species that are often microbes, lichens and mosses. The pioneers over a few generations alter the habitat conditions by their growth and development.

• The organic matter produced by these pioneer species produce organic acids during decomposition that dissolve and etch the substratum releasing nutrients to the substratum. Organic debris accumulates in pockets and crevices, providing soil in which seeds can become lodged and grow.

• The pioneer species disappear as the habitat conditions change and invasion of new species progresses, leading to the replacement of the preceding community.

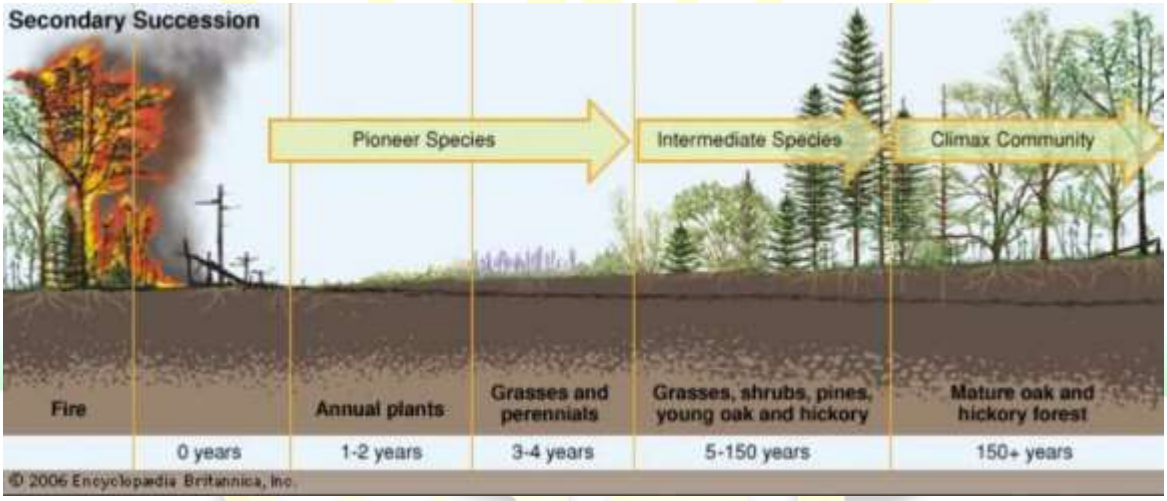
SECONDARY SUCCESSION

• Secondary succession is the sequential development of biotic communities after the complete or partial destruction of the existing community.

• A mature or intermediate community may be destroyed by natural events such as floods, droughts, fires, or storms or by human interventions such as deforestation, agriculture, overgrazing, etc.

• It is usually faster than primary succession.

• Example: An abandoned farmland can witness such succession over time. It is first invaded by hardy species of grasses that can survive in bare, sun-baked soil. These grasses may be soon joined by tall grasses and herbaceous plants. These dominate the ecosystem for some years along with mice, rabbits, insects and seed-eating birds. Eventually, some trees come up in this area, seeds of which may be brought by wind or animals. And over the years, a forest community develops. Development of trees depends on presence of sun, rain, nutrients and no disturbing factors like fire.



TYPES OF HABITAT

TERRESTRIAL SUCCESSION

• Xerosere: Succession that occurs on land where moisture content is low for e.g. on bare rock is known as xerarch. Plants growing in xeric condition are called xerophytes.

• Derosere: Succession occurs on a dry soil or rock.

• Psammosere: The succession which occurs on sand dunes is called Psammosere.

• Halosere: The succession which occurs on saline soil is called Halosere.

AQUATIC SUCCESSION

• Hydrosere: Succession that takes place in a water body, like ponds or lake is called Hydrosere.

TYPE OF ORGANISM

AUTOGENIC SUCCESSION

When succession is brought about by living inhabitants of that community itself, the process is called autogenic succession.

ALLOGENIC SUCCESSION

When succession is brought about by outside forces it is known as allogenic succession.

Biotic Interactions

• The interaction that occurs among different individuals of the same species is called intraspecific interaction while the interaction among individuals of different species in a community is termed as interspecific interaction.

• Specific terms are applied to interspecific interactions depending upon whether the interaction is beneficial (+), harmful (-) or neutral (0) to individuals of the species.

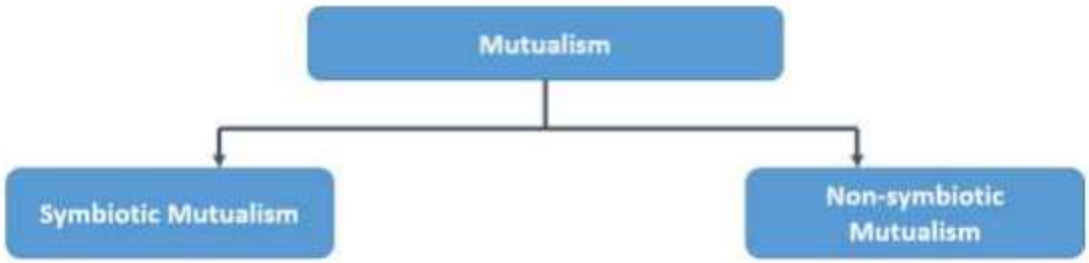
• There are 7 main types of interaction

S no.	Interaction	Species 1	Species 2
1	Mutualism	+	+
2	Commensalism	+	0
3	Competition	-	-
4	Predation	+	-
5	Parasitism	+	-

6	Amensalism	-	0
7	Neutralism	0	0

MUTUALISM

• Mutualism is the name given to associations between pairs of species that bring mutual benefit. The individuals in the populations of each mutualist species grow and/or survive and/or reproduce at a higher rate when in the presence of individuals of the other species.

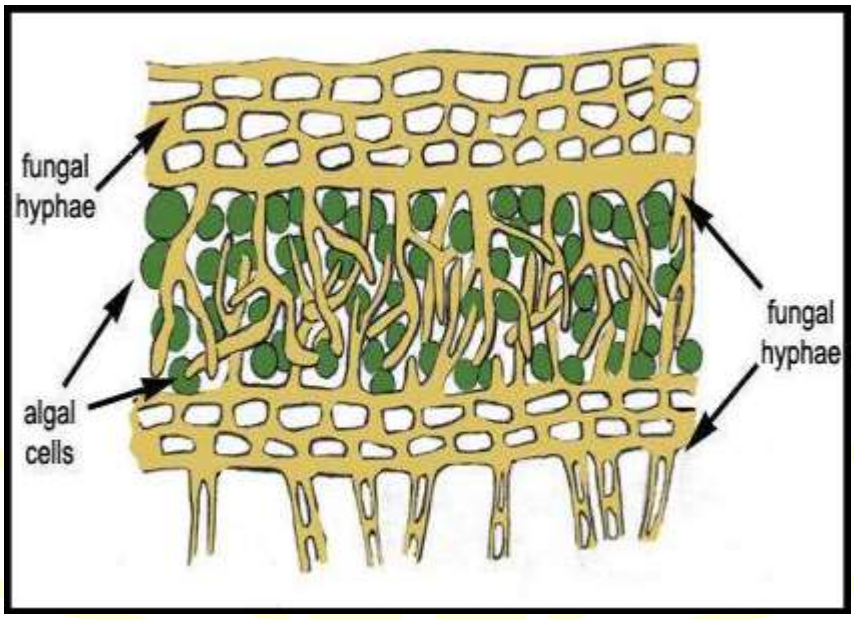


SYMBIOTIC MUTUALISM

• In a symbiotic mutualism, individuals interact physically and their relationship is biologically essential for survival. At least one member of the pair cannot live without close contact with the other.

SYMBIOTIC MUTUALISM: LICHENS

• Lichen: the fungal-algal symbiosis that occurs in lichens is a common example. The morphological structure of a lichen is a mass of fungal hyphae that forms around a small colony of algae cells. In this mutualism, the alga produces carbohydrates and other food by products through photosynthesis and metabolism, while the fungus absorbs the required minerals and water to allow for these processes to occur.



SYMBIOTIC MUTUALISM: MYCORRHIZAE

• Mycorrhizae are symbiotic relationships that form between fungi and plants. The fungi colonize the root system of a host plant, providing increased water and nutrient absorption capabilitieswhile the plant provides the fungus with carbohydrates formed from photosynthesis. Mycorrhizae also offer the host plant increased protection against certain pathogens.

• Fungi are heterotrophic organisms, and must absorb their food. Fungi also have the ability to easily absorb elements such a phosphorus and nitrogen which are essential for life. Plants are autotropic, producing their food in the form of carbohydrates through the process of photosynthesis. However, plants often have difficulty obtaining and absorbing many of the essential nutrients needed for life, specifically nitrogen and phosphorus which they get with help of the fungi.

SYMBIOTIC MUTUALISM: CORALS REEFS

• Most reef-building corals contain photosynthetic algae, called zooxanthellae that live in their tissues. The corals and algae have a mutualistic relationship.

• The coral provides the algae with a protected environment and compounds they need for photosynthesis.

• In return, the algae produce oxygen and help the coral to remove wastes. Most importantly, zooxanthellae supply the coral with glucose, glycerol, and amino acids, which are the products of photosynthesis. The coral uses these products to make proteins, fats, and carbohydrates, and produce calcium carbonate. In addition to providing corals with essential nutrients, zooxanthellae are responsible for the unique and beautiful colours of many stony corals.

NON-SYMBIOTIC MUTUALISM

• In this interaction, the mutualists live independent lives yet cannot survive without each other. The most obvious example of an interaction of this type is the relationship between flowering plants and their insect pollinators.

• Example: Bees and many species of flowering plants interact with each other in a mutualistic fashion. In this interaction, the flower becomes pollinated by the insect, while the bee receives food in the form of pollen and nectar.

COMMENSALISM

• In this relationship one of the species benefits while the other is neither harmed nor benefited.

• Example 1: Sucker fish, remora often attaches to a shark by means of its sucker which is present on the top side of its head. This helps the remora get protection, a free ride as well as meal from the left over of the shark's meal. The shark does not however get any benefit nor is it adversely affected by this association.

• Example 2: The relationship between trees and epiphytic plants. Epiphytes live on the surface of other plants like ferns, mosses and orchids and use the surface of trees for support and for obtaining sunlight and moisture. The tree gets no benefit from this relationship nor are they harmed.

• Example 3: The interaction between sea anemone that has stinging tentacles and the clown fish that lives among them. The fish gets protection from predators which stay away from the stinging tentacles. The anemone does not appear to derive any benefit by hosting the clown fish.

• Example 4: Cow dung provides food and shelter to dung beetles. The beetles have no effect on the cows.

• Example 5: The relationship between birds like common myna or cattle egrets and cattle. This bird moves about in the pastures, and follows livestock such as cattle and horses. The cattle egret eats up the insects hiding under vegetation close to the grounds, which get stirred up when the cattle walk through them.

COMPETITION

• When two or more organisms in the same community seek the same resource (e.g., food, water, nesting space, ground space), which is in limiting supply to the individuals seeking it, they compete with one another.

• This is an interaction between two populations in which both species are harmed to some extent as resources are reduced for each of them and thus harming their growth.

• If the competition is among members of the same species, it is called intraspecific. Competition among individuals of different species it is referred to as interspecific competition.

• Individuals in populations experience both types of competition to a greater or lesser degree.

PREDATION

• In this relations predators benefit as they get food while prey loses his life and is directly harmed.

• Predators tend to be larger than their prey and consume them from the outside.

• Predators like leopards, tigers and cheetahs use speed, teeth and claws to hunt and kill their prey.

• They keep prey populations under control. But for predators, prey species could achieve very high population densities and cause ecosystem instability.

• Predators also help in maintaining species diversity in a community, by reducing the intensity of competition among competing prey species.

PARASITISM

• Parasitism involves parasite usually a small size organism living in or on another living species called the host from which the parasite gets its nourishment and often shelter.

• Many organisms like animal, bacteria and viruses are parasites of plants and animals.

• Plants like dodder plant (Cuscuta) and mistletoe (Loranthus) are parasites that live on flowering plants.

• Parasites that feed on the external surface of the host organism are called ectoparasites. E.g. lice on humans. Many marine fish are infested with ectoparasitic copepods.

• The female mosquito is not considered a parasite, although it needs our blood for reproduction. This is because it doesn't live on the host.

• In contrast, endoparasites are those that live inside the host body at different sites (liver, kidney, lungs, red blood cells, etc.).

• Brood parasitism in birds is a fascinating example of parasitism in which the parasitic bird lays its eggs in the nest of its host. E.g. cuckoo (koel).

AMENSALISM

• Amensalism is an interaction where one species suffers and the other interacting species experiences no effect. One particular form of amensalism is allelopathy which occurs with plants.

Allelopathy involves the production and release of chemical substances by one species that inhibit the growth of another.

• Example 1: The bread mould fungi Pencillium produce penicillin an antibiotic substance which inhibits the growth of a variety of bacteria.

• Example 2: A large tree shades a small plant, retarding the growth of the small plant. The small plant has no effect on the large tree.

• The black walnut secrets a chemical from its roots that harms neighbouring plants, an example of amensalism.

NEUTRALISM

• Neutralism describes the relationship between two species which do interact but do not affect each other.

• True neutralism is extremely unlikely and impossible to prove.

SPECIES

PAINTED STORK

• This species is widespread throughout Indian subcontinent and Asian plains. It is mainly resident with only some seasonal movements.

• The Painted Stork is threatened by habitat loss, disturbance, pollution, egg and chick collection and hunting of adults. But in spite of several protected areas, the species is currently classified as Near Threatened.

• The Painted Stork frequents a variety of wet habitats such as marshes, lakes, ponds, freshwater swamp forest, and also flooded cultivated fields. The Painted Stork feeds on fish, crustaceans, amphibians, reptiles and insects.

BLACK NECKED CRANE

• The black-necked crane (Grus nigricollis) is a medium-sized crane in Asia that breeds on the Tibetan Plateau and remote parts of India and Bhutan.

• The breeding areas are alpine meadows, lakeside and riverine marshes and river valleys. They also make use of barley and wheat fields in these areas.

• It is a vulnerable species.

DO IT YOURSELF

QUESTION 7

Q. Read about the following organisations and find out the nature of these organisations, their members, and the work done by it.

SAWEN: South Asia Wildlife Enforcement Network

IPCC: International Panel for climate change

SACEP: South Asia Co-operative Environment Programme

IV. BIODIVERSITY PART 1 - IMPORTANT CONCEPTS

QUESTION 1

Q. Consider the following statements : [2011]

1. Biodiversity is normally greater in the lower latitudes as compared to the higher latitudes.

2. Along the mountain gradients, biodiversity is normally greater in the lower altitudes as compared to the higher altitudes.

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

Answer: c

EXPLANATION

BIODIVERSITY

• The word "biodiversity" is an abbreviated version of "biological diversity".

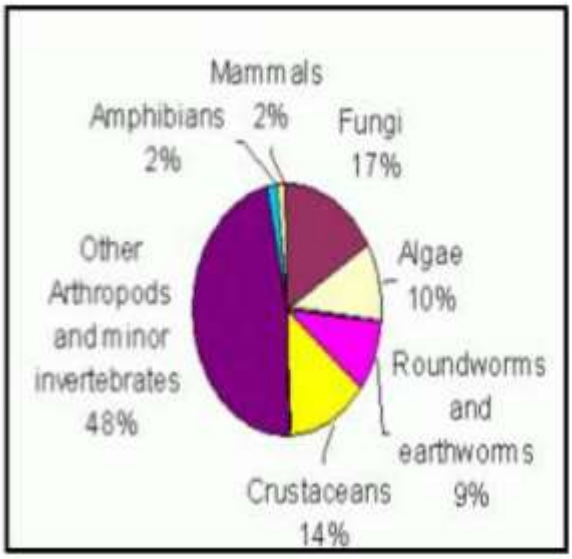
• The Convention on Biological Diversity defines biodiversity as: "the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part; this includes diversity within species, between species, and of ecosystems."

• Thus, Biodiversity refers to the variety of forms – the different plants, animals and micro-organisms. It also includes the genes they contain and the ecosystem they form.

• Estimates of the number of species on Earth vary from 3 million to 100 million. The UN Convention on Biological Diversity says there are some 13 million species, of which 1.75 million have been described.

Bio-diversity Distribution

Number of described species on Earth	
Species	**Number**
Bacteria	4,000
Protoctists (algae, protozoa)	80,000
Animals - vertebrates	52,000
Animals - invertebrates	1,272,000
Fungi	72,000
Plants	270,000
Total described species	**1,750,000**
Possible total of all species (including unknown species)	14,000,000



• Biodiversity is not evenly distributed, rather it varies greatly across the globe as well as within regions. The study of the spatial distribution of organisms, species and ecosystems, is the science of biogeography. Among other factors, the diversity of all living things (biota) depends on temperature, precipitation, altitude, soils, geography and the presence of other species. The major factors that directly impact distribution are:

✓ Latitude

Biodiversity is normally greater in the lower latitudes as compared to the higher latitudes. Generally, there is an increase in biodiversity from the poles to the tropics. Thus localities at lower latitudes have more species than localities at higher latitudes. This is often referred to as the latitudinal gradient in species diversity.

✓ Altitude

Biodiversity is normally greater in the lower altitudes as compared to the higher altitudes. The high attitude region has mainly tundra ecosystem with low ecological productivity and low biodiversity.

✓ Hemisphere

Generally, species density is greatest in the Southern Hemisphere. Seventy per cent of the world's species is found in just 12 countries: Australia, Brazil, China, Colombia, Costa Rica, the Democratic Republic of Congo, Ecuador, India, Indonesia, Madagascar, Mexico and Peru.

QUESTION 2

Q. Biodiversity forms the basis for human existence in the following ways : [2011]

1. Soil formation

2. Prevention of soil erosion

3. Recycling of waste

4. Pollination of crops

Select the correct answer using the codes given below

(a) 1,2 and 3 only

(b) 2, 3 and 4 only

(c) 1 and 4 only

(d) 1, 2, 3 and 4 only

Answer: d

EXPLANATION

SERVICES PROVIDED BY BIODIVERSITY

• Biodiversity has multiple roles in relation to the delivery of ecosystem services and represents therefore a central component of the framework. It mainly provides three types of services

QUESTION 3

Q. The Himalayan range is very rich in species diversity. Which one among the following is the most appropriate reason for this phenomenon? [2011]

(a) It has a high rainfall that supports luxuriant vegetative growth.

(b) It is a confluence of different bio-geographical zones.

(c) Exotic and invasive species have not been introduced in this region.

(d) It has less human interference.

Answer: b

EXPLANATION

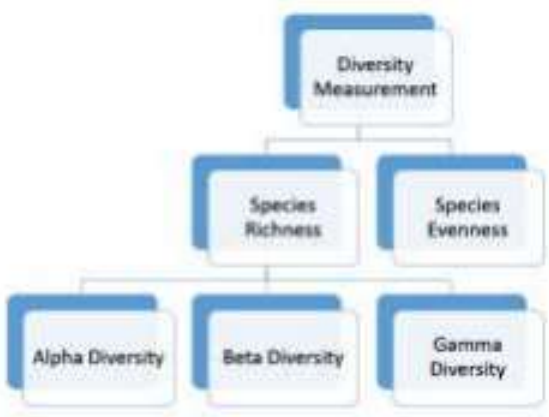
LEVELS OF BIODIVERSITY

• Biodiversity is considered to exist at three levels: Genetic, Species and Ecosystem Diversity.

Genetic Diversity	Species Diversity	Ecosystem Diversity
1. Genetic diversity is the **total number of genetic characteristics in the genetic makeup of a species.** 2. A single species might show high diversity at the genetic level **[E.g. Man: Chinese, Indian American, African etc.]. India has more than 50,000 genetically different strains of rice, and 1,000 varieties of mango.** 3. Genetic diversity allows species to **adapt to changing environments.** This diversity aims to ensure that some species survive drastic changes and thus carry on desirable genes.	1. It is the ratio of one species population over total number of organisms across all species in the given biome. 'Zero' would be infinite diversity, and 'one' represents only one species present. 2. More than **70 per cent of all the species recorded are animals**, while plants (including algae, fungi, bryophytes, gymnosperms and angiosperms) comprise no more than 22 per cent of the total. 3. Among **animals, insects are the most species-rich taxonomic group**, making up more than 70 per cent of the total. That means, out of every 10 animals on this planet, 7 are insects. Among vertebrates fishes constitute largest diversity.	1. Ecological or Ecosystem diversity refers to the **different types of habitats**. A habitat is the cumulative factor of the climate, vegetation and geography of a region. 2. It includes **various biological zones**, like lake, desert, coast, estuaries, wetlands, mangroves, coral reefs etc. 3. At the ecosystem level, India, for instance, with its deserts, rain forests, mangroves, coral reefs, wetlands, estuaries, and alpine meadows has a greater ecosystem diversity than a Scandinavian country like Norway.

MEASUREMENT OF BIODIVERSITY/ SPECIES DIVERSITY

Diversity is a single statistics in which the number of species richness and evenness are compounded.



Species Richness

It is the measure of number of species found in a community.

Species Evenness

It measures the proportion of a species at a given site, e.g. low evenness indicates that a few species dominate the site.

MEASURE OF SPECIES RICHNESS

Alpha Diversity

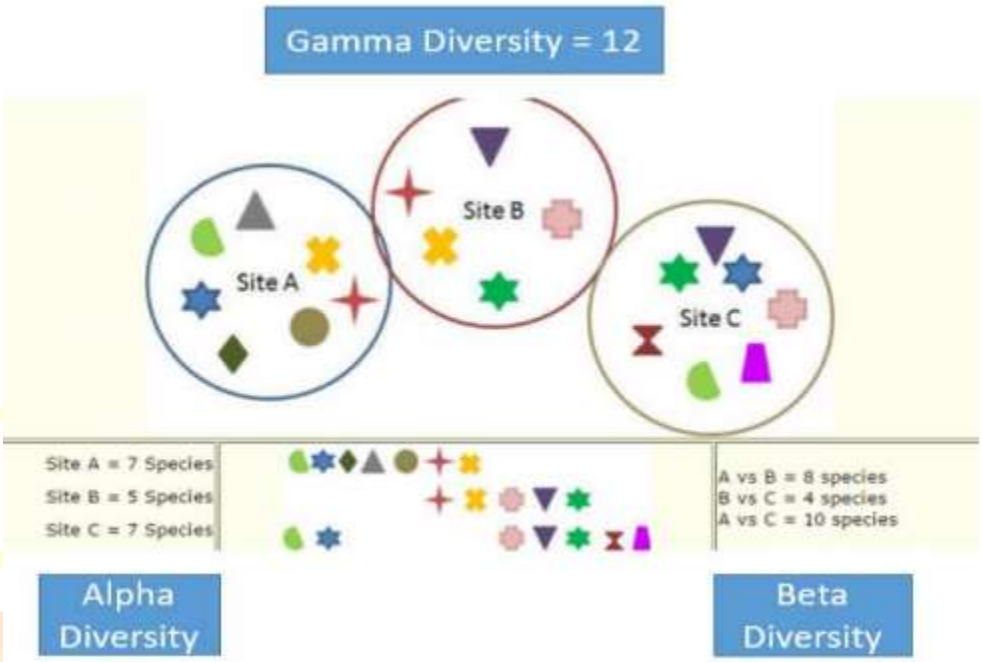
It refers to the diversity within a particular area or ecosystem, and is usually expressed by the number of species (i.e., species richness) in that ecosystem.

Beta Diversity

It is a comparison of diversity between ecosystems, usually measured as the change in amount of species between the ecosystems.

Gamma Diversity

It is a measure of the overall diversity for the different ecosystems within a region. Gamma diversity is 12 in these three habitats.



SPECIES RICHNESS IN INDIA

• India is a recognized as one of the mega-diverse countries, rich in biodiversity and associated traditional knowledge.

• India has 23.39% of its geographical area under forest and tree cover.

• With just 2.4% of the land area, India accounts for nearly 7% of the recorded species even while supporting almost 18% of human population.

• In terms of species richness, India ranks seventh in mammals, ninth in birds and fifth in reptiles.

• India Represents:

✓ Two 'Realms'

✓ Five Biomes

✓ Ten Bio-geographic Zones

Measures of Indian Biodiversity

REALMS

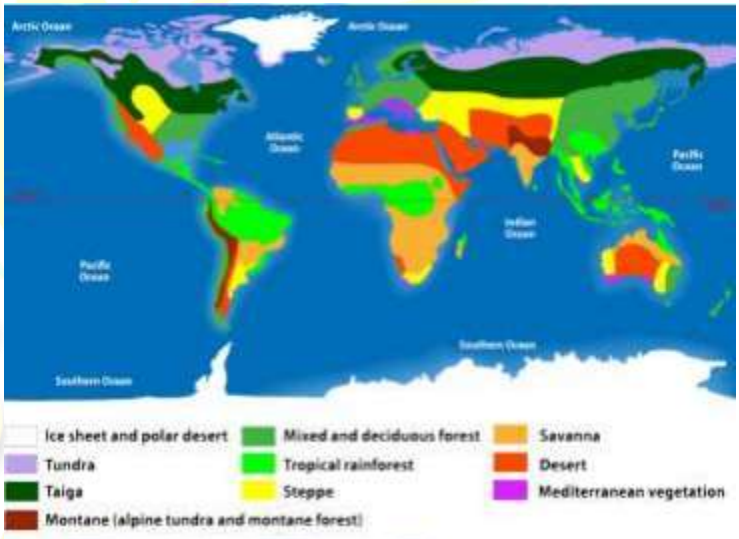
• Biogeographic realms are large spatial regions within which ecosystems share a broadly similar biota. Realm is a continent or sub-continent sized area with unifying features of geography and fauna & flora. There are 8 main realms in world.

• The Indian region is composed of two realms.

They are:

✓ The Himalayan region represented by Palearctic Realm and

✓ The rest of the sub-continent represented by Malayan Realm



BIOMES

• The term biome means the main groups of plants and animals living in areas of certain climate patterns. It includes the way in which animals, vegetation and soil interact together.

• The five biomes of India are:

✓ Tropical Humid Forests

✓ Tropical Dry or Deciduous Forests (including Monsoon Forests)

✓ Warm deserts and semi-deserts

✓ Coniferous forests and

✓ Alpine meadows.

BIOGEOGRAPHIC ZONES

• Biogeographic zones were used as a basis for planning wildlife protected areas in India. Biogeographic zones is a region consisting of animal and plants with similar or shared characteristics throughout. There are 10 biogeographic zones which are distinguished clearly in India. They are further sub-divided into provinces for a detailed study. The major biogeographic zones of India are as follows:

✓ Trans-Himalayas

✓ An extension of the Tibetan plateau, harboring high-altitude cold desert in Laddakh (J&K) and

Lahaul Spiti (H.P) comprising 5.7 % of the country's landmass.

✓ Himalayas

The entire mountain chain running from north-western to north-eastern India, comprising a diverse range of biotic provinces and biomes, 7.2 % of the country's landmass.

✓ Desert

The extremely arid area west of the Aravalli hill range, comprising both the salty desert of Gujarat and the sand desert of Rajasthan. 6.9% of the country's landmass.

• Semi-arid

The zone between the desert and the Deccan plateau, including the Aravalli hill range. 15.6 % of the country's landmass.

✓ Western Ghats

The hill ranges and plains running along the western coastline, south of the Tapti River, covering an extremely diverse range of biotic provinces and biomes. 5.8% of the country's landmass.

✓ Deccan Peninsula

The largest of the zones, covering much of the southern and southcentral plateau with a predominantly deciduous vegetation. 4.3 % of the country's landmass.

✓ Gangetic plain

Defined by the Ganges river system, these plains are relatively homogenous in terrain but have high diversity. 11% of the country's landmass.

✓ North-east India

The plains and non-Himalayan hill ranges of north-eastern India, with a wide variation of vegetation. 5.2% of the country's landmass.

✓ Islands

The Andaman and Nicobar Islands in the Bay of Bengal, with a highly diverse set of biomes and Lakshadweep group of Islands are part of it. 0.03% of the country's landmass comes under this type.

✓ Coasts

A large coastline distributed both to the west and east of India.

Exotic Species: - Exotic species, often referred to as alien, non-native, non-indigenous, or introduced species, are those that occur in areas outside of their natural geographic range. It has arrived there by human activity, either deliberate or accidental. Alien species have been moved by humans to areas outside of their native ranges. Once transported, they become removed from the predators, parasites, and diseases that kept them in balance in their native environments. As a result of the loss of these controls, they often become pests in the areas into which they are introduced.

Invasive Species: - An invasive species is a species that is not native to a specific location (an introduced species), and that has a tendency to spread to a degree believed to cause damage to the environment, human economy or human health. It is a subset of exotic species.

QUESTION 4

Q. Three of the following criteria have contributed to the recognition of Western Ghats, Sri Lanka and Indo-Burma regions as hotspots of biodiversity : [2011]

1. Species richness

2. Vegetation density

3. Endemism

4. Ethno-botanical importance

5. Threat perception

6. Adaption of flora and fauna to warm and humid conditions

Which three of the above are correct criteria in this context?

(a) 1, 2 and 6

(b) 2, 4 and 6

(c) 1, 3 and 5

(d) 3, 4 and 6

Answer: c

EXPLANATION

BIO-DIVERSITY HOTSPOTS

• Hot spots are the richest and most threatened reservoirs of plant and animal life of the earth. They have maximum number of endemic species.

• 25 terrestrial hot spots have been identified for the conservation of biodiversity. They occupy 1.4% of the earth's surface and 20% of worlds the human population lives in these areas. Around the world, these

sites support nearly 60% of the world's plant, bird, mammal, reptile, and amphibian species, with a very high share of endemic species.

• A biodiversity hotspot is a biogeographic region with significant levels of biodiversity that is threatened with destruction. The status is designated by Conservation International.

• Norman Myers first gave this list of 25 hotspots in 1988 which was later revised by Conservation International.

• To qualify as a biodiversity hotspot on Myers 2000 edition of the hotspot-map, a region must meet two strict criteria viz.

✓ Must have at least 1,500 species of vascular plants as endemics (> 0.5% of world's total)

✓ Has to have lost at least 70% of its primary vegetation habitat.

Endemic Species: - Endemic species are plants and animals that exist only in one geographic region. Species can be endemic to large or small areas of the earth: some are endemic to a particular continent, some to part of a continent, and others to a single island. Usually an area that contains endemic species is isolated in some way, so that species have difficulty spreading to other areas, or it has unusual environmental characteristics to which endemic species are uniquely adapted.

• In isolated environments such as the Hawaiian Islands, Australia, and the southern tip of Africa, as many of 90% of naturally occurring species are endemic.

• Some common example are Asiatic lion found only in Gir forests of Gujarat, Sangai Deer found in Loktak lake of Manipur, Lion tailed macaque in Western Ghats, Kashmir stag in Kashmir, etc.

LIST OF HOTTEST BIODIVERSITY HOTSPOTS IN INDIA

There are 4 biodiversity hot spots present in India. They are:

• The Eastern Himalayas [Arunachal Pradesh, Bhutan, Eastern Nepal]

• Indo-Burma and [Purvanchal Hills, Arakan Yoma, Eastern Bangladesh]

• The Western Ghats and Sri Lanka

• Andaman & nicobar island part of Sundaland

The Eastern Himalayas

• The Eastern Himalayas is the region encompassing Bhutan, north-eastern India (Sikkim and Arunachal Pradesh mainly), and southern, central, and eastern Nepal.

• The abrupt rise of the Himalayan Mountains from less than 500 meters to more than 8,000 meters results in a diversity of ecosystems that range from alluvial grasslands and subtropical broad leaf forests along the foothills to temperate broad leaf forests in the mid hills, mixed conifer and conifer forests in the higher hills, and alpine meadows above the tree line.

• Biodiversity of the Eastern Himalayas

✓ The Eastern Himalayan hotspot has nearly 163 globally threatened species (both flora and fauna) including the One-horned Rhinoceros [Vulnerable], the Wild Asian Water buffalo [Endangered].

✓ Mammals like the Golden langur, The Himalayan tahr, the pygmy hog, Langurs, Asiatic wild dogs, sloth bears, Gaurs, Muntjac, Sambar, Snow leopard, Black bear, Blue sheep, Takin, the Gangetic dolphin, wild water buffalo, swamp deer call the Himalayan ranged their home.

The Indo Burma region

• The Indo-Burma region encompasses several countries.

• It is spread out from Eastern Bangladesh to Malaysia and includes North-Eastern India south of Brahmaputra River, Myanmar, the southern part of China's Yunnan province, Lao People's Democratic Republic, Cambodia, Vietnam and Thailand. The Indo-Burma region is spread over 2 million sq. km of tropical Asia. Since this hotspot is spread over such a large area and across several major landforms, there is a wide diversity of climate and habitat patterns in this region.

• Biodiversity:

✓ Many of the species, especially some freshwater turtle species, are endemic.

✓ Almost 1,300 bird species exist in this region including: the white-eared night-heron [Endangered], the grey-crowned crocias [Endangered], and the orange-necked partridge [Near Threatened].

✓ It is estimated that there are about 13,500 plant species in this hotspot, with over half of them endemic. Ginger, for example, is native to this region.

The Western Ghats

• Western Ghats, also known as the "Sahyadri Hills" encompasses the mountain forests in the southwestern parts of India and highlands of south-western Sri Lanka.

• The wide variation of rainfall patterns in the Western Ghats, coupled with the region's complex geography, produces a great variety of vegetation types.

• Biodiversity:

✓ These include scrub forests in the low-lying rain-shadow areas and the plains, deciduous and tropical rainforests up to about 1,500 meters, and a unique mosaic of montane forests and rolling grasslands above 1,500 meters.

✓ The important populations include Asian elephant, Niligiri tahr, Indian tigers, lion tailed macaque [All Endangered], Indian Giant squirrel [Least Concern], etc.

The Sundaland region

• Sundaland is a region in South-East Asia that covers Thailand, Malaysia, Singapore, Brunei and Indonesia. India is represented by the Nicobar Islands.

• Biodiversity

✓ The Andaman and Nicobar Islands have a tropical rainforest canopy, made of a mixed flora with elements from Indian, Myanmar, Malaysian and endemic floral strains. So far, about 2,200 varieties of plants have been recorded, out of which 200 are endemic and 1,300 do not occur in mainland India. It also contain mangroves, deciduous, sub-montane forests along with evergreen rainforests.

✓ It has a unique fauna. Around 50 unique mammals are found here like Saltwater crocodile , the State Animal of Andaman - dugong, also known as the sea cow, which can be found in Little Andaman.

✓ About 270 species of birds are found in the territory; 14 of them are endemic, the majority to the Nicobar island group.

✓ The territory is home to about 225 species of butterflies and moths. Ten species are endemic to these Islands. Mount Harriet National Park is one of the richest areas of butterfly and moth diversity on these islands.

Hope spots

• A hope spot is an area of ocean that merits special protection because of its wildlife and significant underwater habitats.

• Andaman and Nicobar & Lakshadweep Islands have been named as the new "hope spots" by IUCN & oceanographer Sylvia Earle of Mission Blue, an organization involved in the study of oceans.

QUESTION 5

Q. Which of the following can be threats to the biodiversity of a geographical area? [2012]

1. Global warming

2. Fragmentation of habitat

3. Invasion of alien species

4. Promotion of vegetarianism

Select the correct answer using the codes given below :

(a) 1, 2 and 3 only

(b) 2 and 3 only

(c) 1 and 4 only

(d) 1, 2, 3 and 4

Answer: a

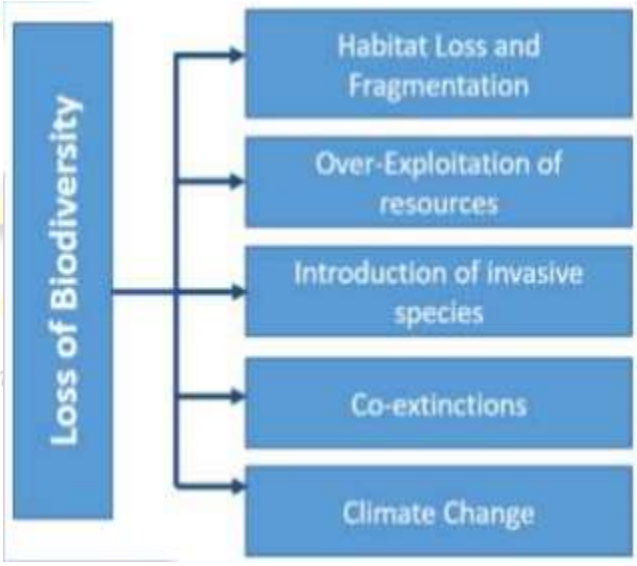
EXPLANATION

LOSS OF BIODIVERSITY

• The IUCN Red List (2004) documents the extinction of 784 species in the last 500 years. Some examples of recent extinctions include the three subspecies (Bali, Javan and Caspian) of tiger.

• During the long period (> 3 billion years) since the origin and diversification of life on earth there were five episodes of mass extinction of species.

• Sixth Extinction, presently is in progress with current species extinction rates estimated to be 100 to 1,000 times faster than in the pre-human times.



• Hence, since the beginning extinction is a natural process, but what is the cause of worry is that now the rate of extinction has increased. The major causes for increase in loss of biodiversity are due to anthropogenic factors.

QUESTION 6

Q. The term "sixth mass extinction/sixth extinction" is often mentioned in the news in the context of the discussion of [2018]

(a) Widespread monoculture practices in agriculture and large-scale commercial farming with indiscriminate use of chemicals in many parts of the world that may result in the loss of good native ecosystems.

(b) Fears of a possible collision of a meteorite with the Earth in the near future in the manner it happened 65 million years ago that caused the mass extinction of many species including those of dinosaurs.

(c) Large scale cultivation of genetically modified crops in many parts of the world and promoting their cultivation in other parts of the world which may cause the disappearance of good native crop plants and the loss of food biodiversity.

(d) Mankind's over-exploitation/misuse of natural resources, fragmentation/loss of natural habitats, destruction of ecosystems, pollution and global climate change.

Answer: d

EXPLANATION

MASS EXTINCTION

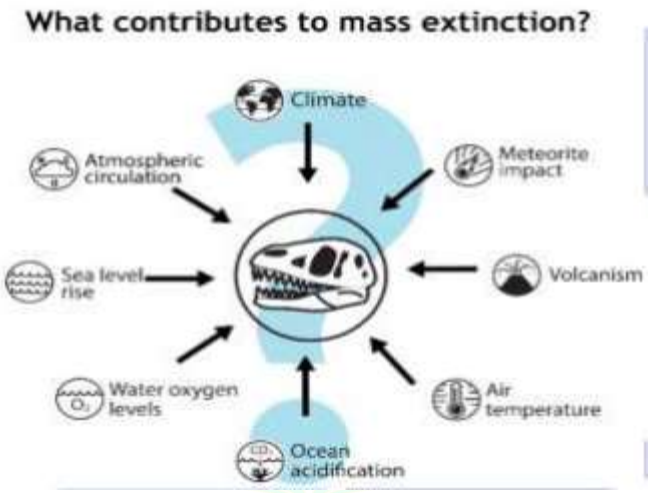
• A "mass extinction" can be defined as a time period in which a large percentage of all known species living at the time goes extinct, or is completely wiped out.

• There are several causes for mass extinctions such as climate change, geologic catastrophes (such as large amounts of volcanic eruptions), or even meteor strikes on the Earth's surface.

• Usually, after a very large mass extinction event, there is a very rapid period of speciation among

the few species that do survive. Since so many species die off during these catastrophic events, there is so much more room for the surviving species to spread out and so many niches in the environments that need to be filled.

• As populations separate and move away, they adapt over time to the new environmental conditions and eventually are reproductively isolated from the original populations of the species. This leads to development of new species and hence, mass extinctions contribute to evolution.



MAJOR MASS EXTINCTIONS

• Throughout the 4.6 billion years of history the Earth has been around, there have been five known major mass extinctions that wiped out an overwhelming majority of all species living at that time.

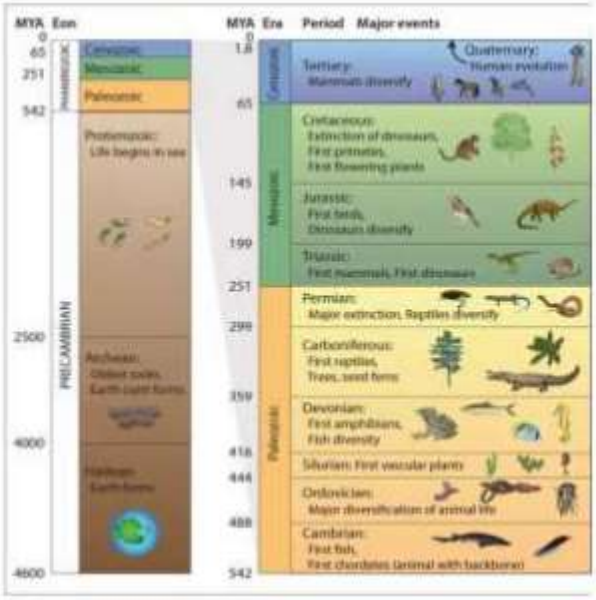
• These five major mass extinction events include the Ordovician Mass Extinction, Devonian Mass Extinction, Permian Mass Extinction, Triassic-Jurassic Mass Extinction, and Cretaceous-Tertiary (or the K-T) Mass Extinction. To understand them a brief understanding of geological time scale is required.

Geological Time scale

• The geologic time scale (GTS) is a system of chronological dating. It is used by geologists, palaeontologists, and other Earth scientists to describe the timing and relationships of events that have occurred during Earth's history.

• The primary defined divisions of time are eons, in sequence the Hadean, the Archean, the Proterozoic and the Phanerozoic. The first three of these can be referred to collectively as the Precambrian supereon. Eons are divided into eras, which are in turn divided into periods, epochs and ages.

EON	ERA	PERIOD	MILLIONS OF YEARS AGO	KEY EVENTS
Phanerozoic	Caenozoic	Quaternary	1.6	Humans evolve
		Tertiary		
	Mesozoic	Cretaceous	138	Extinction of Dinosaurs
		Jurassic		
		Triassic	240	
	Paleaozoic	Permian		Permian mass extinction
		Carboniferous	330	
		Devonian	410	
		Silurian		Invertebrates become common
		Ordovician	500	
		Cambrian		
Proterozoic		Also known as Precambrian	3500	Earliest life
Archean				
Hadean				



Ordovician Mass Extinction

• When: The Ordovician Period of the Paleozoic Era (about 440 million years ago).

• Size of the Extinction: Up to 85% of all living species at the time were eliminated.

• Suspected Cause or Causes: Continental Drift and subsequent climate change.

Devonian Mass Extinction

• When: The Devonian Period of the Paleozoic Era (about 375 million years ago).

• Size of the Extinction: Nearly 80% of all living species at the time were wiped out.

• Suspected Cause or Causes: Lack of oxygen in the oceans, quick cooling of air temperatures, possibly volcanic eruptions and/or meteor strikes.

Permian Mass Extinction

• When: The Permian Period of the Paleozoic Era (about 250 million years ago).

• Size of the Extinction: An Estimated 96% of all species living on Earth at the time.

• Suspected Cause or Causes: Possibly asteroid strikes, volcanic activity, climate change, and microbes.

Triassic-Jurassic Mass Extinction

• When: At the end of the Triassic Period of the Mesozoic Era (about 200 million years ago).

• Size of the Extinction: More than half of all known species living at the time.

• Suspected Cause or Causes: Major volcanic activity with basalt flooding, global climate change, and changing pH and sea levels of the oceans.

Cretaceous-Tertiary Mass Extinction

• When: At the end of the Cretaceous Period of the Mesozoic Era (about 65 million years ago).

• Size of the Extinction: Nearly 75% of all known species living at the time.

• Suspected Cause or Causes: Extreme asteroid or meteor impact.

Anthropogenic Mass Extinction

• When: In the current Holocene era.

• Size of the Extinction: Larger than previous extinctions and faster.

• Suspected Cause or Causes: Human activities leading to habitat destruction and overexploitation of resources, Climate change due to global warming and ozone layer.

QUESTION 7

Q. Why is a plant called Prosopis juliflora often mentioned in news? (2018)

a. Its extract is widely used in cosmetics.

b. It tends to reduce the biodiversity in the area in which it grows.

c. Its extract is used in the synthesis of pesticides.

d. None of the above

Answer: b

EXPLANATION

INVASIVE SPECIES

Characteristics

• Common characteristics of these species include rapid reproduction and growth, high dispersal ability, phenotypic plasticity (ability to adapt physiologically to new conditions), and ability to survive on various food types and in a wide range of environmental conditions.

• Effects

✓ Loss of biodiversity mainly native endemic species.

✓ Habitat degradation.

✓ Reduced ecological productivity.

✓ Reduced crop yields due to introduction of pests and pathogens.

COMMON INVASIVE FLORA

Prosopis juliflora/Mesquite

• Nativity: Mexico

• Distribution in India: Throughout

• Features: Aggressive colonizer. Common weed of waste lands, scrub lands and degraded forests.

Townsend Grass

• Nativity: Tropical West Asia

• Distribution in India: Throughout

• Features: Very common along streams and banks of rivers.

Congress Grass / parthenium

• Nativity: Tropical North America

• Distribution in India: Throughout

• Features: Aggressive colonizer. Common weed of cultivated fields, forests, overgrazed pastures, waste lands and gardens.

Balsam

• Nativity: Tropical America

• Distribution in India: Throughout

• Features: Aggressive colonizer. Common along railway tracks; also runs wild in gardens.

Water Hyacinth

• Nativity: Tropical America

• Distribution in India: Throughout

• Features: Aggressive colonizer. Abundant in still or slow floating waters. Nuisance for a aquatic ecosystem.

Datura/ Mad plant

• Nativity: Tropical America

• Distribution in India: Throughout

• Features: Aggressive colonizer. Occasional weed on disturbed ground.

Touch Me Not/ sleeping grass

• Nativity: Brazil

• Distribution in India: Throughout

• Features: Aggressive colonizer. Common weed of cultivated fields, scrubs lands and degraded forests.

Black Mimosa

• Nativity: Tropical North America

• Distribution in India: Himalaya, Western Ghats

• Features: Aggressive colonizer. It invades water courses and seasonally flooded wetlands.

Lantana Camara

• Nativity: Tropical America

• Distribution in India: Throughout

• Features: Aggressive colonizer. Common weed of forests, plantations, habitation, waste lands and scrubs lands.

COMMON INVASIVE FAUNA

African apple snail

• It is most invasive among all alien fauna in India. It is mollusc and was first reported in Andaman and Nicobar. Now it is found all across country and is threatening habitats of several native species.

S no.	Other Common Examples
1.	Lectobyte Invasa
2.	Crazy Ant
3.	Myna
4.	Gold Fish
5.	Pigeon
6.	Donkey
7.	House Gecko
8.	Tilapia
9.	Indian Bullfrog

Cat Fish

• The African catfish (Clarias gariepinus), aka the African sharp tooth catfish, is native to Africa and West Asia, where it is found pretty much everywhere—in lakes and rivers, swamps, agricultural canals, wells, even drains. In India, it was first seen in Andhra Pradesh, one of the hot spots of the Indian aquaculture boom of the 1990s. It has since colonized major rivers and water bodies, destroying native fish stock.

Cotton Mealy Bug

• Native to North America, it has severely affected cotton crops in Deccan.

DO IT YOURSELF

QUESTION 8

Q. Read about the following organisations and find out the nature of these organisations, their headquarters and about their objectives.

Critical Ecosystem Partnership Fund

Alliance for Zero Extinction

Global Climate change Alliance

V. BIODIVERSITY PART 2 – IMPORTANT FLORA & FAUNA

QUESTION 1

Q. The "Red Data Books'' published by the International Union for Conservation of Nature and Natural Resources (IUCN) contain lists of ? [2011]

1. Endemic plant and animal species present in the biodiversity hotspots.

2. Threatened plant and animal species.

3. Protected sites for conservation of nature and natural resources in various countries.

Select the correct answer using the codes given below:

(a) 1 and 3

(b) 2 only

(c) 2 and 3

(d) 3 only

Answer: b

QUESTION 2

Q. In India, if a species of tortoise is declared protected under Schedule I of the Wildlife (Protection) Act, 1972, what does it imply ? [2017]

(a) It enjoys the same level of protection as the tiger.

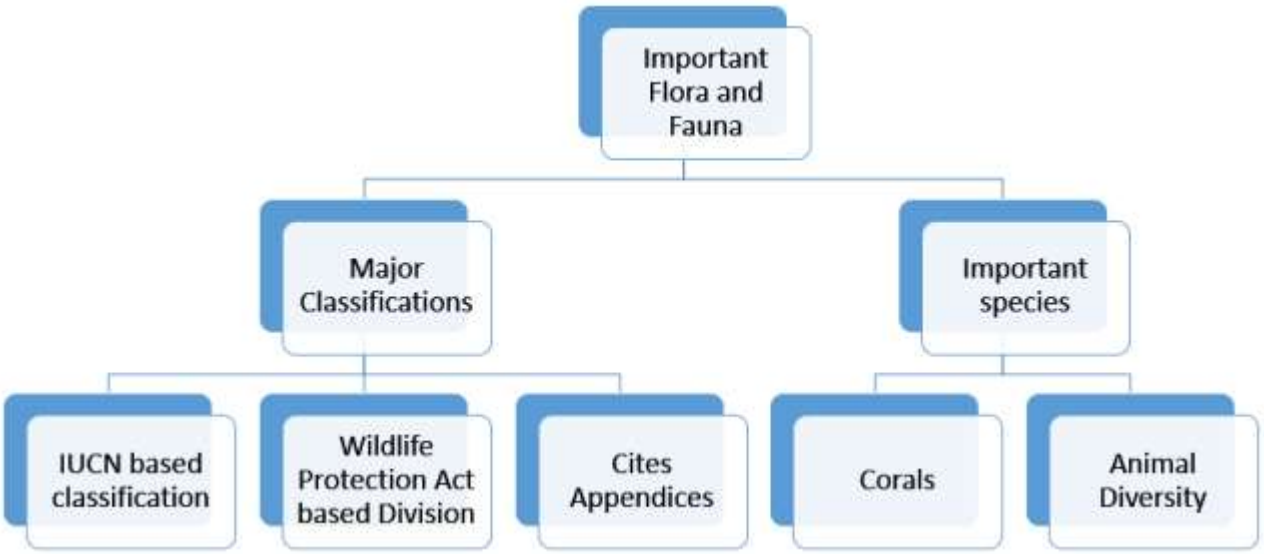
(b) It no longer exists in the wild, a few individuals are under captive protection; and now it is impossible to prevent its extinction.

(c) It is endemic to a particular region of India.

(d) Both (b) and (c) stated above are correct in this context.

Answer: a

EXPLANATION



IUCN RED DATA BOOK

• The IUCN Red List of Threatened Species (also known as the IUCN Red List or Red Data List), founded in 1965.

• It has evolved to become the world's most comprehensive inventory of the global conservation status of biological species.

• It uses a set of criteria to evaluate the extinction risk of thousands of species and subspecies.

• Major species assessors include Birdlife International, Zoological Society of London, the World

Conservation Monitoring Centre, and many Specialist Groups within the IUCN Species Survival Commission (SSC).

Aim

The IUCN formally stated goals of the Red List are:

✓ To provide scientifically based information on the status of species and subspecies at a global level,

✓ To draw attention to the magnitude and importance of threatened biodiversity,

✓ To influence national and international policy and decision-making, and

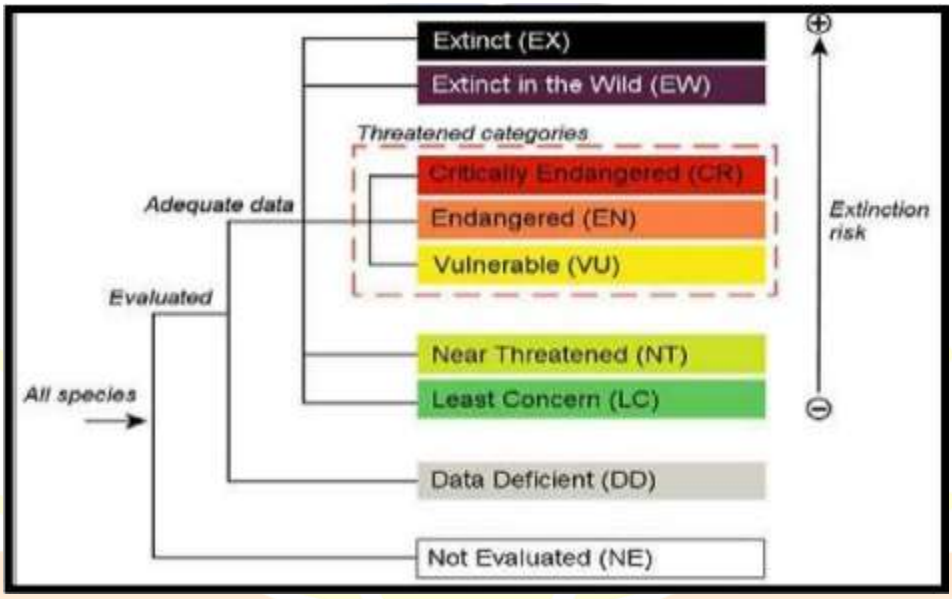
✓ To provide information to guide actions to conserve biological diversity.

Special pages

✓ It contains Red, Pink and Green pages. Red is symbolic of the danger that some species of both plants and animals presently experience throughout the globe.

✓ The Pink pages in the Red data book include the critically endangered species. Green pages are used for those species that were formerly endangered but have now recovered to a point where they are no longer threatened.

IUCN Categories



IUCN Red List Criteria

EXTINCT (EX)

A taxon is Extinct when there is no reasonable doubt that the last individual has died. A taxon is presumed extinct when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), and throughout its historic range have failed to record an individual.

EXTINCT IN WILD (EW)

A taxon is Extinct in the Wild when it is known only to survive in cultivation, in captivity or as a naturalized population (or populations) well outside the past range. A taxon is presumed Extinct in the wild when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), and throughout its historic range have failed to record an individual.

CRITICALLY ENDANGERED (CR)

A taxon is classified critically endangered if:

✓ An observed, estimated, inferred or suspected population size reduction of ≥90% over the last 10 years or three generations, whichever is the longer,

✓ Population size estimated to number fewer than 250 mature individuals and an estimated continuing decline of at least 25% within three years or one generation or less than 50 mature individuals

✓ Area of occupancy estimated to be less than 10 km2 with severely fragmented habitat and restricted to 1 location or a continued decline in population.

ENDANGERED (EN)

A taxon is endangered if:

✓ An observed, estimated, inferred or suspected population size reduction of ≥70% over the last 10 years or three generations whichever is longer.

✓ Extent of occurrence estimated to be less than 5,000 km2 with severely fragmented habitat with not more than 5 locations or continued decline in population.

✓ Population size estimated to number fewer than 2500 mature individuals or less and an estimated continuing decline of at least 20% within five years or two generation or less than 50 mature individuals

VULNERABLE (VU)

A taxon is vulnerable if:

✓ An observed, estimated, inferred or suspected population size reduction of ≥50% over the last 10

years or three generations.

✓ Extent of occurrence estimated to be less than 20,000 km2 , and estimates indicating severely fragmented or known to exist at no more than 10 locations or continued decline in population.

✓ Population size estimated to number fewer than 10,000 mature individuals and an estimated continuing decline of at least 10% within 10 years or three generations or less than 1000 mature individuals

NEAR THREATENED (NT)

A taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.

LEAST CONCERNED (LC)

A taxon is Least Concern when it has been evaluated against the criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant taxa are included in this category

DATA DEFICIENT (DD)

A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution are lacking.

NOT EVALUATED (NE)

A taxon is Not Evaluated when it has not yet been evaluated against the criteria. By 2015 the IUCN had assessed and allocated conservation statuses to over 76,000 species worldwide. From these it had categorised some 24,000 species as globally threatened at one conservation level or another. However, despite estimates varying widely as to the number of species existing on Earth (ranging from 3 million up to 30 million), this means the IUCN's 'not evaluated' (NE) category is by far the largest of all nine extinction risk categories.

CITES: Convention on International Trade in Endangered Species of Wild Fauna and Flora

KEY FEATURES

• It is an International agreement to regulate worldwide commercial trade in wild animal and plant species. It also restricts trade in items made from such plants and animals, such as food, clothing, medicine, and souvenirs

• It was signed on March 3, 1973 (Hence world wildlife day is celebrated on March 3).

• It is administered by the United Nations Environment Programme (UNEP).

• Secretariat — Geneva (Switzerland).

• CITES is legally binding on state parties to the convention, which are obliged to adopt their own domestic legislation to implement its goals.

Classification

It classifies plants and animals according to three categories, or appendices, based on how threatened. They are:

• Appendix I: It lists species that are in danger of extinction. It prohibits commercial trade of these plants and animals except in extraordinary situations for scientific or educational reasons.

• Appendix II species: They are those that are not threatened with extinction but that might suffer a serious decline in number if trade is not restricted. Their trade is regulated by permit.

• Appendix III species: They are protected in at least one country that is a CITES member states and that has petitioned others for help in controlling international trade in that species.

Wildlife Protection Act, 1972

The Wildlife Protection Act, 1972 is an Act of the Parliament of India enacted for protection of plants and animal species. The Act established schedules of protected plant and animal species. The act provides for the protection of wild animals, birds and plants and matters connected with them, with a view to ensure the ecological and environmental security of India. Key provisions are:

• Extends to the whole of India, except the State of Jammu and Kashmir which has its own wildlife act.

• It provides for prohibition on use of animal traps except under certain circumstances.

• It provides for protection of hunting rights of the Scheduled Tribes in Andaman and Nicobar Islands

• Has provisions for the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)

• It has six schedules which give varying degrees of protection.

• The act constitutes a National Board for Wildlife and also sets up National Tiger Conservation Authority.

• Five kinds of protected areas can be notified in the Act. These are:

✓ National Parks

✓ Conservation Reserves

✓ Wildlife Sanctuaries

✓ Community Reserves

✓ Tiger Reserves

SCHEDULES

• Schedule I and II are the most potent sections of the act. This section covers animals which are in the category of endangered species. The sections in this schedule give absolute protection to certain species and these cannot be infringed on any account.

• Schedule III and IV: These also have roughly the same provisions of Section I and II, but cover animals that are not in danger of becoming extinct. The penalties under this section are also less than Schedule I and II.

• For wild animals in Schedule II, III or IV, chief wildlife warden or authorized officers can permit their hunting in a specified area if they have become dangerous to humans or property (including standing crops on any land.

• Schedule V delineates animals that can be hunted like ducks, deer's, mice, crow, etc. They are called vermin. Recently, there was a request by Himachal Pradesh government to declare rhesus monkey a 'vermin'.

• Schedule VI concerns cultivation and plant life and gives teeth to setting up more protected animal parks.

QUESTION 3

Q. Consider the following statements (2018)

1. Most of the world's coral reefs are in tropical waters.

2. More than one-third of the world's coral reefs are located in the territories of Australia,

Indonesia and Philippines.

3. Coral reefs host far more number of animal phyla than those hosted by tropical rainforests.

Which of the statements given above is/are correct?

(a) 1 and 2 only

(b) 3 only

(c) 1 and 3 only

(d) 1, 2 and 3

Answer: d

QUESTION 4

Q. Which of the following have coral reefs? [2014]

1. Andaman and Nicobar Islands

2. Gulf of Kachchh

3. Gulf of Mannar

4. Sunderbans

Select the correct answer using the code given below.

(a) 1, 2 and 3 only

(b) 2 and 4 only

(c) 1 and 3 only

(d) 1, 2, 3 and 4

Answer: a

EXPLANATION

CORAL REEFS

• In tropical seas, many types of coral animals and marine organisms such as coral polyps, calcareous algae, shell-forming creatures and lime-secreting plants live in large colonies. Under favourable conditions, the colony of corals grows in profusion just below the water level. Among the numerous organism that forms the part of the coral habitat, the polyps are the abundant species. Each polyp resides in a tiny cup of coral made of calcium carbonate and when a polyp dies the cup cement together to form the reef structure.

• There are two major types of corals: hard corals and soft corals, such as sea fans and gorgonians. Only hard corals build reefs. While the majority of coral reefs are found in tropical and sub-tropical waters, there are also deep water corals in colder regions.

• There are also non-reef building species such as the 'precious corals' of the Pacific Ocean and the 'red coral' of the Mediterranean Sea which may survive in the colder and even the deeper waters. As a rule, they thrive well only in the warmer tropical seas.

• Coral reefs are one of the largest and most diverse ecosystems on earth. Although distributed across 100 countries worldwide and vital for coastal protection, tourism and marine life, including fisheries,

coral reefs occupy an area of about 284,300 km^2. This is less than 0.2% of the total area under oceans. Yet coral reefs support about 25% of all marine species which is more than tropical rainforest animal species. These ecosystems are packed with the highest densities of animals to be found anywhere on the planet.

Distribution of Coral Reefs

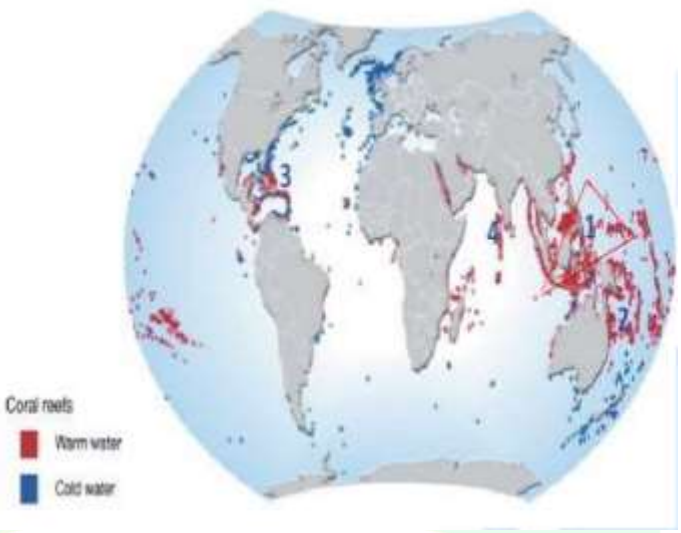
CORAL REEFS IN WORLD

• Coral Triangle Spread across several countries in the Asia Pacific region, the Coral Triangle is home to more species than any other marine area in the world and is called the underwater equivalent of rainforests of the Amazon.

• Great Barrier Reef in Australia stretching across 2300 km make it the world's largest coral reef ecosystem.

• Belize Barrier Reef: The largest barrier reef in the northern hemisphere.

• Maldives-Chagos-Lakshadweep Atolls is the largest atoll system in the world and the most extensive coral reef system in the Indian Ocean.



Distribution of Coral Reefs

CORAL REEFS IN INDIA

The major reef formations in India are restricted to the Gulf of Mannar, Palk bay, Gulf of Kutch, Andaman and Nicobar Islands and the Lakshadweep islands. While the Lakshadweep reefs are atolls, the others are all fringing reefs. Patchy coral is present in the inter-tidal areas of the central west coast of the country.

Conditions for coral reef building

• The surface water temperature of the ocean must not be less than 20 degrees Celsius. The condition virtually limits the areal distribution of corals to the tropical, and sub-tropical zones.

• Again they will not flourish where cold current flows and around the cold upwelling zones, as the surface temperature of the water is below the ideal requirement. Since most of the cold current flows along the western border of continents, it explains the absence of corals from western coasts.

• Zooxanthellae a type of algae live in a symbiotic relationship with coral polyps, algae produce food through photosynthesis and provide energy to polyps. So, the survival of corals is dependent on photosynthesis. As a result, the corals are found at a depth not exceeding 180 feet. Below 180 feet depth, the sunlight is too faint for photosynthesis to take place.

• The water should be salty and free from sediment. Corals, therefore, survive best in the moving ocean water well away from the silty coasts or muddy mouths of streams and rivers. The seaward side of the coral reefs is best developed because of the supply of oxygenated water by the constant flow of waves and tides.

Coral Bleaching

Bleaching refers to the paling of coral colour. It occurs when the density of zooxanthellae residing inside the reefs declines or the concentration of photosynthetic pigments within the zooxanthellae fall. Coral

reef bleaching is a reaction to the stress applied on the coral polyps. It can be induced by a variety of factors, alone or in combination. The following stressors have been implicated in coral reef bleaching events.

• Temperature: Corals live in a narrow temperature range and seasonal spikes or lows can affect this ideal temperature zone which can result in coral bleaching.

• Subaerial Exposure: Sudden exposure of reef flat corals to the atmosphere during events such as extreme low tides, El Nino Southern Oscillation (ENSO) - related sea level drops or tectonic uplift can potentially induce bleaching.

• Sedimentation: Relatively few instances of coral bleaching have been linked to it.

• Fresh Water Dilution: Rapid dilution of reef waters from storm-generated precipitation and runoff has been demonstrated to cause coral bleaching.

CORAL BLEACHING CONDITIONS

• Xenobiotics: Zooxanthellae loss occurs during exposure of coral to elevated concentrations of various chemical contaminants such as copper, herbicides, and oil. Because high concentrations of xenobiotics are required to induce zooxanthellae loss, bleaching from such sources is usually extremely localized and transitory.

• Epizootics: Pathogen-induced bleaching is different from other types of bleaching. Most coral diseases cause patchy or whole colony death and sloughing of soft tissues, resulting in a white skeleton but not bleached corals.

• Excess nutrients, such as, ammonia and nitrate from fertilisers and household products entering the reef ecosystem may lead to bleaching like condition. The nutrients might increase the number of zooxanthellae in the coral, but it is possible that the nutrient overload increases the susceptibility of coral to diseases.

Before we proceed to some more UPSC Previous Year Questions asked in context of Biodiversity part 2, let us first go through some important facts associated with important flora and fauna as UPSC has asked repeated questions from these topics and revising the theory will allow you to solve the questions easily.

IMPORTANT FLORA AND FAUNA

Sea Dugong or sea cow

• TYPE: Mammal

• IUCN STATUS: Vulnerable

• CONSERVATION EFORTS: Included in schedule I of

• WPA and CITES Appendix-I List.

• HABITAT: Restricted to the coastal habitats which support sea grass meadows

• FEATURES: Strictly marine herbivorous mammal

• DISTRIBUTION: Maximum population in Red sea and Persian Gulf. In India, they are found in Gulf of Kutch, the only population remaining in western India and Gulf of Mannar. The Gulf of Mannar Biosphere (GoMB) has highest population in India. They are also found in Andaman and Nicobar Islands.

• THREATS: Incidental capture in fishing gear, Hunting, Boat strikes and boating activities (e.g. acoustic pollution), Loss of habitat caused by human settlement on coasts, trawling destructive fishing, natural processes (e.g. cyclones and tsunamis), threats to sea grass (including untreated sewage disposal, coastal dredging and reclamation), Chemical pollution (e.g. oil spills) and Climate change.

Lion Tailed Macaque

• IUCN STATUS: Endangered

• CONSERVATION EFFORTS: Included in Appendix I of CITES, Schedule I, Part I, of the Indian Wildlife (Protection) Act, 1972

• HABITAT: Mainly diurnal arboreal, it prefers the upper canopy of primary tropical evergreen rainforest but may also be found in monsoon forest in hilly country and in disturbed forest.

• FEATURES: Unlike other macaques it avoids human

• DISTRIBUTION: It can be found in Karnataka, Tamil Nadu and Kerala in the western ghat region. Found in Kudremukh National park, Periyar National Park, Silent Valley National Park, Schendurney Park, Indira Gandhi National park, etc.

• THREATS: Habitat loss, Hunting, Illegal trade.

One Horned Rhino

• TYPE: Mammal and Herbivores

• IUCN STATUS : Vulnerable

• CONSERVATION EFFORTS: Rhino Vision 2020, CITES Appendix -1,

• HABITAT: Tropical and Subtropical Grasslands, Savannas, and Shrublands.

• FEATURES: The species is solitary, except when adult males or rhinos nearing adulthood gather at wallows or to graze. Males have loosely defined home ranges that are not well defended and often overlap. They primarily graze, with a diet consisting almost entirely of grasses as well as leaves, branches of shrubs and trees, fruit, and aquatic plants.

• DISTRIBUTION: Formerly, extensively distributed in the Gangetic plains, today the species is restricted to small habitats in Indo- Nepal terai and North Bengal, and Assam. In India rhinos are found in Kaziranga, Orang, Pobitara, Jaldapara, and Dudhwa National Park.

• THREATS: Habitat loss, Hunting, Illegal trade.

Flying Squirrel

• TYPE: Mammal

• IUCN STATUS: Critically Endangered

• CONSERVATION EFFORTS: Schedule-I of WPA, 1972

• HABITAT: Deciduous and coniferous forests and woodlands.

• FEATURES: Arboreal and Nocturnal. They are not capable of flight in the same way as birds or bats but are able to glide from one tree to another with the aid of a patagium, a furry, parachute-like membrane that stretches from wrist to ankle.

• DISTRIBUTION: restricted to a single valley in the Namdapha Tiger Reserve in Arunachal Pradesh

• THREATS: Poaching of animals for food, habitat loss and degradation,

• Landslides and flooding that results in habitat loss.

Royal Bengal tiger

• IUCN STATUS: Endangered

• CONSERVATION EFFORTS: Included in

Schedule-I of WPA, 1972 and Appendix-I of CITES, Project Tiger started

• HABITAT: In the Indian subcontinent, tigers inhabit tropical moist evergreen forests, tropical dry forests, tropical and subtropical moist deciduous forests, mangroves, subtropical and temperate upland forests, and alluvial grasslands.

• FEATURES: National animal of India and Bangladesh

• DISTRIBUTION: The Bengal tiger is found primarily in India with smaller populations in Bangladesh, Nepal, Bhutan, China and Myanmar. The tigers in the Sundarbans in India and Bangladesh are the only ones in the world inhabiting mangrove forests.

• THREATS: Hunting and Loss of habitat.

Kashmir Stag

• TYPE: Mammal

• IUCN STATUS: Critically Endangered

• CONSERVATION EFFORTS: Included in Schedule- I of the Indian Wildlife (Protection) Act, 1972 and Jammu & Kashmir Wildlife (Protection) Act, 1978 and Project hangul started by Govt of India.

• HABITAT: Dense riverine forests in the high valleys and mountains

• FEATURES: Subspecies of elk native to India (endemic to Jammu and Kashmir)

• DISTRIBUTION: Kashmir Valley and northern Chamba district in Himachal Pradesh. Protected in Dachigam National Park in Zabarwan Range of the Western Himalayas.

• THREATS: Habitat loss, Hunting, Poaching and over-grazing by livestock.

Indian Gazelle (Chinkara)

• IUCN STATUS: Least Concerned

• CONSERVATION EFFORTS: Included in Schedule-I of WPA, 1972 and Appendix-I of CITES,

• HABITAT: Arid plains and hills, grasslands and desert areas,dry scrub and light forests

• FEATURES: Smallest Asiatic Antilope and are shy and avoid human habitation.

• DISTRIBUTION: Western and central India, extending through Pakistan, south-western Afghanistan and into northcentral Iran. The Thar Desert of western India remains a stronghold. Found sharing habitat with Nilgai.

• THREATS: Excess hunting in Iran, Pakistan and Afghanistan and Loss of habitat through overgrazing, conversion to agriculture and industrial development.

Red Panda

• TYPE: Mammal

• IUCN STATUS : Endangered

• CONSERVATION EFFORTS: CITES Appendix-I

• HABITAT: Temperate forests

• FEATURES: State animal of Sikkim, West Bengal and Arunachal Pradesh. It is arboreal. They feed mainly on bamboo, but also eats eggs, birds, and insects. It is a solitary animal, mainly active from dusk to dawn, and is largely sedentary during the day. Red panda is endemic to the temperate forests of the Himalayas, and ranges from the foothills of

western Nepal to China in the east.

• DISTRIBUTION: Native to the eastern Himalayas and south-western China. It is mainly found in Kanchendzonga National Park (NP) — Sikkim, Neora Valley NP – West Bengal, Namdapha National Park – Arunachal Pradesh, Singalila National Park –West Bengal

• THREATS: Habitat loss and fragmentation and habitat degradation due to commercial logging, expansion of agriculture, land use changes etc., Natural disasters, bamboo flowering (which results in death of the plant and typically occurs synchronously across large areas) and forest fires.

Pygmy Hog

• TYPE: Mammal

• IUCN STATUS: Critically Endangered

• CONSERVATION EFFORTS:

• HABITAT: Relatively undisturbed, tall 'terai' grasslands.

• FEATURES: World's smallest pig, indicator species in grassland ecosystem

• DISTRIBUTION: Previously spread across India, Nepal, and Bhutan. Now only found in Assam (Manas Wildlife Sanctuary and its buffer reserves).

• THREATS: Habitat loss, Hunting, Illegal trade.

Olive Ridley Turtle

• TYPE: Reptile

• IUCN STATUS: Vulnerable

• Conservation Efforts: Included in Appendix –I of CITES, Schedule I of WPA, 1972

• HABITAT: Warm and tropical waters of primarily in the Pacific, Indian Ocean

• And Atlantic Ocean.

• FEATURES: Synchronised mass nesting called Arridabas, Mostly carnivorous, feeding on such creatures as jellyfish, snails, crabs, and shrimp. They will occasionally eat algae and seaweed.

• DISTRIBUTION:

• NESTING SITES: Hope Island of Coringa Wildlife Sanctuary (Andra Pradesh), Gahirmatha beach (Odisha), Astaranga coast(Odisha), Beach of Rushikulya River and Devi River mouth

• THREATS: Poaching for their meat, shell and leather, and their eggs, Pet trading, Accidental killing of adult turtles through entanglement in trawl nets and gill nets due to uncontrolled fishing during their mating season around nesting beaches, Development and exploitation of nesting beaches for ports, and tourist centres, Predators like feral dogs and pigs, ghost crabs, snakes etc, Light pollution and ingestion of marine debris that causes perforation of the digestive system and exposure to chemicals and hence death.

Swamp Deer

• TYPE: Mammal

• IUCN STATUS: Vulnerable

• CONSERVATION EFFORTS: Schedule-I WPA, 1972 and Appendix-I of CITES

• HABITAT: They prefer tall grasslands and open habitats. They found in swampland and a variety of forest types ranging from dry to moist deciduous to evergreen. They also found in grassy floodplains, wooded areas, and found near water bodies.

• FEATURES: State animal of Madhya Pradesh and Uttar Pradesh

• DISTRIBUTION: Central and northern India and southern Nepal. In India mainly in states with Ganges River, Brahmaputra River flowing through it and in Kanha National Park –Madya Pradesh, Dudhwa National Park – Uttar Pradesh, Manas National Park — Assam and Kaziranga National Park — Assam

• THREATS: Poaching and destruction of wetlands.

Kharai Camel

• TYPE: Mammal

• IUCN STATUS : Critically Endangered

• HABITAT: Arid and coastal ecosystem

• DISTRIBUTION: Gujarat

• FEATURES: Kharai Camel or Swimming Camels are found only in Gujarat's Bhuj area. It grazes on saline / mangrove trees and is tolerant to high saline water. It can

swim up to three kilometers into the sea in search of mangroves, their primary food. The camel is distinct from other camels because of its rounded back, long and thin legs and small feet. It is a domestic breed of camel.

• THREATS: Salt mining and habitat destruction.

Indian Wild Ass

• TYPE: Mammal

• IUCN STATUS : Endangered (2015)

• CONSERVATION EFFORTS:

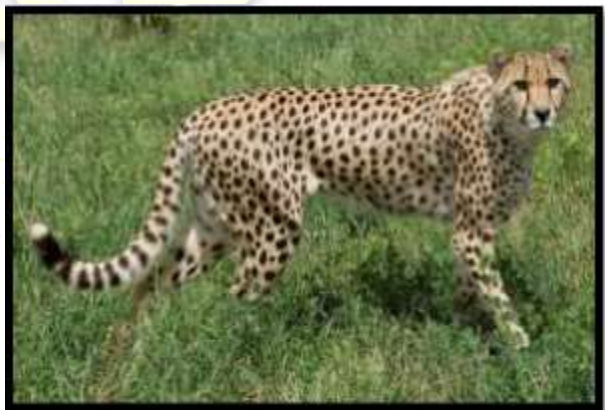
• HABITAT: Saline deserts (Rann), arid grasslands and shrub lands are its preferred environment.

• FEATURES: It is also called Ghor Khar or Ghud Khur; one of the fastest Indian animal; herbivores; endemic species

• DISTRIBUTION: Found predominantly in the Little Rann of Kutch and its surrounding areas in Gujarat. It is also found in southern Pakistan, Afghanistan, and south-eastern Iran.

• THREATS: Disease, habitat degradation due to salt activities, the invasion of the Prosopis juliflora shrub, and encroachment and grazing by the Maldhari.

Cheetah



• TYPE: Mammal

• IUCN STATUS: Vulnerable

• CONSERVATION EFFORTS: Cites Appendix-I

• HABITAT: Mostly arid habitats like dry forests, scrub forests, and savannahs.

• FEATURES: Cheetah, fastest land animal was declared extinct in India in 1952. India's last spotted Asiatic cheetah (Acinonyx jubatus venaticus) had died in Chhattisgarh in 1947.

• DISTRIBUTION: North, Southern and East Africa, and a few localities in Iran.

• THREATS: Man-animal conflict, Habitat loss and poaching for the illegal pet trade.

Gangetic Dolphin (Ganges Susu)

• TYPE: Mammal

• IUCN STATUS : Endangered

• CONSERVATION EFFORTS: Included in Schedule- I of the Indian Wildlife (Protection) Act, 1972 and Cites Appendix-1

• HABITAT: Freshwater riverine ecosystem

• FEATURES: Indicator species of freshwater ecosystem. They are essentially blind. They hunt by emitting ultrasonic sounds, which bounces off of fish and other prey, enabling them to "see" an image in their mind. The government of India declared it the National Aquatic Animal in 2009.

• DISTRIBUTION: Ganges river dolphins once lived in the Ganges-Brahmaputra-Meghna and Karnaphuli-Sangu river systems of Nepal, India, and Bangladesh. But the species is extinct from most of its early distribution ranges

• THREATS: Habitat loss due to water pollution, hunting, caught in fish traps.

Saltwater Crocodile

• IUCN STATUS: Least Concerned

• CONSERVATION EFFORTS: Included in Schedule-I of WPA, 1972 and included in

• Project Crocodile

• HABITAT: Coastal habitat and Mangroves

• FEATURES: Largest Reptile on Planet

• DISTRIBUTION: Native to saltwater habitats and brackish wetlands from India's east coast across Southeast Asia and the Sundaic region to northern Australia and Micronesia.

• THREATS: Hunting for eggs and skin.

Gharial (Gavial or fish eating crocodile)

• IUCN STATUS: Critically Endangered

• CONSERVATION EFFORTS: Included in ScheduleI of WPA, 1972 and

• CITES Appendix-I list.

• HABITAT: Riverine habitat

• FEATURES: The male gharial has a distinctive boss at the end of the snout, which resembles an earthenware pot known in Hindi and hence the name.

• DISTRIBUTION: Gharials once inhabited all the major river systems of the Indian Subcontinent, from the Irrawaddy River in the east to the Indus River in the west. Their distribution is now limited to only 2% of their former range

• India: Found in Girwa River, Chambal River, Ken River, Son River, Mahanadi River, Ramganga River, and 2 National parks i.e. National Chambal Sanctuary and Katerniaghat Wildlife Sanctuary.

• Nepal: Rapti-Narayani River

• THREATS: Hunting, Decrease of riverine habitat as dams, barrages, irrigation canals and artificial embankments were built; siltation and sand-mining changed river courses, Depletion of fish resources, Entanglement in fishing nets.

Great Indian Bustard

• TYPE: Bird

• IUCN STATUS : Critically Endangered

• CONSERVATION EFFORTS: CITES Appendix I, Schedule 1 of WPA, Project Great Indian

• HABITAT: Arid and semi-arid grasslands with scattered short scrub, bushes and low intensity cultivation in flat or gently undulating terrain. It avoids irrigated areas

• FEATURES: Heaviest of the flying birds and these birds are often found associated in the same habitat as blackbuck, State bird of Rajasthan

• DISTRIBUTION: Found in India and the adjoining regions of Pakistan

• In India, the bird was historically found in Punjab, Haryana, Uttar Pradesh, Madhya Pradesh, Chhattisgarh, Odisha, Andhra Pradesh, Rajasthan, Gujarat, Maharashtra, Karnataka and Tamil Nadu. Today the bustard is restricted to isolated pockets in Andhra Pradesh, Gujarat, Karnataka, Maharashtra, Madhya Pradesh andRajasthan It is conserved at Desert National Park Sanctuary —Rajasthan, Rollapadu Wildlife Sanctuary – Andhra Pradesh and Karera Wildlife Sanctuary– Madhya Pradesh

• THREATS: Habitat loss, Hunting, Sand mining and stone quarrying.

Great Indian Horn Bill

• TYPE: Bird

• IUCN STATUS : Vulnerable

• CONSERVATION EFFORTS: Appendix-I of Cites

• HABITAT: Forest Ecosystem

• DISTRIBUTION: Great hornbills are found in the forests of India, Bhutan, Nepal, Mainland Southeast Asia, and Indonesian Island of Sumatra and North eastern region of India. In the subcontinent they are found in a few forest areas in the Western Ghats and in the forests along the Himalayas.

• FEATURES: State bird of Kerala and Arunachal Pradesh. Predominantly frugivorous, but is an opportunist and will prey on small mammals, reptiles and birds. Culturally significant as beaks and head are used in charms, flesh is believed to be of medicinal value, young birds are considered a delicacy, tribesmen in parts of north-eastern India and Borneo use the feathers for headdresses, and the skulls are often worn as decorations.

• THREATS: Habitat loss, Hunting.

Sangai Brow-Antleer Deer (Dancing Deer)

• IUCN STATUS : Endangered

• CONSERVATION EFFORTS: Listed in Schedule-I of WPA and appendix-I of Cites

• HABITAT: Floating marshy grasslands

• FEATURES: It is an endemic and rare sub species of

brow antlered deer found only in Manipur. It is the state animal of Manipur. Its habitat is restricted to the marshy wetland of Keibal Lamjao over the floating biomass in Loktak Lake which is locally called 'phumdi'. It is also one of the seven Ramsar sites of international importance. Keibal Lamjao is the only floating national park in India. Phumdi is the floating mass of entangled vegetation formed by the accumulation of organic debris and biomass with soil.

• DISTRIBUTION: Manipur

• THREATS: Poaching and habitat destruction.

Leatherback Sea Turtle

• TYPE: Reptiles

• IUCN STATUS : Vulnerable

• CONSERVATION EFFORTS: Listed in Cites Appendix-I and Schedule-I of WPA

• HABITAT: Ocean ecosystem

• FEATURES: It is the largest of all living turtles and is the fourth-heaviest modern reptile behind three crocodilians.

• DISTRIBUTION: Circumglobal, present in all the world's oceans except Arctic and Antarctic; nesting areas are in the tropics, non-nesting range extends to sub-polar regions. Hence we can say it has cosmopolitan global range

• THREATS: Poaching, intense egg collection and fisheries bycatch

Snow Leopard

• TYPE: Mammal

• IUCN STATUS : Vulnerable

• CONSERVATION EFFORTS: Listed in Cites Appendix-I and Schedule-I of WPA

• HABITAT: Inhabits alpine and subalpine zones at elevations from 3,000 to 4,500 m (9,800 to 14,800 ft.), ranging from western Afghanistan to Mongolia and western China(Himalaya and Tibetan Plateau)

• FEATURES: State animal of Himachal Pradesh

• DISTRIBUTION: Himalayas and Altai Mountains of Russia. In India this animal habitat is in Jammu and Kashmir, Himachal Pradesh, Uttarakhand, Sikkim and Arunachal Pradesh.

• THREATS: Poaching for their fur, infrastructure developments and climate change

QUESTION 5

Q. With reference to 'dugong', a mammal found in India, which of the following statements is/an; correct? [2015]

1. It is an herbivorous marine animal.
2. It is found along the entire coast of India.
3. It is given legal protection under Schedule I of the Wildlife (Protection) Act, 1972.

Select the correct answer using the code given below.

(a) 1 and 2

(b) 2 only

(c) 1 and 3

(d) 3 only

Answer: c

QUESTION 6

Q. The marine animal called Dugong which is vulnerable to extinction is [2009]

(a) Amphibian

(b) Bony fish

(c) Shark

(d) Mammal

Answer: d

QUESTION 7

Q. Which one of the following is the national aquatic animal of India? [2015]

(a) Saltwater crocodile

(b) Olive ridley turtle

(c) Gangetic dolphin

(d) Gharial

Answer: c

QUESTION 8

Q. Other than poaching, what are the possible reasons for the decline in the population of Ganges River Dolphins? [2014]

1. Construction of dams and barrages on rivers

2. Increase in the population of crocodiles in rivers

3. Getting trapped in fishing nets accidentally

4. Use of synthetic fertilizers and other agricultural chemicals in crop-fields in the vicinity of rivers

Select the correct answer using the code given below.

(a) 1 and 2 only

(b) 2 and 3 only

(c) 1, 3 and 4 only

(d) 1, 2, 3 and 4

Answer: c

QUESTION 9

Q. Other than poaching, what are the possible reasons for the decline in the population of Ganges River Dolphins? [2014]

1. Construction of dams and barrages on rivers.

2. Increase in the population of crocodiles in rivers.

3. Getting trapped in fishing nets accidentally.

4. Use of synthetic fertilizers and other agricultural chemicals in crop-fields in the vicinity of rivers.

Select the correct answer using the code given below.

(a) 1 and 2 only

(b) 2 and 3 only

(c) 1, 3 and 4 only

(d) 1, 2, 3 and 4

Answer: c

QUESTION 10

Q. In which of the following States is lion-tailed macaque found in its natural habitat? [2013]

1. Tamil Nadu

2. Kerala

3. Karnataka

4. Andhra Pradesh

Select the correct answer using the codes given below.

(a) 1, 2 and 3 only

(b) 2 only

(c) 1, 3 and 4 only

(d) 1, 2, 3 and 4

Answer: a

QUESTION 11

Q. A sandy and saline area is the natural habitat of an Indian animal species. The animal has no

predators in that area but its existence is threatened due to the destruction of its habitat. Which one of the following could be that animal? [2011]

(a) Indian wild buffalo

(b) Indian wild ass

(c) Indian wild boar

(d) Indian gazelle

Answer: b

QUESTION 12

Q. In which of the following regions of India are you most likely to come across the `Great Indian Hornbill' in its natural habitat? [2017]

(a) Sand deserts of northwest India

(b) Higher Himalayas of Jammu and Kashmir

(c) Salt marshes of western Gujarat

(d) Western Ghats

Answer: d

QUESTION 13

Q. What is/are unique about 'Kharai camel', a breed found in India? [2017]

1. It is capable of swimming up to three kilometres in seawater.

2. It survives by grazing on mangroves.

3. It lives in the wild and cannot be domesticated.

Select the correct answer using the code given below.

(a) 1 and 2 only

(b)) 3 only

(c) 1 and 3 only

(d) 1, 2 and 3

Answer: a

QUESTION 14

Q. Consider the following: [2012]

1. Black necked crane

2. Cheetah

3. Flying squirrel

4. Snow leopard

Which of the above are naturally found in India?

a) 1, 2 and 3 only

b) 1, 3 and 4 only

c) 2 and 4 only

d) 1, 2, 3 and 4

Answer: b

QUESTION 15

Q. Which one of the following groups of animals belongs to the category of endangered species? [2012]

(a) Musk Deer, Red Panda and Asiatic Wild Ass

(b) Kashmir Stag, Cheetal, Blue Bull and Great Indian Bustard

(c) Snow Leopard, Swamp Deer, Rhesus Monkey and Saras (Crane)

(d) Lion-tailed Macaque, Blue Bull, Hanuman Langur and Cheetal

Answer: a

DO IT YOURSELF

QUESTION 16

Q. What is the difference between the antelopes Oryx and Chiru? [2012]

(a) Oryx is adapted to live in hot and arid areas whereas Chiru is adapted to live in steppes and semidesert areas of cold high mountains.

(b) Oryx is poached for its antlers whereas Chiru is poached for its musk.

(c) Oryx exists in western India only whereas Chiru exists in north-east India only.

(d) None of the statements (a), (b) and (c) given above is correct.

VI. BIODIVERSITY PART 3 – CONSERVATION

QUESTION 1

Q. Which one of the following is not a site for in-situ method of conservation of flora? [2011]

(a) Biosphere Reserve

(b) Botanical Garden

(c) National Park

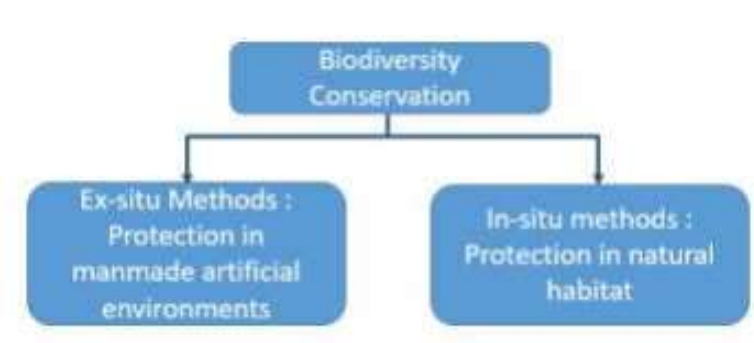
(d) Wildlife Sanctuary

Answer: b

EXPLANATION

BIODIVERSITY CONSERVATION

Biodiversity is the biological diversity which includes the variety of the whole species present on earth. It includes different animals, plants, micro-organisms and their genes, water ecosystems, terrestrial, and marine ecosystems in which they all are present. Whatever we do to protect the number and variety of plants and animals is known as biodiversity conservation. There are two main ways to conserve biodiversity.



Before we proceed to some more UPSC Previous Year Questions asked in context of Biodiversity Conservation, let us first go through some important facts associated with it. UPSC has asked repeated questions from these topics and revising the theory will allow you to solve the questions easily.

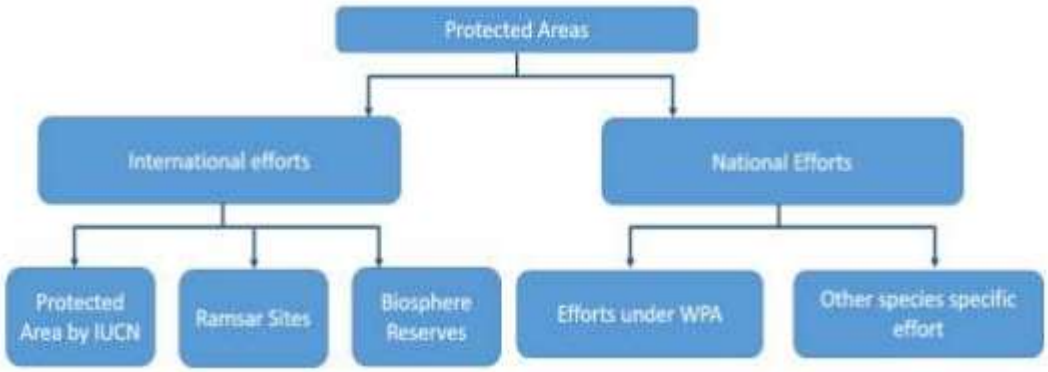
PROTECTED AREA

• A protected area is a geographically defined area that is designated or regulated and managed to achieve specific conservation objectives. It may be set aside for the protection of biological diversity, and of natural and associated cultural resources and is managed through legal or other effective means. It also includes Marine Protected Areas, the boundaries of which will include some area of ocean, and Transboundary Protected Areas that overlap multiple countries which remove the borders inside the area for conservation and economic purposes.

• In the past, it was assumed that the best way to preserve biodiversity was to conserve it through protected areas by reducing human activities or completely excluding humans. Population growth and poverty were seen as main causes of environmental degradation; people were regarded as a problem from which the environment needed protecting. Accordingly, protected areas and parks were fenced off from local people, traditional practices were prohibited, and people were held under penalties of fines or imprisonments for utilising park resources. However, there are very controversial scientific and social problems with this approach, which was characterized by serious conflicts between local communities and the state.

• PA management has taken on a more holistic approach to assessing biodiversity and environmental protection - it has to be effective in linking conservation with human needs. PA

management must take into account the local people's realities, that is, policy formulation must be based on a more realistic understanding of the social and political dimensions of natural resources management. Protected areas have been declared both nationally and internationally.



INTERNATIONAL EFFORTS

IUCN Protected Area

The categories of PAs under IUCN (International Union for Conservation of Nature) are:

✓ **Category I (Strict Protection and areas called strict natural reserve or Wilderness area)** it is an area which is protected from all but light human use in order to preserve the geological and geomorphical features of the region and its biodiversity. These areas are often home to dense native ecosystems that are restricted from all human disturbance outside of scientific study, environmental monitoring and education.

✓ **Category II** A national park is similar to a wilderness area in its size and its main objective of protecting functioning ecosystems. However, national parks tend to be more lenient with human visitation and its supporting infrastructure. National parks are managed in a way that may

contribute to local economies through promoting educational and recreational tourism on a scale that will not reduce the effectiveness of conservation efforts.

✓ **Category III (Conservation of Natural Features or natural monuments)** Similar to National Parks, but usually smaller areas protecting a single spectacular natural feature or historic site. It contains culturally influenced natural features.

✓ **Category IV** A habitat or species management area focuses on more specific areas of conservation (though size is not necessarily a distinguishing feature), like an identifiable species or habitat that requires continuous protection rather than that of a natural feature.

✓ **Category V** The areas are conserved for Landscape/Seascape and Recreation purposes. Sometimes called protected landscapes/seascapes.

✓ **Category VI Protected Area with sustainable use of natural resources**. Human involvement is allowed but not industrial activities.

UNESCO (United Nations Educational, Scientific and Cultural Organization) BIOSPHERE RESERVE (BR)

✓ Biodiversity reserves are large areas of protected land for conservation of wild life, plant and animal resources and traditional life of tribals living in that area. They may have one or more national parks or wildlife sanctuaries in it.

✓ These regions of environmental protection roughly correspond to IUCN Category V Protected areas.

✓ UNESCO came with the functions and concept of Biosphere reserve. The difference between them and existing protected areas are the coverage of entire biodiversity and not just a species. These

are areas where community and environment can co-exist while respecting each other's needs.

✓ Biosphere reserves are nominated by national governments and remain under the sovereign jurisdiction of the states where they are located. Their status is internationally recognized under UNESCO's Man and Biodiversity program.

✓ **Man & Biosphere Programme**

• UNESCO's Man and the Biosphere (MAB) Programme was launched in 1971 with aim of promoting interdisciplinary research, training, and communications in field of ecosystem conservation and rational use of natural resources.

• Under this programme, World Network of Biosphere reserves (WNBR) is declared. World Network of Biosphere Reserves currently counts 686 sites in 122 countries all over the world, including 20 transboundary sites.

Structure and Design of Biosphere Reserves

In order to undertake complementary activities of biodiversity conservation and development of sustainable management aspects, Biosphere Reserves are demarcated into three inter-related zones.

These are:-

✓ Natural or Core Zone

The core zone is kept absolutely undisturbed. It must contain suitable habitat for numerous plant and animal species, including higher order predators and may contain centres of endemism. The core zone is to be kept free from all human pressures external to the system.

✓ Manipulation or Buffer Zone

In the Buffer Zone, which adjoins or surrounds core zone, uses and activities are managed in ways that protect the core zone. These uses and activities include restoration, demonstration sites for enhancing value addition to the resources, limited recreation, tourism, fishing and grazing, which

are permitted to reduce its effect on core zone. Research and educational activities are to be encouraged. Human activities, if natural within BR, are likely to be permitted to continue if these do not adversely affect the ecological diversity.

✓ Transition Zone outside the Buffer Zone

The Transition Zone is the outermost part of a Biosphere Reserve. This is usually not delimited. This includes settlements, crop lands, managed forests and area for intensive recreation, and other economic uses characteristic of the region.

Biosphere Reserve (BR) in India

India has total 18 Biosphere Reserves. There is World Network of Biosphere reserves (WNBR) under MAB programme with 500 BRs around the world. Out of the 18 BRs in India, 11 are designated under WNBR and remaining 7 are domestic biosphere reserves.

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CIVIL SERVICES ACHIEVERS' POINT

A ONE STOP SOLUTION FOR UPSC/APSC/SSC & BANKING

LIST OF BIOSPHERE RESERVE DESIGNATED BY WORLD NETWORK OF BIOSPHERE RESERVE

S no.	Biosphere Reserve
1	Nilgiri
2	Gulf of Mannar
3	Sunderban
4	Nanda Devi
5	Nokrek
6	Pachmarhi
7	Simlipal
8	Achanakmar-Amarkantak
9	Great Nicobar
10	Agasthyamala
11	kanchendzonga

Ramsar Convention

• It is an international treaty which aims conservation and sustainable utilization of wetlands.

• The Ramsar Convention is the only global environmental treaty that deals with a particular ecosystem. The Convention uses a broad definition of the types of wetlands covered in its mission, including lakes and rivers, swamps and marshes, wet grasslands and peat lands, oases, estuaries, deltas and tidal flats, near-shore marine areas, mangroves and coral reefs, and human-made sites such as fish ponds, rice paddies, reservoirs, and salt pans.

• It was signed in Ramsar, Iran, on 2 February, 1971. It is celebrated as World wetland day.

• At the center is 'Wise use' concept. Wise use refers to 'maintenance of ecological character within

the context of sustainable development.'

• Conference of the Parties (COP) is the Convention's governing body consisting of all governments that have ratified the treaty. COP is the policy-making organ of the Convention which adopts decisions (Resolutions and Recommendations) to administer the work of the Convention. It meets regularly after three years. The recent meeting was held in 2018 at Dubai, United Arab Emirates.

The country with the highest number of Sites is the United Kingdom with 170. The country with the greatest area of listed wetlands is Bolivia. There are more than 2200 Ramsar sites across the world. In India there are 27 sites.

Criteria for Ramsar Sites

• If it contains a representative, rare, or unique example of a natural or near-natural wetland type.

• If it supports vulnerable, endangered, or critically endangered species; or threatened ecological communities.

• If it supports populations of plant and/or animal species important for maintaining the biological diversity of a particular biogeographic region.

• If it supports plant and/or animal species at a critical stage in their life cycles, or provides refuge during adverse conditions.

• If it regularly supports 20,000 or more water birds.

• If it regularly supports 1% of the individuals in a population of one species or subspecies of water birds.

• If it supports a significant proportion of indigenous fish subspecies

• If it is an important source of food for fishes, spawning ground, nursery and/or migration path.

• If it is an important source of food and water resource, increased possibilities for recreation and ecotourism, etc.

Montreux Record

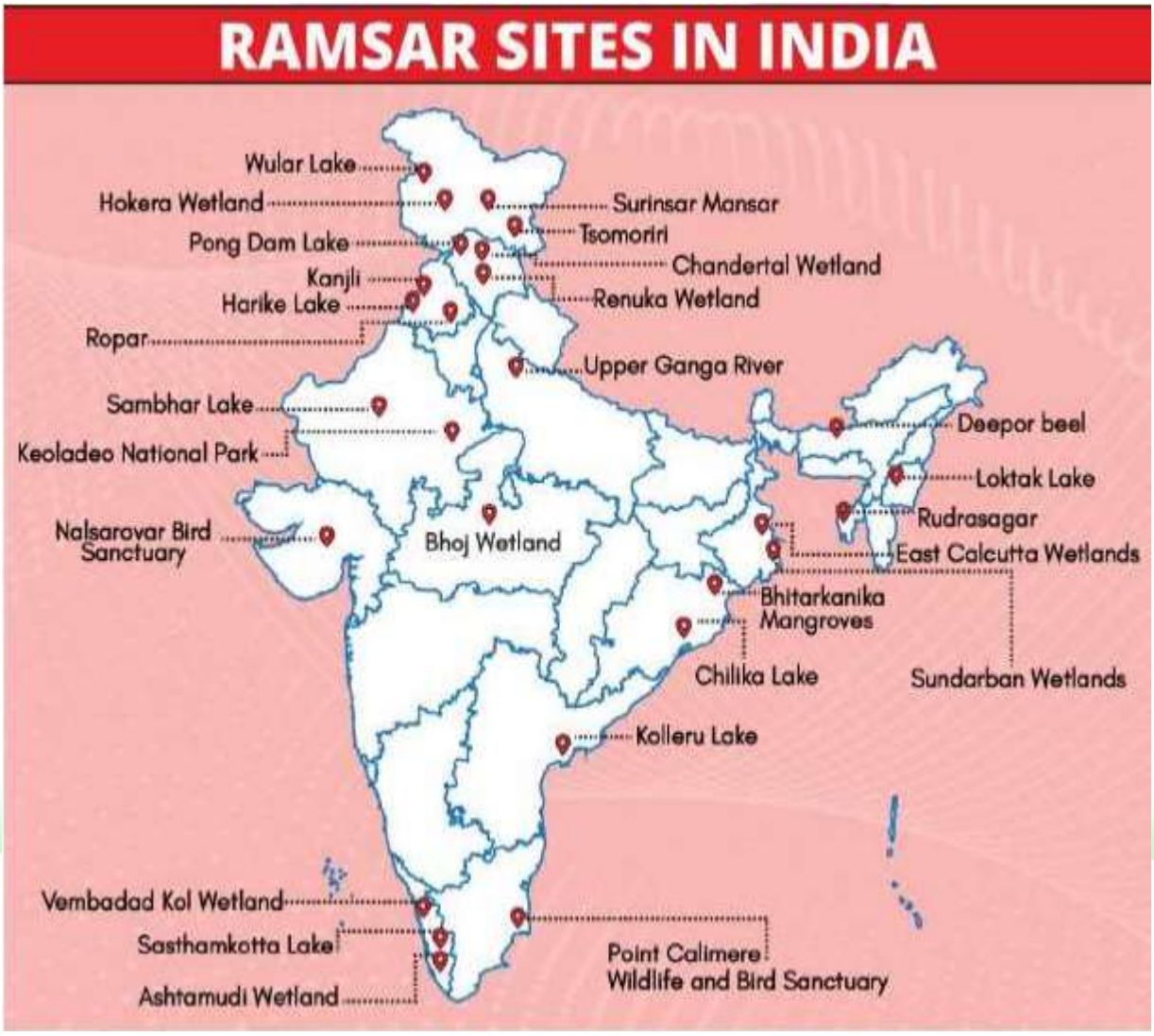
• Montreux Record under the Convention is a register of wetland sites.

• It is a list of Wetlands of International Importance where changes in ecological character have occurred, are occurring, or are likely to occur as a result of technological developments, pollution or other human interference.

• The Montreux Record was established by Recommendation of the Conference of the Contracting Parties (1990).

• Sites may be added to and removed from the Record only with the approval of the Contracting Parties in which they lie.

• Currently, two wetlands of India are in Montreux record viz. Keoladeo National Park, Rajasthan and Loktak Lake, Manipur. Further, Chilka Lake was placed but was later removed.



Elephants Conservation Efforts

• **MIKE: Monitoring of Illegal killing of Elephants**

✓ This programme was started in 2003 in South Asia under CITES.

✓ The main purpose was to provide information needed for elephant range states to make appropriate management for conservation of elephants and measure levels and trends in illegal killings.

✓ Under the programme data is collected on monthly submitted to regional headquarters at Delhi.

• **E-8 Countries:**

✓ At international level E-8 countries regularly meet to create awareness among people on efforts needed for elephant conservation. The E-8 countries include India, Botswana, Republic of Congo, Thailand, Indonesia, Kenya, Srilanka and Tanzania. They also started with E-50:50 Forum which includes 50 states working for elephant conservation.

MIKE SITES IN INDIA

Mike Sites	Location
Chirang Ripu Dhang Patki	Assam
Eastern Dooars	West Bengal
Deomali	Arunachal Pradesh
Garo Hills	Meghalaya
Mayurbhanj	Orissa
Mysore	Karnataka
Nilgiri	Tamil Nadu
Shivalik	Uttarakhand
Wayanad	Kerala

QUESTION 2

Q. India is a party to the Ramsar Convention and has declared many areas as Ramsar sites. Which

of the following statements best describes as to how we should maintain these sites in the context of this convention? [2010]

(a) Keep all the sites completely inaccessible to man so that they will not be exploited.

(b) Conserve all the sites through ecosystem approach and permit tourism and recreation only.

(c) Conserve all the sites through ecosystem approach for a period without any exploitation, with specific criteria and specific period for each site, and then allow sustainable use of them by future generations.

(d) Conserve all the sites through ecosystem approach and allow their simultaneous sustainable use.

Answer: d

QUESTION 3

Q. If a wetland of international importance is brought under the 'Montreux Record', what does it imply? [2014]

(a) Changes in ecological character have occurred, are occurring or are likely to occur in the wetland as a result of human interference

(b) The country in which the wetland is located should enact a law to prohibit any human activity within five kilometres from the edge of the wetland

(c) The survival of the wetland depends on the cultural practices and traditions of certain communities living in its vicinity and therefore the cultural diversity therein should not be destroyed.

(d) It is given the status of 'World Heritage Site'
Answer: a

QUESTION 4

Q. Out of all the biosphere reserves in India, few have been recognized on the World Network by UNESCO. Which one of the following is not one of them? [2008]

(a) Gulf of Mannar

(b) Kanchenjunga

(c) Nanda Devi

(d) Seshachalam

Answer: d

QUESTION 5

Q. Which one of the following is not a Biosphere reserve? [2005] [1995]

(a) Agasthyamali

(b) Anna Mallai

(c) Nilgiri

(d) Panchmarhi

Answer: b

So now that you have gone through the internationl efforts for Bio-Diversity Conservation, let us now take a look at some important national efforts as well. After going through this theory, we shall be analysing and solving some more previous year questions from this topic.

NATIONAL EFFORTS UNDER WILDLIFE PROTECTION ACT

• The Wildlife Protection Act, 1972 is an Act of the Parliament of India enacted for protection of plants and animal species. The Act established schedules of protected plant and animal species. The act provides for the protection of wild animals, birds and plants and matters connected with them, with a view to ensure the ecological and environmental security of India. Key provisions are:

• The act constitutes a National Board for Wildlife and also sets up National Tiger Conservation Authority specifically for conserving tiger.

• Four kinds of protected areas can be notified in the Act. These are:

✓ National Parks

✓ Conservation Reserves

✓ Wildlife Sanctuaries

✓ Community Reserves

National Park

• The National parks of India are IUCN category II protected areas.

• An area, whether within a sanctuary or not, can be notified by the state government to be constituted as a National Park, by reason of its ecological, faunal, floral, geomorphological, or zoological association or importance, needed to for the purpose of protecting & propagating or developing wildlife therein or its environment.

• National Parks act as an apt place for preserving animals by providing natural habitat and prey.

The anthropogenic activities like developmental activities, industrial activities, forestry, poaching, hunting, and cultivation are not permitted.

• The boundaries of National Parks are well defined and no private activities are allowed inside the National Park. The state governments with a notification can declare an area as National park. The state government can fix and alter boundaries of the National Parks with prior consultation and approval with National Board of Wildlife.

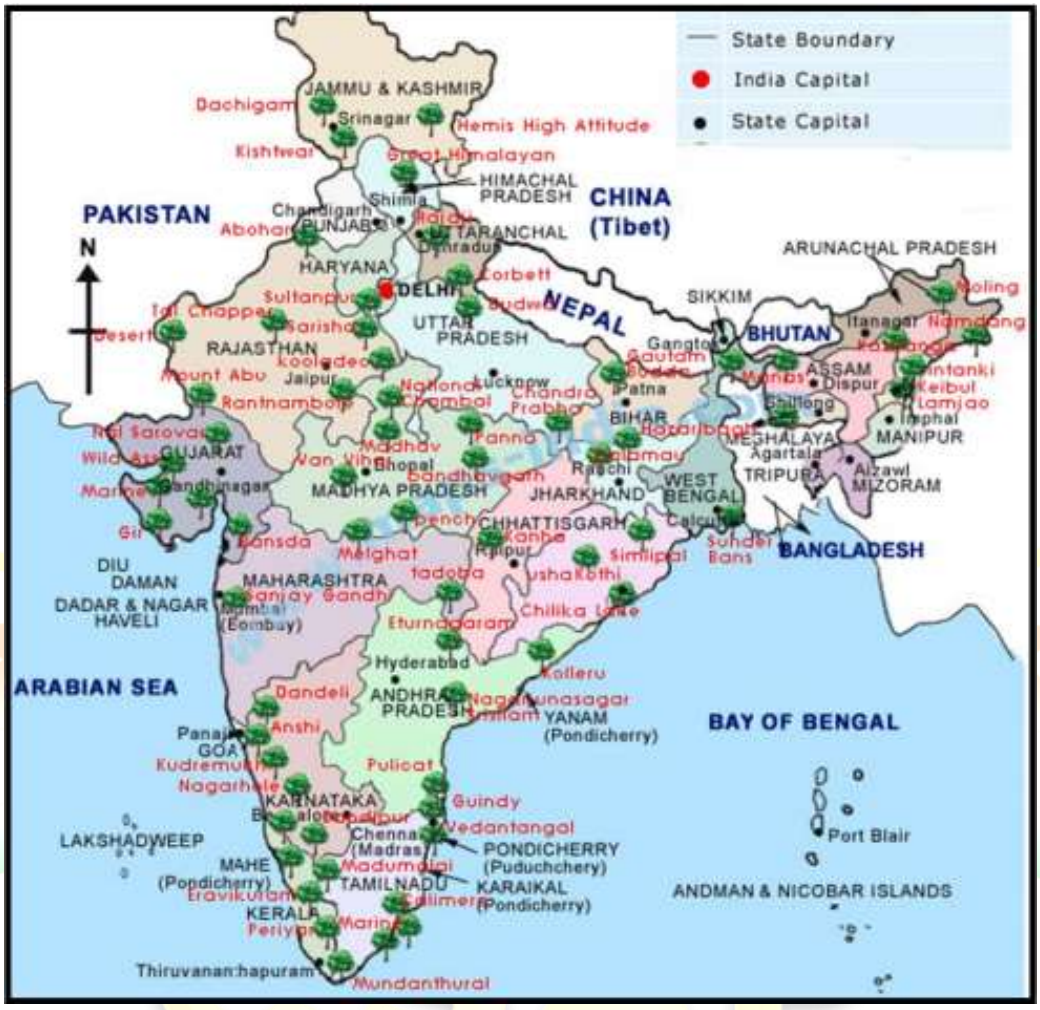
• India's first national park was established in 1935 as Hailey National Park, now known as Jim Corbett National Park. In 1972, India enacted the Wildlife Protection Act and Project Tiger to safeguard the habitats and conservation of endangered species. There are 104 existing national parks in India covering an area of 40,501 km^2, which is 1.23% of the geographical area of the country (Aug. 2018). MP has maximum national park i.e. 10.

National Parks in India

• National parks can be terrestrial or marine based.

• India boasts of several marine national parks which are hotspots of bio-diversity and home to number of marine creatures including Olive Ridley sea turtles, saltwater crocodile and a mediumsized marine mammal known as Dugong.

• Gulf of Kutch was first such park declared in 1980. The other 4 major parks are Mahatma Gandhi marine national park in Andaman and Nicobar, Malvan Marine Park in Maharashtra, Gulf of Mannar in Tamil Nadu and Bhitarkanika national Park in Odisha.



Wildlife Sanctuary

• Wildlife sanctuary: Wildlife Sanctuaries or wildlife refuges are home to various endangered species. They are safe from hunting, predation or competition. In a Sanctuary, the Chief Wildlife Warden may regulate, control or prohibit grazing. They are safeguarded from extinction in their natural habitat. Certain rights of people living inside the Sanctuary are permitted. Grazing,

firewood collection by tribals is allowed but strictly regulated. Settlements are not allowed (few exceptions: tribal settlements do exist constant; efforts are made to relocate them).

• A Sanctuary can be promoted to a National Park by government notification. A wildlife sanctuary is defined by State Government via a Notification. There is no need to pass a legislation (act) by the state assembly to declare a wildlife sanctuary. Fixation and alternation of boundary can be done by state legislature via resolution. No need to pass an act for alternation of boundaries. No alternation of boundaries in wildlife sanctuaries can be done without approval of the NBWL (National Board of Wildlife).

• There are 543 existing wildlife sanctuaries in India covering an area of 118,918 km2 , which is 3.62 % of the geographical area of the country (National Wildlife Database, June, 2017).

Community Reserve

• Community reserves act as buffer zones to or connectors and migration corridors between established national parks, wildlife sanctuaries and reserved and protected forests of India. These

protected area categories were first introduced in the Wildlife (Protection) Amendment Act of 2002 − the amendment to the Wildlife Protection Act of 1972.

• These categories were added because of reduced protection in and around existing or proposed protected areas due to private ownership of land, and land use.

• The state government may notify any community land or private land as Community reserve, provided that the members of the community or individuals concerned are agreeable to offer such area or voluntary demand declaring such area, for protecting flora and fauna as well as their traditions, cultures and practices.

• The reserve is maintained through a Community Reserve Management Committee.

• No change in land use pattern shall be made within the Community Reserve, except in accordance with resolution passed by the committee and approval of state government.

Conservation Reserve

• Conservation reserves in India are terms denoting protected areas of India which typically act as buffer zones to or connectors and migration corridors between established national parks, wildlife sanctuaries and reserved and protected forests of India.

• These protected area categories were first introduced in the Wildlife (Protection) Amendment Act of 2002 − the amendment to the Wildlife Protection Act of 1972. These categories were added because of reduced protection in and around existing or proposed protected areas due to private ownership of land, and land use.

• It is an area owned by state government, adjacent to national parks and sanctuaries. The state

government declares the area as conservation reserve after consultations with local communities.

Here, community rights are preserved.

• It is managed through Conservation Reserve and management committee.

• Tiruppadaimarathur conservation reserve in Tamil Nadu was the first such reserve undertaken by villagers to protect bird nesting in their village.

QUESTION 6

Q. In which one among the following categories of protected areas in India are local people not allowed to collect and use the biomass? [2012]

(a) Biosphere Reserves

(b) National Parks

(c) Wetlands declared under Ramsar Convention

(d) Wildlife Sanctuaries

Answer: b

QUESTION 7

Q. The most important strategy for the conservation of biodiversity together with traditional human life is the establishment of [2014]

(a) biosphere reserves

(b) botanical gardens

(c) national parks

(d) wildlife sanctuaries

Answer: a

QUESTION 8

Q. Consider the following statements: [2010]

1. The boundaries of a National Park are defined by legislation.

2. A Biosphere Reserve is declared to conserve a few specific species of flora and fauna.

3. In a Wildlife Sanctuary, limited biotic interference is permitted.

Which of the statements given above is / correct?

(a) 1 only

(b) 2 and 3 only

(c) 1 and 3 only

(d) 1, 2 and 3

Answer: c

QUESTION 9

Q. Which of the following National Parks is unique in being a swamp with floating vegetation that supports a rich biodiversity? [2015]

(a) Bhitarkanika National Park

(b) Keibul Lamjao National Park

(c) Keoladeo Ghana National Park

(d) Sultanpur National Park

Answer: b

QUESTION 10

Q. Consider the following pairs:

Protected area	**Well-known for**
1. Bhiterkanika, Odisha	Salt Water Crocodile
2. Desert National Park, Rajasthan	Great Indian Bustard
3. Eravikulam, Kerala	Hoolock Gibbon

Which of the pairs given above is/are correctly matched? [2010]

(a) 1 only

(b) 1 and 2 only

(c) 2 only

(d) 1, 2 and 3

Answer: b

QUESTION 11

Q. Two important rivers–one with its source in Jharkhand (and known by a different name in Odisha), and another, with its source in Odisha–merge at a place only a short distance from the coast of Bay of Bengal before flowing into the sea. This is an important site of wildlife and biodiversity and a protected area. Which one of the following could be this? [2011 - I]

(a) Bhitarkanika

(b) Chandipur-on-sea

(c) Gopalpur-on-sea

(d) Simlipal

Answer: a

QUESTION 12

Q. The first marine sanctuary in India, within its bounds coral reefs, mollusca, dolphins, tortoises and various kinds of sea birds, has been established in: [1999]

(a) Sundarbans ‘

(b) Chilka Lake

(c) Gulf of Kutch

(d) Lakshadweep

Answer: c

In addition to the biodiversity conservation efforts under Wildlife Protection Act, there are some other important efforts as well. These efforts are specific to a particular species.

Let us now learn about some of these important efforts and the questions that have been asked in their context.

OTHER EFFORTS

Tiger Reserve

The state government shall on recommendation of NTCA notify an area as a tiger reserve. They are areas that are notified for the protection of tiger and its prey and are governed by Project Tiger launched in 1973. In 1973, the Palamau Tiger Reserve, and 8 other tiger reserves were created in the country based on a ‘core-buffer’ strategy.

CORE ZONE

The core area is kept free of biotic disturbances and forestry operations, where collection of minor forest produce, grazing, human disturbances are not allowed within. These areas are required to be kept for the purposes of tiger conservation, without affecting the rights of the Scheduled Tribes or such other forest dwellers.

BUFFER ZONE

The Act defines buffer zone as the area peripheral to the critical tiger habitat or core area providing supplementary habitat for dispersing tigers, besides offering scope for co-existence of human activity (tribals). The limits of such areas are determined with the concerned Gram Sabha and an Expert Committee constituted for the purpose.

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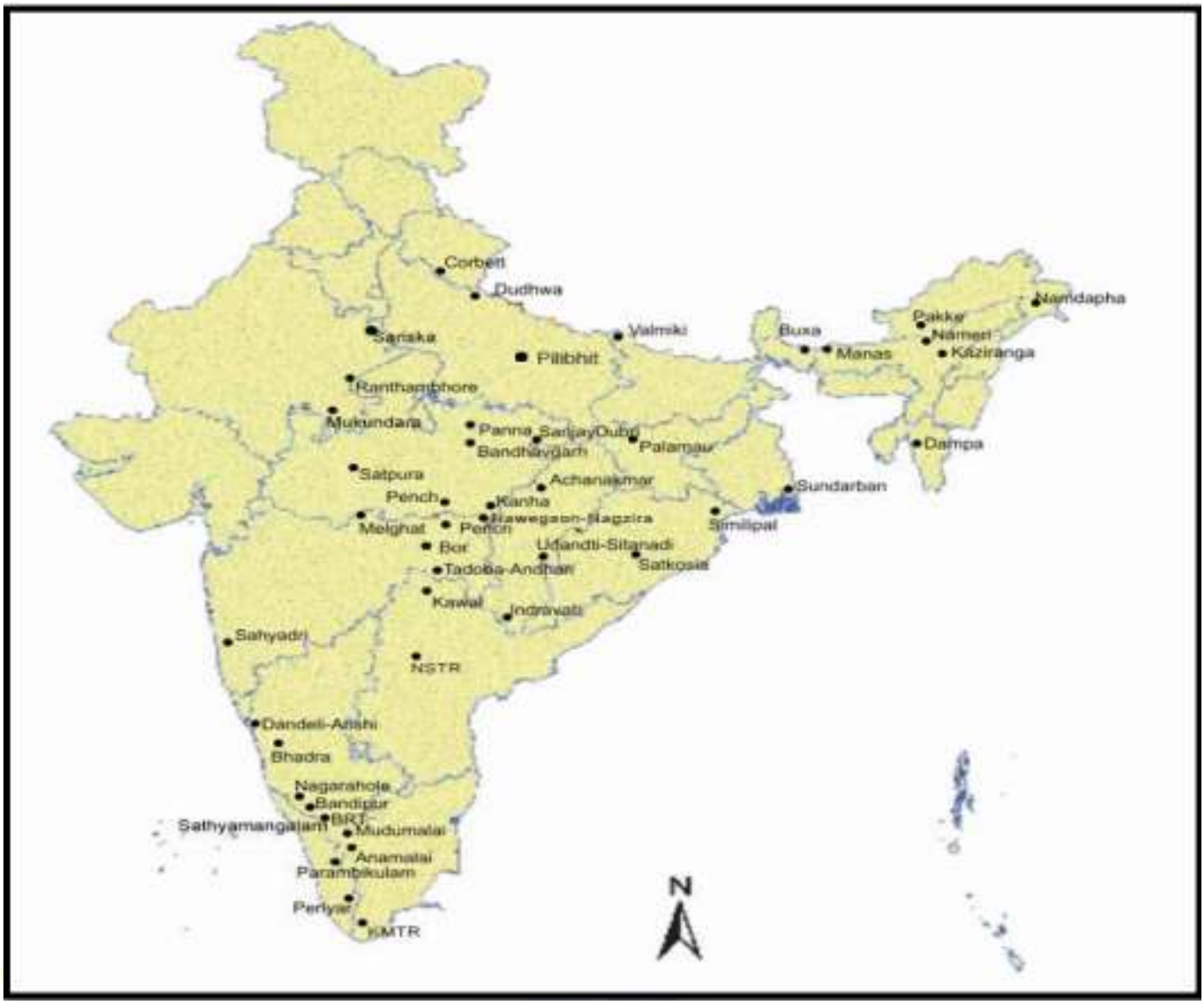
CIVIL SERVICES ACHIEVERS' POINT

A ONE STOP SOLUTION FOR UPSC/APSC/SSC & BANKING



Leadership through knowledge...

Sacred Groves

The Sacred Groves comprises of patches of forest or natural vegetation- from a few trees to forests of several acres-that are usually dedicated to local folk deities. The sacred groves are important repositories of flora and fauna diversity that have conserved by local communities in a sustainable manner. The degree of sanctity of the sacred forests varies from one grove to another. In some forests even the dry foliage and fallen fruits are not touched. People believe that any kind of disturbance will offend the local deity, causing diseases, natural calamities or failure of crops. For example, the Garo and the Khasi tribes of northeastern India completely prohibit any human interference in the sacred groves. In other groves, deadwood or dried leaves may be picked up, but the live tree or its branches are never cut. For example, the Gonds of central India prohibit the cutting of a tree but allow fallen parts to be used.

CLASSIFICATION OF SACRED GROVES

Traditional Sacred Groves – It is the place where the village deity resides, who is represented by an elementary symbol

Temple Groves – Here a grove is created around a temple and conserved. Groves around the burial or cremation grounds.

Sl.No.	State	Local term for Sacred Groves	No. of documented sacred groves
1	Andhra Pradesh	Pavithravana	580
2	Arunachal Pradesh	Gumpa Forests (Sacred Groves attached to Buddhist monestries)	101
3	Goa	Deorai, Pann	55
4	Jharkhand	Sarana	29
5	Kerala	Kavu, Sara Kavu	299
6	Maharashtra	Devrai, Devrahati, Devgudi	1559
7	Manipur	Gamkhap, Mauhak (sacred bamboo reserves)	166
8	Meghalaya	Ki Law Lyngdoh, Ki Law Kyntang, Ki Law Niam	101
9	Puducherry	Kovil Kadu	108
10	Rajasthan	Orans, Kenkris, Jogmaya	255
11	Tamil Nadu	Swami shola, Koilkadu	527
12	UttaraKhand	Deo Bhumi, Bugyal (sacred alpine meadows)	18
13	West Bengal	Garamthan, Harithan, Jahera, Sabitrithan, Santalburithan	39

Vulture Conservation efforts

• India has nine species of vultures in the wild. These are the Oriental White-backed Vulture (Gyps bengalensis), Slender billed Vulture (Gyps tenuirostris), Long billed Vulture (Gyps indicus), Egyptian Vulture (Neophronpercnopterus), Red Headed Vulture (Sarcogypscalvus), Indian Griffon Vulture (Gyps fulvus), Himalayan Griffon (Gyps himalayen), Cinereous Vulture (Aegypiusmonachus)

and Bearded Vulture or Lammergeier (Gypaetus barbatus).

• In 1998, observations and counts of vultures at Keoladeo National Park, Bharatpur indicated a decline in numbers of vultures. In 1999, the numbers dropped in India, Nepal and Pakistan. With later studies it was found that his was due to the diclofenac painkiller drug found as a residue in their kidneys.

• The government had released the "Vulture Recovery Plan" in 2006. The recovery plan put forward three major recommendations — diclofenac should be banned for veterinary use, a safe alternate for this drug should be found and conservation breeding programme should be initiated. The government took in-situ and ex-situ conservation techniques.

• Ex-situ : Vulture Breeding Centers

The vulture research facility at Pinjore, Haryana became Asia's first Vulture Conservation Breeding Centre in 2005. At present, India has four vulture breeding facilities at Rani, Guwahati (Assam),Pinjore (Haryana),Buxa (West Bengal), and Bhopal (Madhya Pradesh).There are four more centres that are managed by the Central Zoo Authority (CZA) in Junagarh in Gujarat, Nandankanan in Orissa, Hyderabad in Telangana and Muta in Ranchi. Vulture Restraunts have been set up where tables are reserved only for the unique and rare vultures by Maharashtra and Punjab forest departments.

• In-situ : Vulture Safety Zones (VSZ)

The concept of a VSZ is unique for the Asian continent but similar VSZ are in operation in both Europe and Africa. The aim of developing VSZs is to establish targeted awareness activities

surrounding 150 km radius of vultures' colonies so that no diclofenac or the veterinary toxic drugs are found in cattle carcasses, the main food of vultures(to provide safe food). The VSZ is spread around in several hundred kilometers covering the Jim Corbett in Uttarakhand, Dudhwa and Kartamiaghat forest reserves in UP which is adjoining the Indo-Nepal border. Other two are still being set up at Dibrugarh and Chattisgarh. These zones provide a safe source of food that is free of contamination from veterinary drugs, poisons and other agricultural chemicals and a place where vultures can feed free from human disturbances.

Marine Protected Areas (MPAs)

• A marine protected area (MPA) is essentially a space in the ocean where human activities are more strictly regulated than the surrounding waters – similar to parks we have on land. These places are given special protections for natural or historic marine resources by local, state, territorial, native, regional, or national authorities.

• MPAs restrict human activity for a conservation purpose, typically to protect natural or cultural resources. MPAs can be conserved for a number of reasons including economic resources, biodiversity conservation, and species protection.

• India has huge number of such marine protected areas in peninsular India and Island region. Some important regions are Coringa island (Andhra Pradesh), Pulicat lake and Gulf of Mannar in Tamil Nadu, Chorao Island (Goa), Gahhirmatha river, Bhitarkanika and Chilika lake in Odisha, sunderbans and Lothian islands in West Bengal, etc.

QUESTION 13

Q. From the ecological point of view, which one of the following assumes importance in being a good link between the Eastern Ghats and the Western Ghats?

(a) Sathyamangalam Tiger Reserve

(b) Nallamala Forest

(c) Nagarhole National Park

(d) Seshachalam Biosphere Reserve

Answer: a

QUESTION 14

Q. Consider the following protected areas: [2012]

1. Bandipur

2. Bhitarkanika

3. Manas

4. Sunderbans

Which of the above are declared Tiger Reserves?

(a) 1 and 2 only

(b) 1, 3 and 4 only

(c) 2, 3 and 4 only

(d) l, 2, 3 and 4

Answer: b

QUESTION 15

Q. . Consider the following pairs : [2014]

1. Dampa Tiger Reserve : Mizoram

2. Gumti Wildlife Sanctuary : Sikkim

3. Saramati Peak : Nagaland

Which of the above pairs is/are correctly matched?

(a) 1 only

(b) 2 and 3 only

(c) 1 and 3 only

(d) 1, 2 and 3

Answer: c

DO IT YOURSELF

QUESTION 16

Q. In which one of the following States is Pakhui Wildlife Sanctuary located? (2018)

(a) Arunachal Pradesh

(b) Manipur

(c) Meghalaya

(d) Nagaland

QUESTION 17

Q. Apart from these conservation efforts, some other efforts were taken by government which are species specific. Read about these.

(a) Project Elephant and Elephant corridors

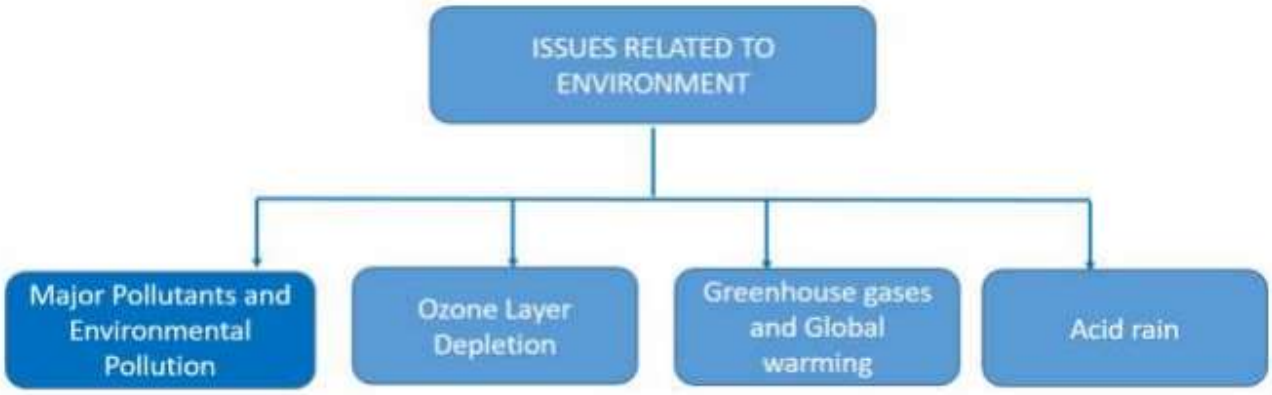
(b) Project Snow leopard

(c) Indian Crocodile Conservation Project

(d) Operation Olivia

VII. ISSUES RELATED TO ENVIRONMENT PART 1

In this chapter, we will be analysing the Previous Year UPSC Prelims Questions asked in context of Issues Related to Environment. let us first revise some of the important facts associated with it before we solve the question. This revision will allow you to answer the questions easily.

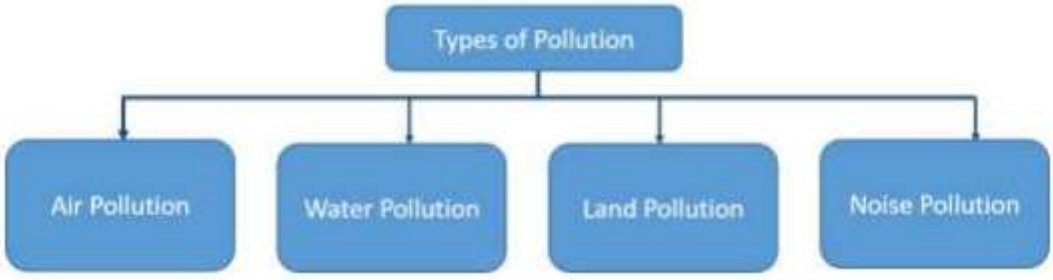


ENVIRONMENTAL POLLUTION

The introduction of contaminants into the natural environment that cause adverse change is referred to as environmental pollution. Pollution can take the form of chemical substances or energy, such as noise, heat or light. Pollutants, the components of pollution, can be either foreign substances/energies or naturally occurring contaminants.

TYPES OF POLLUTANTS

Primary Pollutants	Persist in the form in which they are added to the environment for ex .DDT, Plastic.
Secondary Pollutants	Formed by interaction among primary pollutants viz. PAN by interaction of NOx and Hydrogen.
Biodegradable Pollutants	Waste products which are degraded by microbial action for ex. Sewage.
Non-Biodegradable Pollutants	Not decomposed by microbial action for ex. Plastic, Glass, DDT, Radioactive substances.
Quantitative Pollutants	Occur in nature and become pollutant when their concentration reaches beyond a threshold level for ex. Co2, NOx.
Qualitative Pollutants	Do not occur in nature and are man-made for ex. Fungicides, herbicides, DDT.



TYPE OF POLLUTION

Air Pollution

Air pollution may be defined as the presence of any solid, liquid or gaseous substance

including noise and radioactive radiation in the atmosphere in such concentration that may be directly and/or indirectly injurious to humans or other living organisms, property or interferes with the normal environmental processes. Each year 5.7 lac deaths are caused due to poor air quality. This not only affects health of living organism but ecosystem as a whole. Air pollution affects metabolism and photosynthetic ability of plants. It is also a reason behind other environmental issues like acid rain, ozone layer depletion and global warming.

CAUSES OF AIR POLLUTION

Major Air Pollutant	Source	Features or Effects
CO	By incomplete combustion of fuels, Automobile exhaust, Cigarette smoke, forest fires	• Combines with haemoglobin to form carboxyhaemoglobin, which is highly stable & reduces oxygen carrying capacity of blood. • Slow our reflexes & make us confused & sleepy.
CO2	Fossil Fuels, burning of agricultural residue, volcanic eruption, respiration, forest fires.	Major greenhouse gas and causes global warming.
CFCs	Released mainly from air conditioning systems, aerosol sprays and refrigeration	Detrimental to Ozone layer present in the stratosphere.
O3 or Ozone gas	Formed when NOx particle from vehicle exhaust & volatile Hydrocarbons interact with each other in presence of sunlight (secondary pollutant).	• Useful in stratosphere as traps UV rays. • Toxic when present in troposphere. It also contributes to Greenhouse effect.
SPM in form of dust and soot (<10µm)	Major source of SPM (suspended particulate matter) are vehicles, power plants, construction activities, oil refinery, railway yard, market place, industries, etc.	According to Central Pollution Control Board (CPCB), particulate size 2.5 µm or less in diameter (PM 2.5) are responsible for causing the greatest harm to human health. These cause breathing and respiratory symptoms, irritation, inflammations and pneumoconiosis.

SO2	Produced from burning coal (60 %), mainly in thermal power plants + Petroleum products + in production of paper & smelting of metals	• Major contributor to smog causing lung diseases • Contributes to formation of acid rain.
CH4	Burning of agricultural residue and fossil fuels.	Greenhouse gas contributes to global warming.
Lead	Present in petrol, diesel, lead batteries, paints, hair dye products etc. (Affects children in particular)	Use: Tetraethyl lead (TEL) is used as an anti-knock agent in petrol for smooth and easy running of vehicles. Disadvantages: Damages nervous system & cause digestive problems & in some cases causes cancer. Lead affects children in particular. If inhaled it produces injurious effects on kidney and liver and interferes with development of red blood cells.
NOx	Automobile exhaust, coal burning thermal plants, lightning	• NO_3^- acts as a fertilizer to the soil. • Damages plant leaves & retard rate of photosynthesis. • In Humans causes red haze & lung irritation. • Reacts to forms ozone, photochemical smog and acid rain.

Classical Smog or smog	Vehicular exhaust and from chimneys of industries	• Occurs in cool humid climate • Lowers visibility • Respiratory issues Also called reducing smog
VOCs Volatile organic compounds	The main indoor sources are perfumes, hair sprays, furniture polish, glues, air fresheners, moth repellents, wood preservatives, and other products.	Health hazards: Irritation of the eye, nose and throat, headaches, nausea and loss of coordination, suspected to damage the liver and other parts of the body.
Formaldehyde	Mainly from carpets, particle boards & insulation foam	Causes irritation & skin allergies.
Radon	A gas naturally emitted by soil and due to poor ventilation may be trapped in house	lung cancer
Fly ash	Thermal plants Health hazards: Irritation of the eye, nose and throat, headaches, nausea and loss of coordination, suspected to damage the liver and other parts of the body.	• Advantages : Used in making bricks and cements • Disadvantages: Retards photosynthesis and lowers plant yield.
Photochemical Smog or Los Angeles Smog or Summer Smog (secondary pollutant) NOx + O3 + PAN	It is a secondary pollutant, resulting when two pollutants, nitrogen oxide and hydrocarbons from automobile exhausts, react with one another in the presence of sunlight to produce nitrogen dioxide (N02), ozone (03) and a compound called PAN	• Cause serious health problems, severe plant damage, cracking of rubber & corrosion • Use of Catalytic Converter can prevent release of NO & HC to environment.

	(Peroxyl Acetyl Nitrate).	
PAN (Peroxyacetyl Nitrates) (secondary pollutant)	HC+ NOx + Sunlight	• Causes irritation & allergies

EFFORTS TO REDUCE AIR POLLUTION

• Control of indoor air pollution: Use of wood and dung cakes should be replaced by cleaner fuels such as biogas, kerosene, LPG or electricity. But supply of electricity is limited. Similarly kerosene is also limited. The use of solar cookers must be encouraged. (Targeted by PM Ujjwala scheme)

• Control of Industrial and vehicular Pollution:

✓ Use of cleaner fuels such as liquefied natural gas (LNG) in power plants, fertilizer plants etc. which is cheaper in addition to being environmentally friendly.

✓ Installing devices which reduce release of pollutants like filters, electrostatic precipitators, inertial collectors, scrubbers, gravel bed filters or dry scrubbers.

• Legislative actions:

✓ Implementation of Bharat Emission standards to reduce sulphur and Hydrocarbon content in petrol and diesel.

✓ Passage of EPA act, 1986 and Air pollution act, which came into force in 1981.

• Special indices to measure air pollution and create awareness among public.

MEASURING AIR POLLUTION: AIR POLLUTION INDICES

NATIONAL AIR QUALITY INDEX

• AQI is a colour coded index used to communicate to the public how polluted the air currently is or how polluted it is forecasted to become.

• AQI can be used to represent eight pollutants that pose a threat to human health. These pollutants are: Ground-level Ozone or O3, Particulate Matter (soot and dust) or PM 2.5 and PM 10, Carbon Monoxide or CO, Sulphur Dioxide or SO2, Nitrogen Dioxide or NO2, ammonia or NH3 and lead or Pb.

• The pollutants in the affected air are given a weight based on a formula.

• It was launched by MOEF in 2015 as part of Swachh Bharat Abhiyan.

AQI Category (Range)	PM_{10} 24-hr	$PM_{2.5}$ 24-hr	NO_2 24-hr	O_3 8-hr	CO 8-hr (mg/m^3)	SO_2 24-hr	NH_3 24-hr	Pb 24-hr
Good (0-50)	0-50	0-30	0-40	0-50	0-1.0	0-40	0-200	0-0.5
Satisfactory (51-100)	51-100	31-60	41-80	51-100	1.1-2.0	41-80	201-400	0.5 -1.0
Moderately polluted (101-200)	101-250	61-90	81-180	101-168	2.1- 10	81-380	401-800	1.1-2.0
Poor (201-300)	251-350	91-120	181-280	169-208	10-17	381-800	801-1200	2.1-3.0
Very poor (301-400)	351-430	121-250	281-400	209-748*	17-34	801-1600	1200-1800	3.1-3.5
Severe (401-500)	430 +	250+	400+	748+*	34+	1600+	1800+	3.5+

NATIONAL AMBIENT AIR QUALITY STANDARDS

• National Ambient Air Quality Standards are the standards for ambient air quality set by the Central Pollution Control Board (CPCB) that is applicable nationwide.

• The CPCB has been conferred this power by the Air (Prevention and Control of Pollution) Act, 1981.

• The NAAQS have been revisited and revised in November 2009 for 12 pollutants, which include: sulphur dioxide (S02), nitrogen dioxide (NO2), particulate matter having micron (PM10), particulate matter having size less than 2.5 micron (PM2.5), ozone, lead, carbon monoxide (CO), arsenic, nickel, benzene, ammonia, and BenzoPyrene (BaP).

SAFAR

• SAFAR stands for System of Air Quality and Weather Forecasting And Research

• It is launched in greater metropolitan cities of India to provide location specific information on air quality. It is an early warning system on weather parameters (72 hour advance forecast).

• It was developed indigenously by Indian Institute of Tropical Meteorology (IITM), Pune and operationalized by India Meteorological Department (IMD).

• Pollutants monitored: PM1, PM2.5, PM10, Ozone, CO, NOx (NO, NO2), SO2, BC, Methane (CH4), Non-methane hydrocarbons (NMHC), VOC's, Benzene, Toluene, Xylene Mercury and Black carbon.

• Meteorological Parameters: UV index, Rainfall, temperature, rainfall, humidity, wind speed and wind direction

QUESTION 1

Q. Which one of the following is produced during the formation of photochemical smog? [2003]

(a) Hydrocarbons

(b) Nitrogen Oxide

(c) Ozone

(d) Methane

Answer: c

QUESTION 2

Q. Consider the following: [2011]

1. Carbon dioxide

2. Oxides of nitrogen

3. Oxides of sulphur

Which of the above is/are the emission/emissions from coal combustion at thermal power plants?

(a) 1 only

(b) 2 and 3 only

(c) 1 and 3 only

(d) 1, 2 and 3

Answer: d

QUESTION 3

Q. In the cities of our country, which among the following atmospheric gases are normally

considered in calculating the value of Air Quality Index?

1. Carbon dioxide

2. Carbon monoxide

3. Nitrogen dioxide

4. Sulphur dioxide

5. Methane

Select the correct answer using the code given below.

(a) 1, 2 and 3 only

(b) 2, 3 and 4 only

(c) 1, 4 and 5 only

(d) 1, 2, 3, 4 and 5

Answer: b

Water Pollution

• Water pollution is the addition/presence of undesirable substances to/in water such as organic, inorganic, biological, radiological, heat, which degrades the quality of water so that it becomes unfit for use.

• Water pollution is caused by a variety of human activities such as industrial, agricultural and domestic. Natural sources of pollution of water are soil erosion, leaching of minerals from rocks and decaying of organic matter. Pollutants enter the water environment from two main types of sources.

TYPES OF SOURCES OF WATER POLLUTION

• Point sources: A point source is a single, identifiable source of pollution, such as a pipe or a drain. Industrial wastes are commonly discharged to rivers and the sea in this way.

• Non Point Sources: Non-point sources of pollution are often termed 'diffuse' pollution and refer to those inputs and impacts which occur over a wide area and are not easily attributed to a single source. They are often associated with particular land uses or run-offs from agricultural fields, grazing lands, construction sites, abandoned mines and pits, roads and streets. It is hard to be controlled.

SOURCE OF WATER POLLUTION AND IMPACT

• Sewage Waste

Sewage water include discharges from houses, commercial and industrial establishments connected to public sewerage system. The sewage contains human and animal excreta, food residues, cleaning agents, detergents and other wastes. Domestic and hospital sewage contain many undesirable pathogenic microorganisms, and its disposal into a water without proper treatment.

• Industrial waste

The industries discharge several inorganic and organic pollutants, which may prove highly toxic to the living beings. Discharge of waste water from industries like petroleum, paper manufacturing, metal extraction and processing, chemical manufacturing, iron and steel, etc., that release toxic substances, notably, heavy metals (defined as elements with density > 5 g/cm3 such as mercury, cadmium, copper, lead, arsenic), variety of acids and alkalis, etc.

Thermal pollution

Power plants – thermal and nuclear, chemical and other industries use lot of water for cooling purposes and the used hot water is discharged into rivers, streams or oceans. Discharge of hot water may increase the temperature of the receiving water by 10 to 15 °C above the ambient water temperature. This is thermal pollution. Increase in water temperature decreases dissolved oxygen in water which adversely affects aquatic life.

Groundwater Pollution

✓ In India at many places, the ground water is threatened with contamination due to seepage from industrial and municipal wastes and effluents, sewage channels and agricultural runoff. Pollutants like fluorides, uranium, heavy metals and nutrients like nitrates and phosphates are common in many parts of India.

✓ Dissolved nitrates commonly contaminate groundwater. Excess nitrate in drinking water reacts with haemoglobin to form non-functional methaemoglobin, and impairs oxygen transport. This condition is called methaemoglobinemia or blue baby syndrome.

✓ In India and Bangladesh [Ganges Delta], millions of people are exposed to groundwater contaminated with high levels of arsenic, a highly toxic and dangerous pollutant. Chronic exposure to arsenic causes black foot disease. It also causes diarrhoea, peripheral neuritis, hyperkeratosis and also lung and skin cancer.

✓ Excess fluoride in drinking water causes neuromuscular disorders, gastro-intestinal problems,

teeth deformity, hardening of bones and stiff and painful joints (skeletal fluorosis).

SOURCE AND EFFECTS OF WATER POLLUTION

Radiation pollution

✓ Nuclear accidents near water bodies or during natural calamities like tsunami and earthquakes poses the risk of radiation leakage (radiation exposure) into water bodies. E.g. Fukushima Daiichi nuclear disaster.

✓ Radiation exposure causes mutations in DNA of marine organisms. If those mutations are not repaired, the cell may turn cancerous.

Oil spills

The most common cause of oil spill is leakage during marine transport and leakage form underground storage tanks. Oil spill could occur during off shore oil production as well. Oil being lighter than water covers the water surface as a thin film cutting off oxygen to floating plants and other producers. Within hours of oil spill, the fishes, shellfish, plankton die due to suffocation and metabolic disorders.

Invasive Species

They grow abundantly in eutrophic water bodies, and lead to an imbalance in the ecosystem dynamics of the water body. They cause havoc by their excessive growth leading to stagnation of polluted water. For example Water Hyacinth in West Bengal.

Agricultural run-off

✓ Agricultural runoff contains dissolved salts such as nitrates, phosphates, ammonia and other nutrients, and toxic metal ions and organic compounds.

✓ Fertilizers contain major plant nutrients such as nitrogen, phosphorus and potassium. Excess fertilizers may reach the ground water by leaching or may be mixed with surface water of rivers, lakes and ponds by runoff and drainage.

✓ Pesticides include insecticides, fungicides, herbicides, nematicides, rodenticides and soil fumigants. They contain a wide range of chemicals such as chlorinated hydrocarbons (CHCs. E.g. DDT, Endosulfan etc.), organophosphates, metallic salts, carbonates, thiocarbonates, derivatives of acetic acid Many of the pesticides are non-degradable and their residues have long life.

✓ The animal excreta such as dung, wastes from poultry farms, piggeries and slaughter houses etc. reach the water though run off and surface leaching during rainy season.

✓ A major impact of this nutrient rich agricultural run-off is eutrophication.

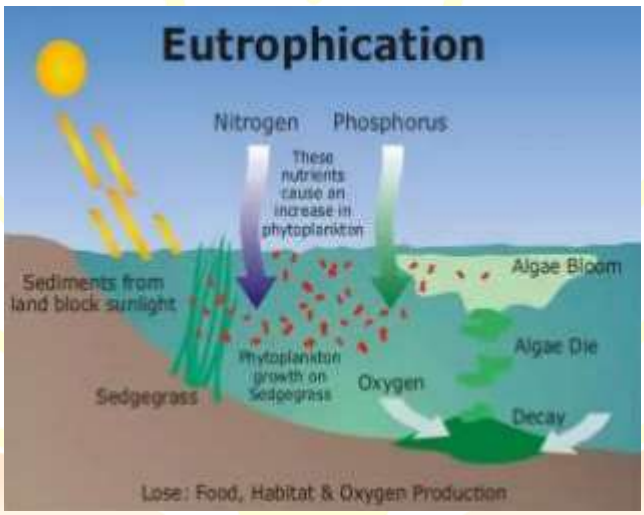
Eutrophication

✓ Eutrophication is an enrichment of water by nutrient salts mainly nitrogen and phosphorus that causes structural changes to the ecosystem such as: increased production of algae and aquatic plants, depletion of fish species, general deterioration of water quality and other effects that reduce and preclude use.

✓ It is characterised by a significant increase of algae (algal bloom) due to the greater availability of one or more growth factors necessary for photosynthesis, such as sunlight, carbon dioxide and nutrients (nitrogen and phosphorus). To destroy all the dead algae, an excessive c environment causing

death of plants and animals and increase in growth of anaerobic organisms.

Consumption of oxygen is required, in some cases almost total, by microorganisms. This creates O_2 deficient



Algal Bloom

An algal bloom or algae bloom is a rapid increase or accumulation in the population of algae in freshwater or marine water systems, and is recognized by the discoloration in the water from their pigments. It is characterised by green, yellowish-brown, or red patches in sea. The red tides in oceans are associated with algal bloom. As more algae and plants grow, others die. This dead organic matter becomes food for bacteria that decompose it. With more food available, the bacteria increase in number and use up the dissolved oxygen in the water. When the dissolved oxygen content decreases, many fish and aquatic insects cannot survive. This results in a dead area. The causes of increase in Nutrients can be natural or manmade.

✓ Manmade causes:

• Run-off rich in chemicals

• Use of excess fertilisers for crop cultivation.

• Discharge of chemical rich waste from industries

✓ Natural causes:

• Upwelling - It is an oceanographic phenomenon that involves wind-driven motion of dense, cooler, and usually nutrient-rich water towards the ocean surface, replacing the warmer, usually nutrient-depleted surface water. The nutrient-rich upwelled water stimulates the growth and reproduction of primary producers such as phytoplankton.

MEASURING WATER POLLUTION

In India, the Central Pollution Control Board (CPCB), an apex body in the field of water quality management, has developed a concept of "designated best use". The quality is measured on the basis of pH; dissolved oxygen, mg/1 BOD or COD; total coliform (MPN/100ml); free ammonia mg/l; electrical conductivity etc. Presence of organic and inorganic wastes in water decreases the dissolved Oxygen (DO) content of the water.

Water having DO content below 8.0 mg/L may be considered as contaminated. Water having DO content below 4.0 mg/L is considered to be highly polluted.

BOD: BIOLOGICAL OXYGEN DEMAND

BOD is a measure of, the amount of oxygen that require for the bacteria to degrade the organic components present in water / waste water. It is expressed in milligrams of oxygen per litre of water.

The higher value of BOD indicates low DO content of water. Since BOD is limited to biodegradable materials. Therefore, it is not a reliable method of measuring pollution load in water.

COD: CHEMICAL OXYGEN DEMAND

Chemical oxygen demand (COD) is a slightly better mode used to measure pollution load in water. COD measures the amount of oxygen in parts per million required to oxidize organic (biodegradable and non-biodegradable) and oxidizable inorganic compounds in the water sample. BOD/COD ratio is a measure of food value. If the ratio is higher, it has higher food and less toxicity. COD is higher than BOD.

QUESTION 4

Q. Which of the following can be found as pollutants in the drinking water in some parts of India? [2013]

1. Arsenic
2. Sorbitol
3. Fluoride
4. Formaldehyde
5. Uranium

Select the correct answer using the codes given below.

(a) 1 and 3 only

(b) 2, 4 and 5 only

(c) 1, 3 and 5 only

(d) 1, 2, 3, 4 and 5

Answer: c

QUESTION 5

Q. Biological Oxygen Demand (BOD) is a standard criterion for

(a) Measuring oxygen levels in blood

(b) Computing oxygen levels in forest ecosystems

(c) Pollution assay in aquatic ecosystems

(d) Assessing oxygen levels in high altitude regions

Answer: c

QUESTION 6

Q. There is a concern over the increase in harmful algal blooms in the seawaters of India. What could be the causative factors for this phenomenon? [2011]

1. Discharge of nutrients from the estuaries.

2. Run-off from the land during the monsoon.

3. Upwelling in the seas.

Select the correct answer from the codes given below:

(a) 1 only

(b) 1 and 2 only

(c) 2 and 3 only

(d) 1, 2 and 3

Answer: d

QUESTION 7

Q. Estuaries possess distinct blooms of excessive growth of a pigmented dinoflagellates. These blooms are called [1998]

(a) red tides

(b) sea tides

(c) black tides

(d) sea flowers

Answer: a

So now you must have understood that pollution is one of the gravest issue of the environment and it can take various forms. In this section we have learnt about Air & Water Pollution.

In addition to the there are some other types as well. Lets us take a look at them and see what kinds of questions have been asked in previous year UPSC Prelims.

We will also learn about the management techniques related to them and try to solve the questions that have been asked in their context.

Soil Pollution

• Soil pollution is defined as 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 main reason why the soil becomes contaminated is due to the presence of man-made waste.

These wastes include e-waste, radioactive wastes from nuclear plants, bio-medical waste (Any

waste which is generated during the diagnosis, treatment or immunization of human beings or animals or in research activities pertaining there to or in the production or testing of biologicals) and inorganic wastes discharged from factories and industries. It can be biodegradable or nonbiodegradable waste.

• There are two main ways to manage waste i.e. bioremediation and phyto-remediation. The bacterium Deinococcus radiodurans has been used to detoxify toluene and ionic mercury which are released from radioactive nuclear waste.

E-WASTE

• Electronic waste, or e-waste, is a term for electronic products that have become unwanted, obsolete, and have reached the end of their useful life. It refers to all items of electrical and electronic equipment (EEE) and its parts that have been discarded by its owner as waste without the intent of re-use.

• Major chemicals released include arsenic (black-foot disease), barium, cadmium (Itai-Itai disease), cobalt, lead, mercury (Minamata disease), PCBs, silver, beryllium, plastic, chromium, brominated flame, etc.

WASTE MANAGEMENT TECHNIQUES

• Bioremediation

Bioremediation is the use of microorganisms (bacteria and fungi) to degrade the environmental contaminants into less toxic forms. The microorganisms may be indigenous to a contaminated area (insitu) or they may be isolated from elsewhere and brought to the contaminated site (ex-situ).

Advantages of Bioremediation

✓ Bioremediation is a natural process.

✓ It is cost effective.

✓ Toxic chemicals are destroyed or removed from environment and not just merely separated.

✓ Low capital expenditure.

✓ Less energy is required as compared to other technologies

✓ Less manual supervision.

Disadvantages of Bioremediation

✓ The process of bioremediation is slow.

✓ Heavy metals are not removed.

✓ For in-situ bioremediation site must have soil with high permeability.

✓ It does not remove all quantities of contaminants.

✓ Substantial gaps exist in the understanding of microbial ecology, physiology and genetic expression and site expression and site engineering.

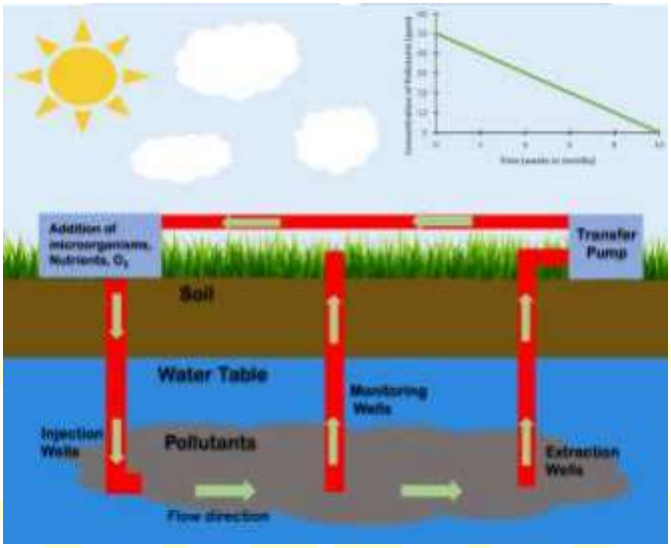
✓ A stronger scientific base is required for rational designing of process and success.

• In-situ Bioremediation

Bioventing: Supply of air and nutrients through wells to contaminated soil to stimulate the growth of indigenous bacteria. It is used for simple hydrocarbons and can be used where the contamination is deep under the surface.

Biosparging: Injection of air under pressure below the water table to increase groundwater oxygen concentrations and enhance the rate of biological degradation of contaminants by naturally occurring bacteria

Bio augmentation: Microorganisms are imported to a contaminated site to enhance degradation process.



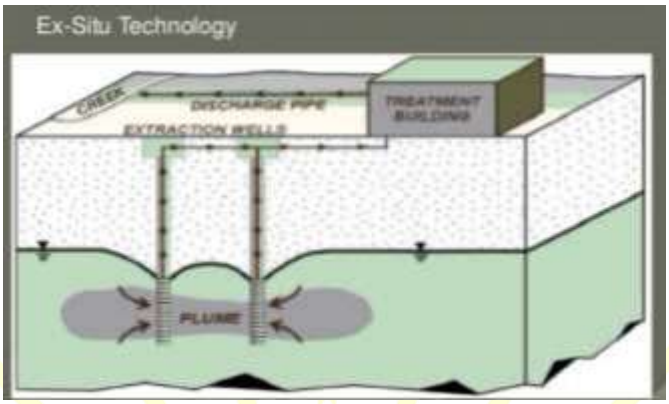
• Ex-situ Bioremediation

Land farming: Contaminated soil is excavated and spread over a prepared bed and periodically tilled until pollutants are degraded. The goal is to stimulate indigenous biodegradative microorganisms and facilitate their aerobic degradation of contaminants.

Composting: Combing contaminated soil with organic amendments like manure for faster decay.

Biopiles: it is a hybrid of land farming and composting. Essentially, engineered cells are constructed as aerated composted piles. Typically used for treatment of surface contamination with petroleum hydrocarbons.

Bioreactors: Soil and water are pumped up from a contaminated plume and processed through an engineered system. Degradation here is faster due to controlled conditions.



• Phytoremediation

Phytoremediation is use of plants to remove contaminants from soil and water. Natural phytoremediation is carried out by mangroves, estuarine vegetation and other wetland vegetation.

It is a:

✓ A low cost, solar energy driven clean-up technique.

✓ Most useful at sites with shallow, low levels of contamination.

✓ Useful for treating a wide variety of environmental contaminants.

✓ Phytoremediation can be applied for producing energy from controlled combustion of harvested biomass or extracting valuable metals from soil.

Phytotechnology	Mechanism	Pollutants	Plants
Phytoextraction	Hyperaccumulation in harvestable parts of plants	Inorganic: Co, Cr, Ni, Pb, Zn, Au, Hg, Mo, Ag, Cd Radionuclides: Sr, Cs, Pb, U	*Brassica juncea, Thalspi caerules-cens, Helianthus annus*
Rhizofilteration	Rhizosphere accumula-tion though sorption, concentration and precipitation	Organics/Inorganics: Metals like Cd, Cu, Ni, Zn,Cr Radionuclides	*Brassica juncea, Helianthus annus,* Tobacco, Rye, Spinach and Corn
Phytovolatilization	Volatilization by leaves through transpiration	Organics/Inorganics: Chlorinated solvents, inorganics (Se, Hg, As)	*Arabidopsis thaliana,* Poplars, Alfalfa, *Brassica juncea*
Phytodegradation	Pollutant eradication	Organic compounds, Chlorinated solvents, Phenols, Herbicides, Munitions	Hybrid poplars, Stonewort, Black willow, Algae
Phytostabilization	Complexation, sorption and precipitation	Inorganics: As, Cd, Cu, Cr, Pb, Zn, Hs	*Brassica juncea,* Hybrid poplars, Grasses

Phytoremediation Technologies

✓ Phytoextraction/phytoaccumulation: plants accumulate contaminants into the roots and aboveground shoots or leaves.

✓ Phytotransformation/phytodegradation: uptake of organic contaminants from soil, and their transformation to more stable, less toxic, less mobile form.

✓ Phytostabilization: plants reduce the mobility and migration of contaminated soil. Leachable constituents are adsorbed and bound into the plant structure.

✓ Rhizodegradation: breakdown of contaminants through the activity existing in the rhizosphere (region of soil in the vicinity of plant roots). This activity is due to the presence of proteins and enzymes produced by the plants or by soil organisms such as bacteria, yeast, and fungi.

✓ Rhizofiltration: water remediation technique that involves the uptake of contaminants by plant

roots. Rhizofiltration is used to reduce contamination in natural wetlands and estuary areas (E.g. Mangroves).

Noise Pollution

• Disturbing or excessive noise is described as noise pollution. It's a loud non-harmonious vibrations that are unpleasant to hear. Usually sound measured in decibels (dB) and there is a decibel scale to measure noise pollution and its levels.

• Upto 20 dB is considered as whisper, 40 dB quiet office, 60 dB normal conversation, above 80 dB is considered as noise pollution on decibel scale.

• Noise pollution is having too many ill-effects on life. It may cause fatigue, permanent deafness, it may develop crack in physical buildings, abortions in pregnant women and prolonged exposure may lead to mental disorders.

• We can control noise pollution by isolating noise and noise sources. At the individual level we should reduce volume to reduce noise pollution. It can also be reduced by planting trees, using proper lubrication and maintenance of machinery, using ear plugs, etc.

QUESTION 8

Q. In the context of solving pollution problems, what is/are the advantage/advantages of bioremediation technique? [2017]

1. It is a technique for cleaning up pollution by enhancing the same biodegradation process that occurs in nature.

2. Any contaminant with heavy metals such as cadmium and lead can be readily and

completely treated by bioremediation using microorganisms.

3. Genetic engineering can be used to create microorganisms specifically designed for bioremediation.

Select the correct answer using the code given below:

(a) 1 only

(b) 2 and 3 only

(c) 1 and 3 only

(d) 1, 2 and 3

Answer: c

QUESTION 9

Q. Due to improper/ indiscriminate disposal of old and used computers or their parts, which of the following are released into the environment as e-waste? [2013]

1. Beryllium

2. Cadmium

3. Chromium

4. Heptachlor

5. Mercury

6. Lead

7. Plutonium

Select the correct answer using the codes given below.

(a) 1, 3, 4, 6 and 7 only

(b) 1, 2, 3, 5 and 6 only

(c) 2, 4, 5 and 7 only

(d) 1, 2, 3, 4, 5, 6 and 7

Answer: b

DO IT YOURSELF

QUESTION 10

Q. Which of the following are some important pollutants released by steel industry in India? [2014]

1. Oxides of sulphur

2. Oxides of nitrogen

3. Carbonmonoxide

4. Carbondioxide

Select the correct answer using the code given below.
(a) 1, 3 and 4 only

(b) 1 and 3 only

(c) 1 and 4 only

(d) 1, 2, 3 and 4

VIII. ISSUES RELATED TO ENVIRONMENT PART 2

QUESTION 1

Q. Consider the following statements about Chlorofluorocarbons, known as ozone-depleting substances, are used [2012]

1. In the production of plastic foams

2. In the production of tubeless tyres

3. In cleaning certain electronic components

4. As pressurizing agents in aerosol cans

Which of the statements given above is/are correct?

(a) 1, 2 and 3 only

(b) 4 only

(c) 1, 3 and 4 only

(d) 1, 2, 3 and 4

Answer: c

EXPLANATION

OZONE LAYER DEPLETION

Ozone layer

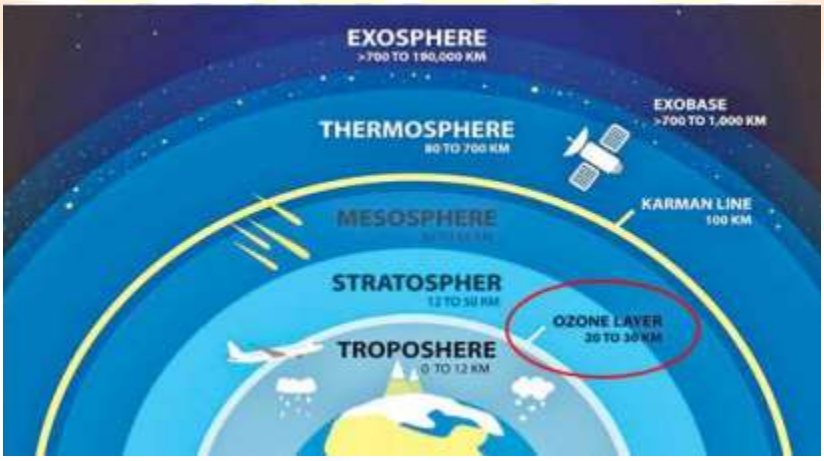
Ozone is a form of oxygen that has three atoms (O3) rather than the more common two atoms (O2). Ozone constitutes only less than 0.002 percent of the volume of the atmosphere. It is created in the upper atmosphere by the action of solar radiation on oxygen molecules. It is found in the form of a thin

layer in the stratosphere between 15 to 48 kilo meters. It strongly absorbs ultraviolet radiation from the sun.

Ozone layer Depletion

When chlorine and bromine atoms come into contact with ozone in the stratosphere, they destroy ozone molecules. One chlorine atom can destroy over 100,000 ozone molecules before it is removed from the stratosphere. Ozone can be destroyed more quickly than it is naturally created.

Some compounds release chlorine or bromine when they are exposed to intense UV light in the stratosphere. These compounds contribute to ozone depletion, and are called ozone-depleting substances (ODS).



Ozone Depleting Substances

Ozone depleting substances are chemicals that destroy the earth's protective ozone layer. They include:

• Chlorofluorocarbons (CFCs)

• Halon

• Carbon tetrachloride (CCl4)

• Methyl chloroform (CH3CCl3)

• Hydro-bromo-fluoro-carbons (HBFCs)

• Hydro-chloro-fluoro-carbons (HCFCs)

• Methyl bromide (CH3Br)

• Bromo-chloromethane (CH2BrCl)

All these have different potentials to deplete ozone layer measures in terms of ozone layer depletion potential.

Ozone Depleting Substances Sources

The main uses of ozone depleting substances include:

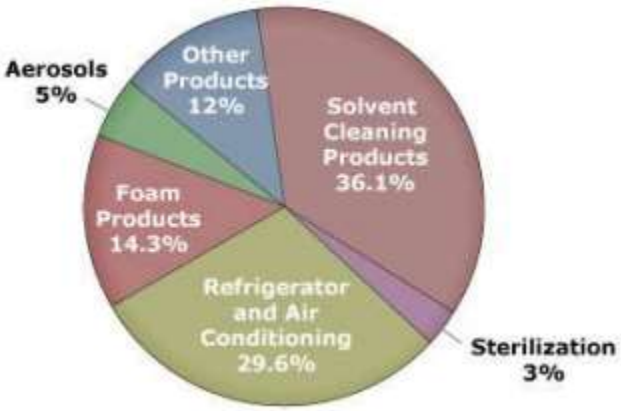
• CFCs and HCFCs in refrigerators and air conditioners,

• HCFCs and halons in fire extinguishers,

• CFCs and HCFCs in foam,

• CFCs and HCFCs as aerosol propellants, and

• Methyl bromide for fumigation of soil, structures and goods to be imported or exported.



QUESTION 2

Q. The formation of ozone hole in the Antarctic region has been a cause of concern. What could be the reason for the formation of this hole? [2011]

(a) Presence of prominent tropospheric turbulence and inflow of chlorofluorocarbons.

(b) Presence of prominent polar front and stratospheric clouds and inflow of chlorofluorocarbons.

(c) Absence of polar front and stratospheric clouds and inflow of methane and chlorofluorocarbons.

(d) Increased temperature at polar region due to global warming.

Answer: b

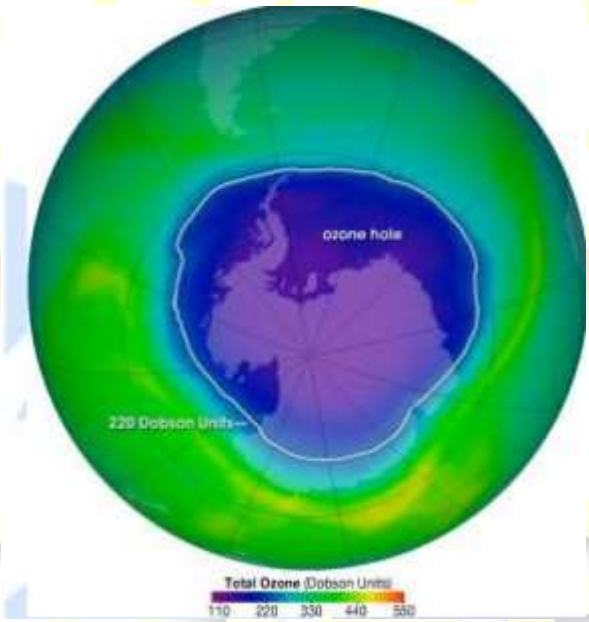
EXPLANATION

OZONE LAYER DEPLETION

Ozone depletion or ozone hole refer to the damage suffered by the ozone layer due to natural and anthropogenic causes. There is a steady decline of about 4% in the total volume of ozone in Earth's stratosphere. Much larger decrease in stratospheric ozone is observed around Earth's polar regions.

The thickness of the ozone in a column of air from the ground to the top of the atmosphere is measured in terms of Dobson units (DU).

The ozone hole is defined geographically as the area wherein the total ozone amount is less than 220 Dobson Units. It is a region of exceptionally depleted ozone in the stratosphere over the Antarctic that happens at the beginning of Southern Hemisphere spring (August–October).



Formation of Ozone hole

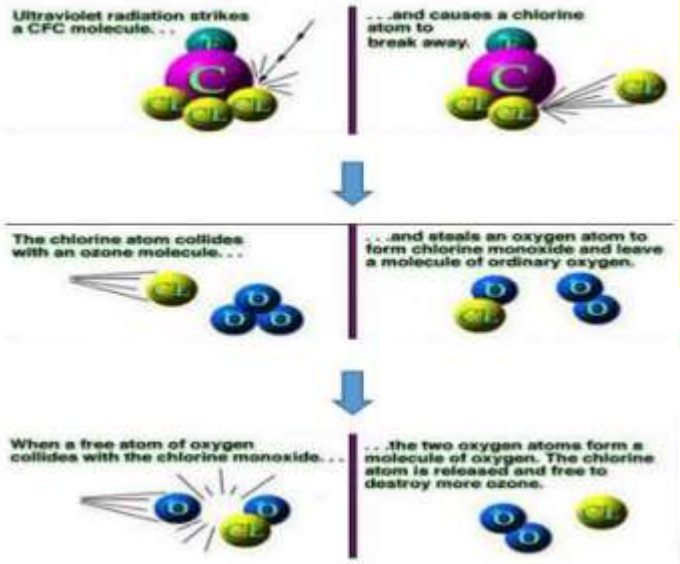
It is attributed to both natural and anthropogenic factors. The manmade factors include addition of Ozone depleting substances in atmosphere while natural phenomenon is related to formation of Polar stratospheric clouds in Antarctica.

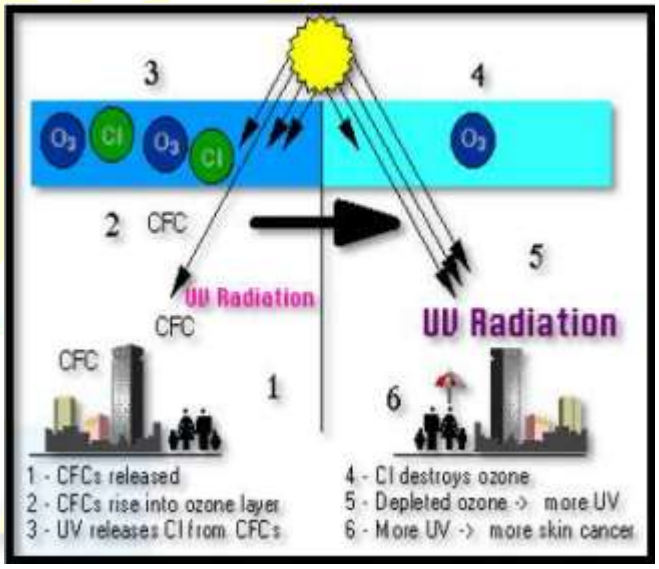
Role of Ozone Depleting Substances: CFC

Chlorofluorocarbons (CFCs), are the primary culprits in ozone layer breakdown. When CFCs reach the upper atmosphere, they are exposed to ultraviolet rays, which causes them to break down into substances that include chlorine. The chlorine reacts with the oxygen atoms in ozone and rips apart the ozone molecule.

One atom of chlorine can destroy more than a hundred thousand ozone molecules as it produces a chain reaction.

Chemical reaction





Role of Polar Stratospheric clouds

• Each spring in the stratosphere over (September - November), atmospheric ozone is rapidly destroyed by chemical processes.

• As winter arrives, a vortex of winds develops around the pole and isolates the polar stratosphere.

When temperatures drop below -78°C (-109°F), thin clouds called Polar stratospheric clouds (PSC) made up of ice, nitric acid, and sulphuric acid mixtures are formed. They are formed mainly during the event of polar vertex in winter more intense at South Pole.

• These PSC provide a surface for reactions to occur and convert some of Cl molecule that originally cannot take part in Ozone layer depletion into forms that can react with ozone molecule and can break it.

• Chemical reactions take place that convert the inactive chlorine reservoir chemicals into more active forms, especially chlorine gas (Cl2).

• When the sunlight returns to the South Pole in October, UV light rapidly breaks the bond between the two chlorine atoms, releasing free chlorine into the stratosphere, where it takes part in reactions that destroy ozone molecules while regenerating the chlorine (known as a catalytic reaction).

• A catalytic reaction allows a single chlorine atom to destroy thousands of ozone molecules. Ozone depletion begins, and the ozone “hole” appears. This hole intensifies during southern summers and can deplete ozone layer by 50% or 90% in extreme cases.

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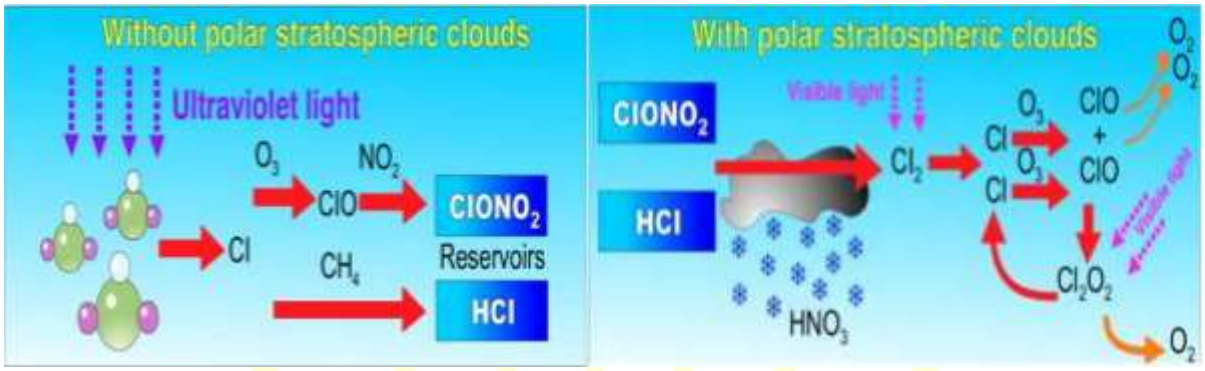
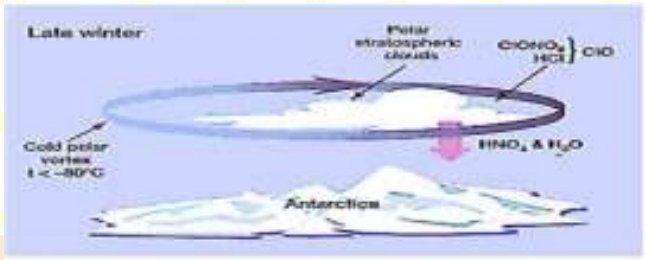




1. Polar stratospheric clouds absorbs nitric acid and form $HNO_3(H_2O)$ crystals which fail to lower levels, they also provide surfaces on which active Cl can be released in the spring.

2 . With nitrogen absent ClO can't revert to $ClONO_2$ or to HCL, sunlight and ClO catalyse the reaction of active Cl with ozone to molecular oxygen.

$(2O_3 + Cl \rightarrow 2ClO + 3O_2)$

3. In November stratospheric warming breaks up the polar vortex, the ozone-destructive processes are terminated and ozone hole is filled up by mid-latitude air with normal ozone concentrations.

In addition to "Ozone Depletion" there are some other contemporary issues as well that pose a threat to the environment around us. Global Warming is one such issue. Lets us take a look at it and see what kinds of questions have been asked in previous year UPSC Prelims related to the phenomenon of Global Warming.

GLOBAL WARMING

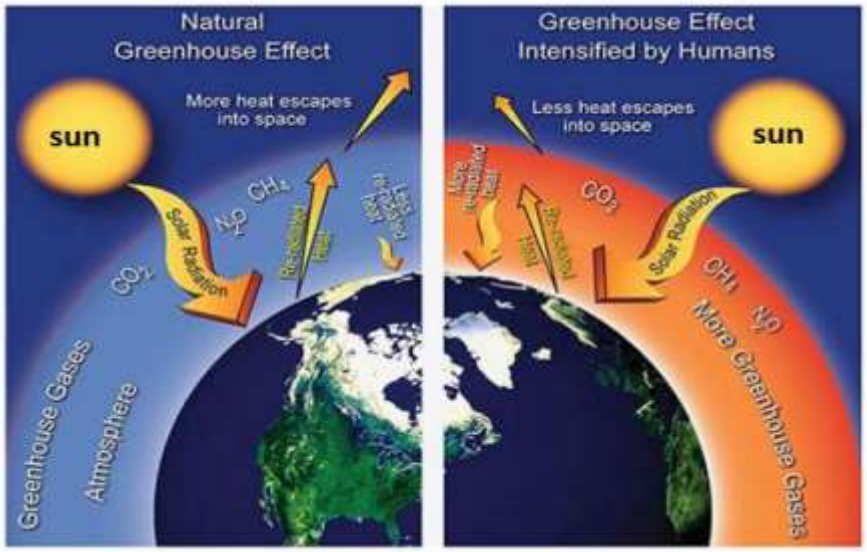
• Global warming is heating up of the globe when the accumulation of greenhouse gases in the atmosphere disturbs the heat budget (balance between incoming and outgoing heat) of the earth, which otherwise remains balanced. Since heat remains trapped within the earth's atmosphere, temperatures begin to rise.

• This can be due to natural factors like change in solar activity or variations in earth's orbit or Man-made factors like increase in greenhouse gases, reduction in carbon sinks by deforestation and ocean acidification, etc.

GREENHOUSE GAS EFFECT

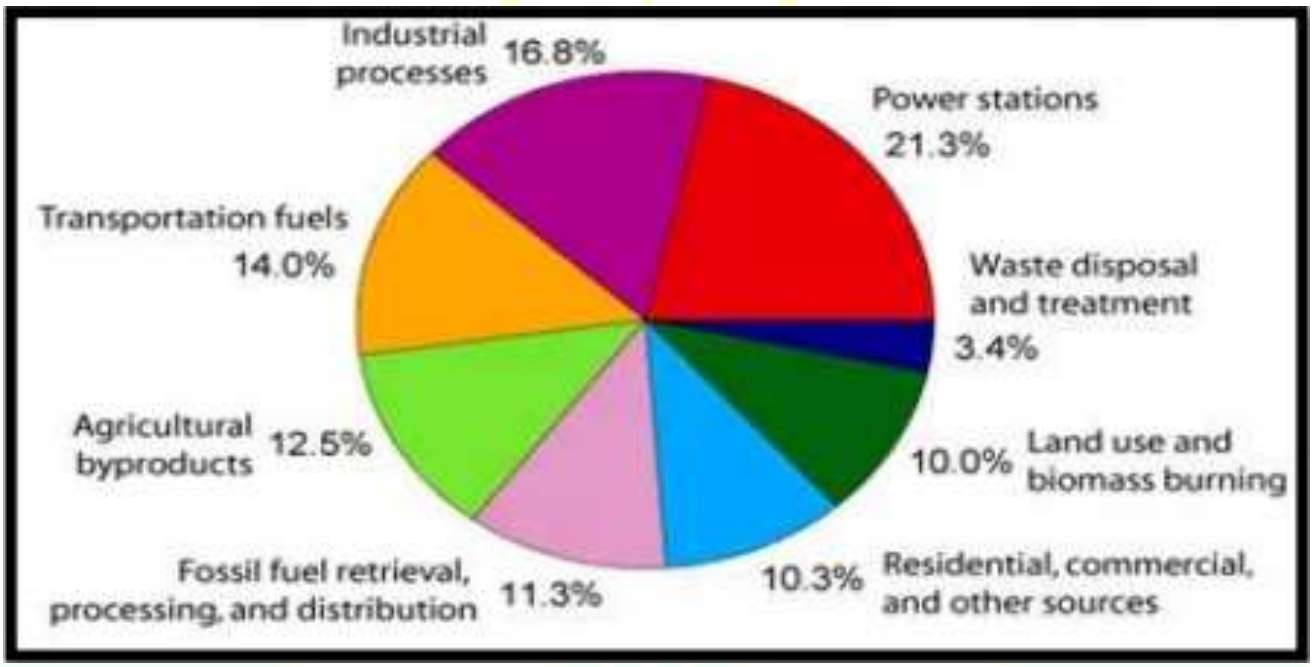
A greenhouse is a structure with walls and roof made chiefly of transparent material, such as glass, in which plants requiring regulated climatic conditions are grown. In a greenhouse, the incident solar radiation (the visible and adjacent portions of the infrared and ultraviolet ranges of the spectrum) passes through the glass roof and walls and is absorbed by the floor, earth, and contents, which become warmer and re-emit the energy as longer-wavelength infrared radiation (heat radiation). As the structure is not open to the atmosphere, heat also cannot escape via convection, so the temperature inside the greenhouse rises. This is known as the 'greenhouse effect'. A greenhouse gas is a gas that absorbs and emits radiant energy within the thermal infrared range.

Gas name	Chemical formula
Carbon dioxide	CO_2
Methane	CH_4
Nitrous oxide	N_2O
CFC-12	CCl_2F_2
HCFC-22	$CHClF_2$
Tetrafluoromethane	CF_4
Hexafluoroethane	C_2F_6
Sulfur hexafluoride	SF_6
Nitrogen trifluoride	NF_3



GREENHOUSE GAS SOURCES

Sector emissions



Greenhouse Gas	SOURCES	SINK	Importance for climate
Carbon Dioxide	• Burning of fossil fuel • Land-use change (deforestation)	•Ocean uptake •photosynthesis	Absorbs infrared radiation; affects stratospheric O_3
Methane	•Biomass burning •Enteric fermentation •Rice paddies	• Reactions with OH • Microorganisms uptake by soils	Absorbs IR; affects tropospheric & stratospheric O_3; produces CO_2
Nitrous Oxide	• Biomass burning • Fossil-fuel combustion • Fertilizers	• Removal by soils • Stratospheric photolysis and rxn with Oxygen	Absorbs IR; affects stratospheric O_3
Ozone	•Photochemical reactions involving O_2	Catalytic chemical reactions involving NO_x species.	Absorbs UV & IR radiation
CFC	Industrial production	dissociated in stratosphere	Absorbs IR; affects stratospheric O_3
Sulphur dioxide	Volcanoes, Coal and Biomass burning	•Dry & wet deposition •Reactions with OH	Forms aerosols, which scatter solar radiation

Global warming Potential

• Global warming potential (GWP) is a measure of how much heat a greenhouse gas traps in the atmosphere up to a specific time horizon, relative to carbon dioxide. It compares the amount of heat trapped by a certain mass of the gas in question to the amount of heat trapped by a

Greenhouse Gas (GHG)	Atmospheric Lifetime (yrs)	Global Warming Potential (GWP)	Primary Current Sources
Carbon dioxide (CO_2)	50-200	1	Fossil fuel use, land use, cement
Methane (CH_4)	12±3	21	Fossil fuel use, agriculture
Nitrous oxide (N_2O)	120	310	Mostly agriculture, ~1/3 are anthropogenic
Hydrofluorocarbons (HFCs)	1.5 to 209	150 to 11,700	Alternative to ozone depleting substances
Perfluorocarbons (PFCs)	2,600 to 50,000	6,500 to 9,200	Primary aluminum production; semiconductor manufacturing
Sulfur Hexafluoride (SF_6)	3,200	23,900	Used in electric power transmission, magnesium and semiconductor industries

similar mass of carbon dioxide and is expressed as a factor of carbon dioxide (whose GWP is standardized to 1). It is different from actual contribution as it depends on mass of gas also.

• The GWP depends on the following factors:

✓ the absorption of infrared radiation by a

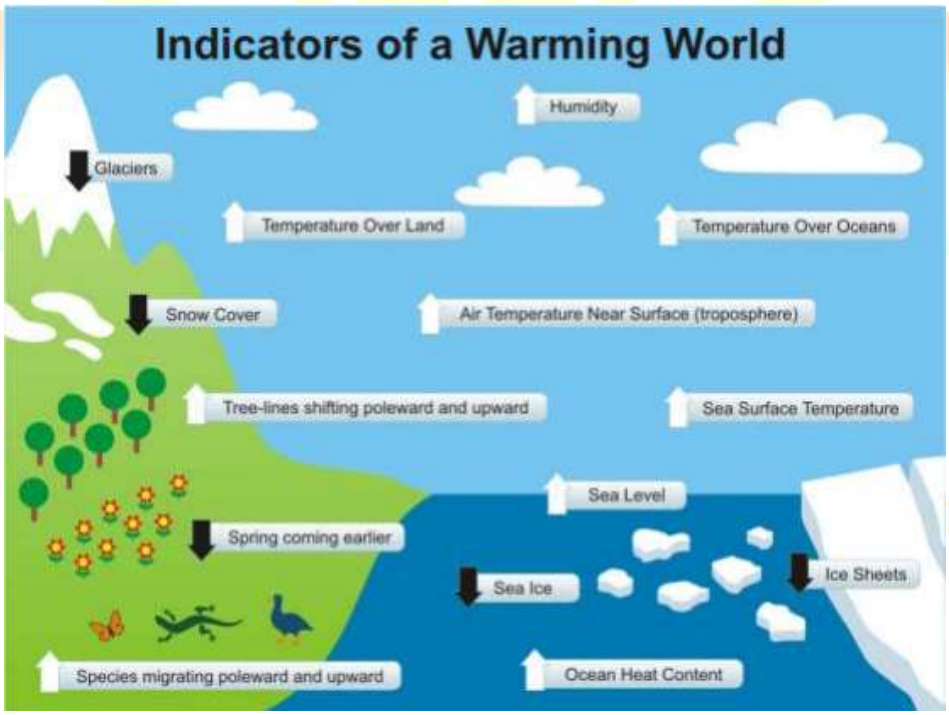
given species

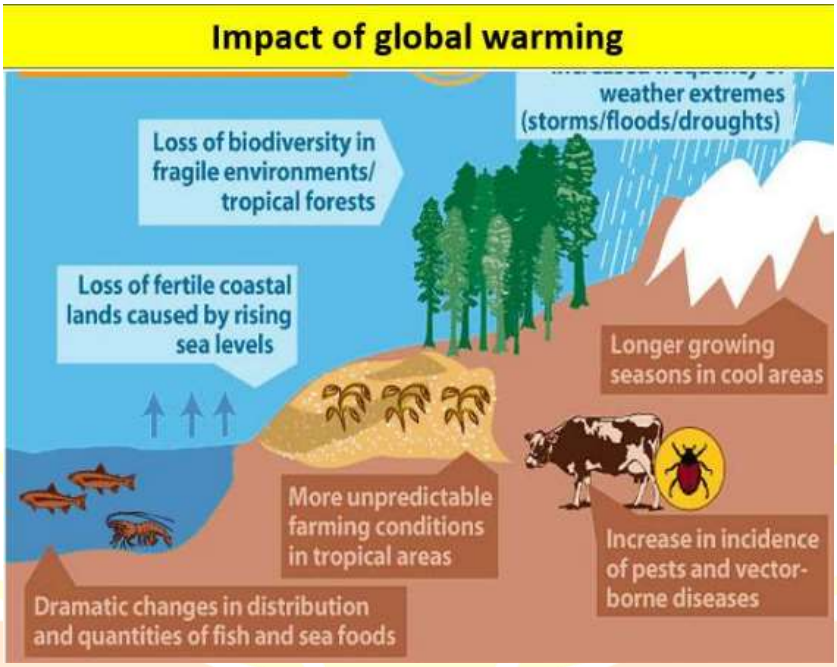
✓ the spectral location of its absorbing wavelengths

✓ the atmospheric lifetime of the species

Relative contribution:

CO2 of fossil fuels> CO2 from deforestation > CH4 > CFC > N2O





Effect of Global warming

CARBON FERTILISATION

• The CO2 fertilization effect or carbon fertilization effect is the increased the rate of photosynthesis in plants that results from increased levels of carbon dioxide in the atmosphere. The effect is stronger at higher temperatures, meaning it will be

higher in the tropics than in the boreal forests.

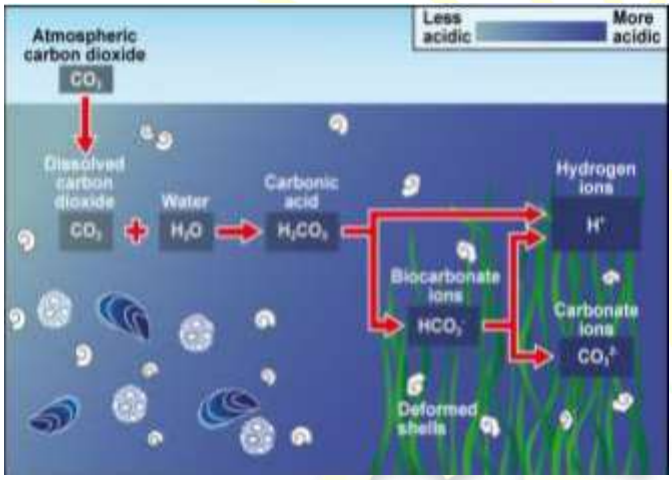
• Effects:

✓ It leads to faster plant growth which further leads to the sequestration of more CO2.

✓ The carbon fertilization effect will cause changes in crop yields. It should increase the crop yields in some regions.

• CO2 fertilization does not apply to all crops. For example, it does not apply to maize.

OCEAN ACIDIFICATION



Ocean acidification is the ongoing decrease in the pH of the Earth's oceans, caused by the uptake of carbon dioxide (CO2) from the atmosphere. An estimated 30–40% of the carbon dioxide from human activity released into the atmosphere dissolves into oceans, rivers and lakes. Checking CO and CO2 emissions and controlling pollution are the only means to reduce ocean acidification.

EFFECTS OF OCEAN ACIDIFICATION

Effects on marine organism

• Ocean acidification reduces the amount of carbonate, a key building block in seawater. This makes it more difficult for marine organisms, such as coral and some plankton, to form their shells and skeletons, and existing shells may begin to dissolve. The survival and growth of species is affected.

• Increasing acidity accentuates coral bleaching as corals are very sensitive to changes in water composition.

Impact on Atmospheric Phenomenon:

• The majority of sulphur in the atmosphere is emitted from the ocean, often in the form of dimethyl-sulphide (DMS) produced by phytoplankton. Some of DMS produced by phytoplankton enters the atmosphere and reacts to make sulphuric acid, which clumps into aerosols, or microscopic airborne particles. Aerosols seed the formation of clouds, which help cool the Earth by reflecting sunlight. But, in acidified ocean water, phytoplankton produce less DMS. This reduction of sulphur may lead to decreased cloud formation, raising global temperatures.

• Intensifies climate change and reduces its capacity as carbon sinks.

Socio-economic impacts

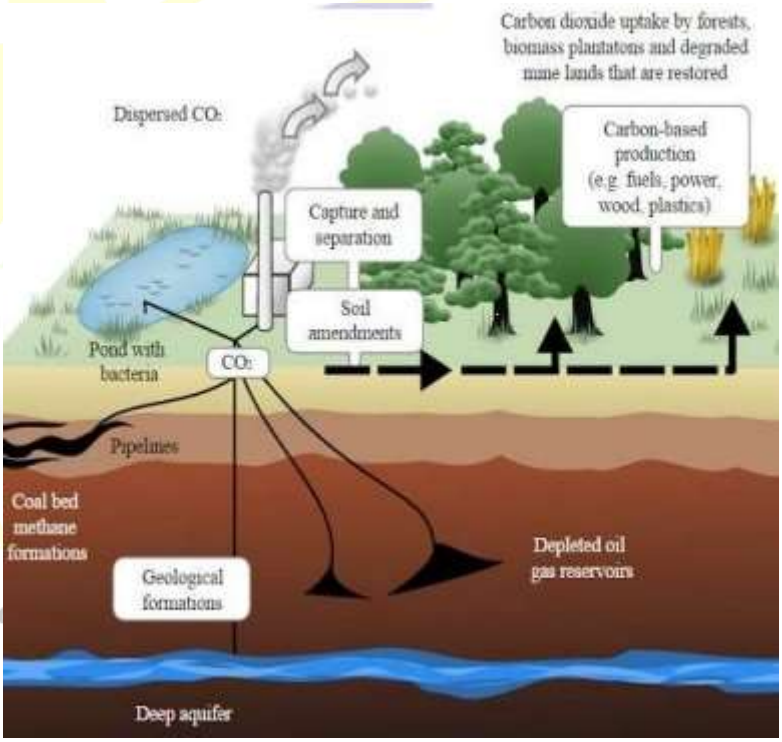
• Impacts availability sea food.

• Impacts coral tourism.

Reducing Global warming by using Carbon sinks

CARBON SINKS

• A carbon sink is a natural or artificial reservoir that accumulates and stores some carbon-containing chemical compound for an indefinite period. The process by which carbon sinks remove carbon dioxide (CO2) from the atmosphere is known as carbon sequestration. A carbon sink is anything that absorbs more carbon sequestration. A carbon sink is anything that absorbs more carbon that it releases, whilst a carbon source is anything that releases more carbon than is absorb.



• Forests, soils, oceans and the atmosphere all

store carbon and this carbon moves between them in a continuous cycle. Plants grab carbon dioxide from the atmosphere to use in photosynthesis. The oceans are a major carbon storage system as phytoplankton take up the gas for photosynthesis, while some carbon dioxide simply dissolves in the seawater. Low temperatures like in polar ice caps increases dissolution and hence play important part in carbon cycle.

QUESTION 3

Q. The increasing amount of carbon dioxide in the air is slowly raising the temperature of the atmosphere, because it absorbs [2012]

(a) the water vapour of the air and retains its heat

(b) the ultraviolet part of the solar radiation

(c) all the solar radiations

(d) the infrared part of the solar radiation

Answer: d

QUESTION 4

Q. Due to their extensive rice cultivation, some regions may be contributing to global warming. To what possible reason/reasons is this attributable? [2010]

1. The anaerobic conditions associated with rice cultivation cause the emission of methane.

2. When nitrogen based fertilizers are used, nitrous oxide is emitted from the cultivated soil.

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

Answer: c

QUESTION 5

Q. Consider the following [2008]

1. Rice fields

2. Coal mining

3. Domestic animals

4. Wetlands

Which of the above are sources of methane, a major greenhouse gas?

(a) 1 and 4 only

(b) 2 and 3 only

(c) 1, 2 and 3 only

(d) 1, 2, 3 and 4

Answer: d

QUESTION 6

Q. Which of the following statements best describes "carbon fertilization"? [2018]

a) Increased plant growth due to increased concentration of carbon dioxide in the atmosphere

b) Increased temperature of Earth due to increased concentration of carbon dioxide in the atmosphere

c) Increased acidity of oceans as a result of increased concentration of carbon dioxide in the atmosphere

d) Adaptation of all living beings on Earth to the climate change brought about by the increased

concentration of carbon dioxide in the atmosphere

Answer: a

QUESTION 7

Q. Human activities in the recent past have caused the increased concentration of carbon dioxide in the atmosphere, but a lot of it does not remain in the lower atmosphere because of [2011]

1. Its escape into the outer stratosphere.

2. The photosynthesis by phytoplankton in the oceans.

3. The trapping of air in the polar ice caps.

Which of the statements given above is/are correct?

(a) 1 and 2

(b) 2 only

(c) 2 and 3

(d) 3 only

Answer: c

QUESTION 8

Q. The acidification of oceans is increasing. Why is this phenomenon a cause of concern? [2012]

1. The growth and survival of calcareous phytoplankton will be adversely affected.

2. The growth and survival of coral reefs will be adversely affected.

3. The survival of some animals that have phytoplankton larvae will be adversely affected.

4. The cloud seeding and formation of clouds will be adversely affected.

Which of the statements given above is /are correct?

(a) 1, 2 and 3 only

(b) 2 only

(c) 1 and 3 only

(d) 1, 2, 3 and 4

Answer: d

QUESTION 9

Q. Consider the following: [2010]

1. Oxides of Hydrogen

2. Oxides of Nitrogen

3. Oxides of Sulphur

Which of the above causes/cause acid rain?

(a) 1 and 2 only

(b) 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

Answer: c

QUESTION 10

Q. Acid rain is caused by the pollution of environment by [2013]

(a) carbon dioxide and nitrogen

(b) carbon monoxide and carbon dioxide

(c) ozone and carbon dioxide

(d) nitrous oxide and sulphur dioxide

Answer: d

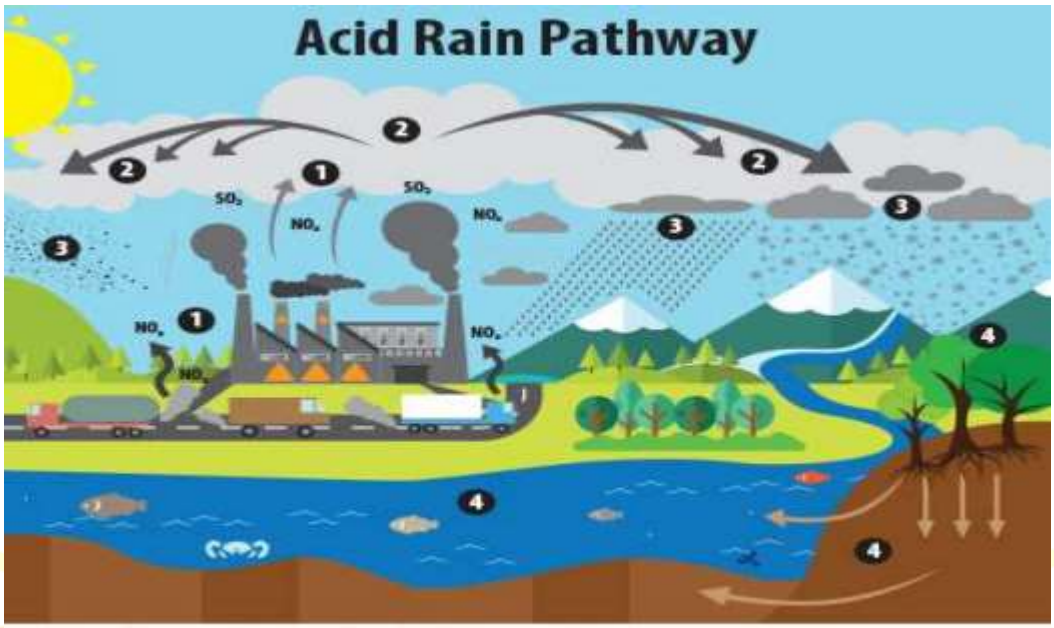
EXPLANATION

ACID RAIN

• Acid rain refers to any precipitation (rain, fog, mist, snow) that is more acidic than normal [pH below 7 = acidic]. It has pH of 5.6 or less.

• Acid rain is caused by atmospheric pollution from acidic gases such as sulphur dioxide and oxides of nitrogen emitted from burning of fossil fuels or from exhausts of factories or vehicles.

• The oxides of Nitrogen and sulphur can be added due to natural or man-made factors.



This image illustrates the pathway for acid rain in our environment: (1) Emissions of SO_2 and NO_x are released into the air, where (2) the pollutants are transformed into acid particles that may be transported long distances. (3) These acid particles then fall to the earth as wet and dry deposition (dust, rain, snow, etc.) and (4) may cause harmful effects on soil, forests, streams and lakes.

Effects

• Ocean Acidification: Ocean acidification is the ongoing decrease in the pH of the Earth's oceans, caused by the uptake of carbon dioxide (CO2) from the atmosphere. An estimated 30–40% of the carbon dioxide from human activity released into the atmosphere dissolves into oceans, rivers and lakes. Acid rain can have a pH between 1 and 6 and has impact on surface ocean chemistry and contributes to ocean acidification.

• Effects on ecosystem: Acid rain damage cuticle of plant leaves resulting etiolation (pale and weak) of foliage. This in turn reduces photosynthesis. Acidic medium promotes leaching of heavy metals like aluminium, lead and mercury. Such metals when percolate into ground water affect soil micro flora/fauna. The optimum pH of most bacteria and protozoa is near neutrality; most fungi prefer an acidic environment, most blue-green bacteria prefer an alkaline environment. So after a long run of acid rain, microbial species in the soil and water shift from bacteria-bound to fungibound and cause an imbalance in the micro flora. This causes a delay in the decomposition of soil

organic material, and an increase in fungal disease in aquatic life and forests.

• Effects on buildings and monuments: Limestone and marble are destroyed by acid rain. Smoke and soot cover such objects. They slowly dissolve/flake away the surfaces because of acid fumes in the air. E.g. Taj mahal

• Effects on humans: The obvious ones are bad smells, reduced visibility; irritation of the skin, eyes and the respiratory tract. Some direct effects include chronic bronchitis, pulmonary emphysema and cancer.

DO IT YOURSELF

QUESTION 11

Q. In the context of mitigating the impending global warming due to anthropogenic emissions of carbon dioxide, which of the following can be the potential sites for carbon sequestration?

1. Abandoned and uneconomic coal seams

2. Depleted oil and gas reservoirs

3. Subterranean deep saline formations

Select the correct answer using the code given below:

(a) 1 and 2 only

(b) 3 only

(c) 1 and 3 only

(d) 1, 2 and 3

QUESTION 12

Q. Read about the following species seen frequently in news. Find out their IUCN status, their habitat and distribution across India.

(a) Malabar Civet

(b) Golden langur

(c) Ganges Shark

(d) Asiatic lion

IX. ENVIRONMENTAL CONSERVATION TECHNIQUES AND INITIATIVES

QUESTION 1

Q. With reference to 'fuel cells' in which hydrogen-rich fuel and oxygen are used to generate electricity. Consider the following statements : [2015-I]

1. If pure hydrogen is used as a fuel, the fuel cell emits heat and water as by-products.

2. Fuel cells can be used for powering buildings and not for small devices like laptop computers.

3. Fuel cells produce electricity in the form of Alternating Current (AC).

Which of the statements given above is / are correct?

(a) 1 only

(b) 2 and 3 only

(c) 1 and 3 only

(d) 1, 2 and 3

Answer: a

EXPLANATION

HYDROGEN FUEL CELL

• A fuel cell is a device that converts chemical potential energy (energy stored in molecular bonds) into electrical energy.

• It uses hydrogen gas (H2) and oxygen gas (O2) as fuel. The products of the reaction in the cell are water, electricity, and heat.

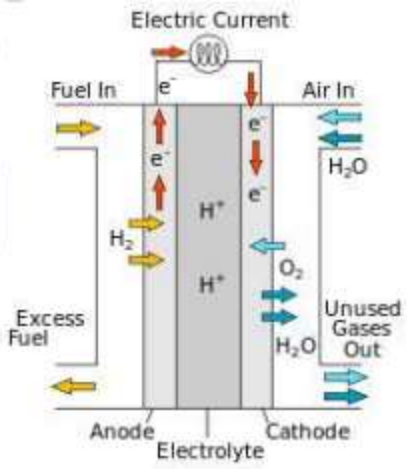


Figure 7 : Hydrogen Fuel Cell

Advantages

• Inherently more efficient than combustion engines and thermal energy generation because chemical potential energy is directly converted into electrical energy.

• Direct emissions from a fuel cell vehicle are just water and a little heat.

• Fuel used is oxygen and hydrogen which can be produced without harming the environment.

• Can be used to power large buildings to small equipments.

DO IT YOURSELF

QUESTION 2

Q. Hydrogen fuel cell vehicles produce one of the following as "exhaust" [2010]

(a) NH3

(b) CH4

(c) H2O

(d) H2O2

QUESTION 3

Q. Which one of the following fuels causes minimum environmental pollution? [1995]

(a) Diesel

(b) Coal

(c) Hydrogen

(d) Kerosene

QUESTION 4

Q. Consider the following kinds of organisms : [2012 - I]

1. Bacteria

2. Fungi

3. Flowering plants

Some species of which of the above kinds of organisms are employed as bio-pesticides?

(a) 1 only

(b) 2 and 3 only

(c) 1 and 3 only

(d) 1, 2 and 3

Answer: d

EXPLANATION

BIO-PESTICIDES

• Bio-pesticides are naturally occurring substances that can be used to control pests.

• They are obtained from various organisms including plants, bacteria and other microbes, fungi, nematodes, etc.

• They are often important components of integrated pest management (IPM) programmes, and have received much practical attention as substitutes to synthetic chemical plant protection products (PPPs).

• Examples:

✓ Bacillus Thuringiensis (Bacteria which has also been used for creating Bt Cotton)

✓ Entomopathogenic Fungi

✓ Various worms which eat insects

✓ Various flowering and non-flowering plants like Neem etc.

Bio-pesticides	Chemicals
1. Friendly to non-target species.	1. Harmful to non-target species.
2. Do not cause pollution.	2. Serious pollution to the environment.
3. Relatively cheaper	3. Relatively expensive.
4. Pest never develop resistance.	4. Pest eventually become resistant.
5. Growing market preference.	5. Diminishing market.

QUESTION 5

Q. Biomass gasification is considered to be one of the sustainable solutions to the power crisis in India. In this context, which of the following statements is/are correct? [2012 - I]

1. Coconut shells, groundnut shells and rice husk can be used in biomass gasification.

2. The combustible gases generated from biomass gasification consist of hydrogen and carbon dioxideonly.

3. The combustible gases generated from biomass gasification can be used for direct heat generation but not in internal combustion engines.

Select the correct answer using the codes given below :

(a) 1 only

(b) 2 and 3 only

(c) 1 and 3 only

(d) 1, 2 and 3

Answer: a

EXPLANATION

BIOMASS GASIFICATION

• Biomass gasification is a process of converting solid biomass fuel into a gaseous combustible gas (called producer gas or syngas) through a sequence of thermo-chemical reactions.

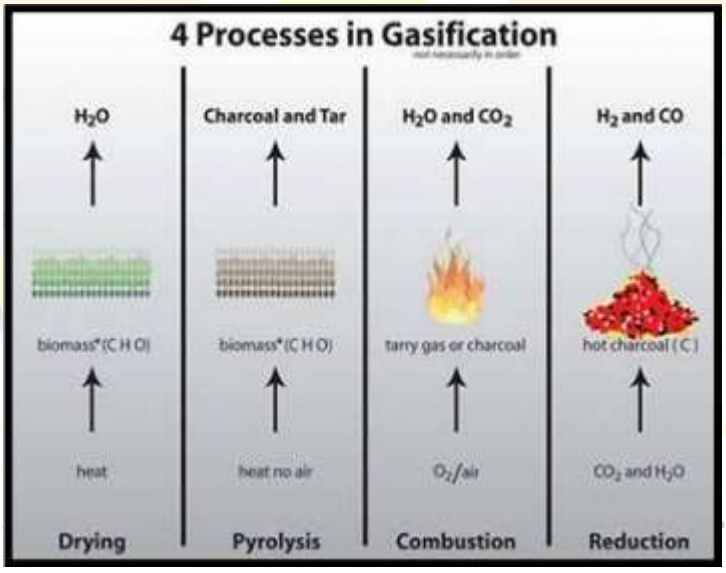
• This is achieved by reacting the material at high temperatures (>700 °C), without combustion, with a controlled amount of oxygen and/or steam.

• The gas produced consists of Carbon monoxide, Hydrogen, Carbon Dioxide and small amounts of methane, ethane etc.

• Applications:

✓ For generating heat and electricity

✓ As a transport fuel along with petrol and diesel



QUESTION 6

Q. Microbial fuel cells are considered a source of sustainable energy. Why? [2011 - I]

1. They use living organisms as catalysts to generate electricity from certain substrates.

2. They use a variety of inorganic materials as substrates.

3. They can be installed in waste water treatment plants to cleanse water and produce electricity.

Which of the following statements given above is/ are correct?

(a) 1 only

(b) 2 and 3 only

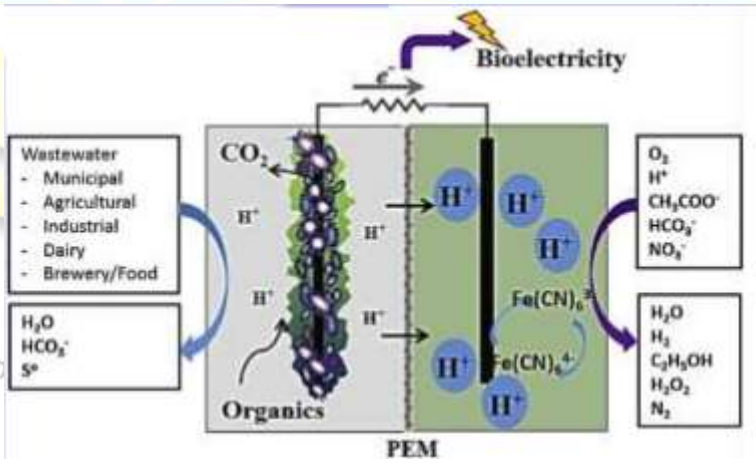
(c) 1 and 3 only

(d) 1, 2 and 3

Answer: d

EXPLANATION

MICROBIAL FUEL CELLS



• A microbial fuel cell (also known as biological fuel cell) is a device that converts chemical energy to electrical energy by the action of microorganisms.

• These organisms act upon a variety of organic and inorganic substrates in anaerobic conditions.

• Carbon dioxide and electricity is produced as a by-product of the

decomposition process.

• These fuel cells can be used for electricity generation, wastewater treatment, sewage treatment and solid waste disposal plants etc.

QUESTION 7

Q. With reference to two non-conventional energy sources called 'coalbed methane' and 'shale gas', consider the following statements: [2014 - I]

1. Coalbed methane is the pure methane gas extracted from coal seams, while shale gas is a mixture of propane and butane only that can be extracted from fine-grained sedimentary rocks.

2. In India, abundant coalbed methane sources exist, but so far, no shale gas sources have been found.

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

Answer: d

EXPLANATION

COAL BED METHANE

• Coal Bed Methane (also known as coal bed gas, sweet gas etc.) is a form of natural gas extracted from coal beds.

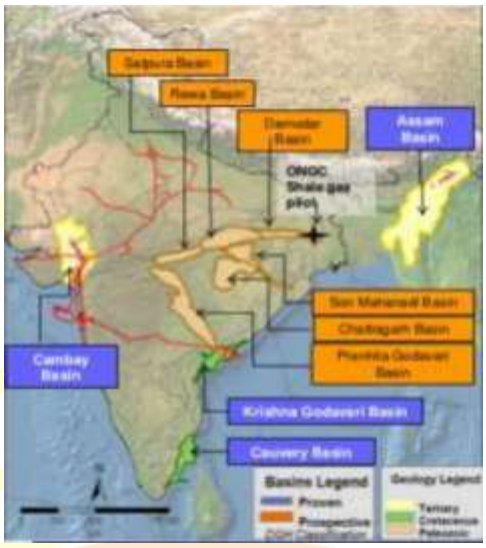
• This methane may exist as free gas, saturated with water or in a liquid state lining the inside of pores within the coal seams.

• Coalbed methane contains very little heavier hydrocarbons such as propane or butane. It often contains up to a few percent carbon dioxide.

• It poses a serious risk to coal miners as this form of methane is highly inflammable.

• Coalbed methane is found in Indian coal mines and is being commercially extracted to produce fuels like CNG etc.

SHALE GAS



• Shale gas is natural gas that is found trapped within shale (a type of sedimentary rock) formations.

• This gas mainly consists of methane but also includes small amount of carbon dioxide, nitrogen oxides and other hydrocarbons.

• At present, only a few countries, including USA, Canada & China, have significant commercial shale gas production.

• Potential shale gas reserves have also been found in India in various sedimentary formations of the peninsular river basins and coasts.

QUESTION 8

Q. Match List-I (Fuel gases) with List-II (Major constituents) and select the correct answer using the codes given below the lists: [2004]

List-I	**List-II**
A. CNG	1. Carbon monoxide, Hydrogen
B. Coal gas	2. Butane, Propane
C. LPG	3. Methane, Ethane
D. Water gas	4. Hydrogen, Methane, Carbon monoxide

Codes:

(a) A-2; B-1; C-3; D-4

(b) A-3; B-4; C-2; D-1

(c) A-2; B-4; C-3; D-1

(d) A-3; B-1; C-2; D-4

Answer: b

EXPLANATION

WATER GAS

• Water gas is a combustion fuel containing carbon monoxide (CO) and hydrogen gas (H2).

• Water gas is made by passing steam over heated hydrocarbons.

COAL GAS

• Coal gas is a flammable gaseous fuel including hydrogen, carbon monoxide, methane, ethylene and volatile hydrocarbons together with small quantities of non-calorific gases such as carbon dioxide and nitrogen.

• It is produced when coal is heated strongly in the absence of air.

• It is also known as Town gas, referring to manufactured gaseous fuels produced for sale to consumers and municipalities.

SYNTHESIS GAS

• Syngas, or synthesis gas, is a fuel gas mixture consisting primarily of hydrogen, carbon monoxide, and very often some carbon dioxide.

• Syngas can be produced from many sources, including natural gas, coal, biomass, or virtually any

hydrocarbon feedstock, by reaction with steam or oxygen.

NATURAL GAS

• Natural gas is a naturally occurring hydrocarbon gas mixture consisting primarily of methane, but commonly including varying amounts of other higher alkanes, and sometimes a small percentage of carbon dioxide, nitrogen, hydrogen sulphide, or helium.

LIQUEFIED PETROLEUM GAS

• It is a flammable mixture of propane and butane, heavy hydrocarbon gases.

• It is formed after refining the petroleum crude.

QUESTION 9

Q. It is possible to produce algae-based biofuels, but what is/are the likely limitation(s) of developing countries in promoting this industry? [2017]

1. Production of algae based biofuels is possible in seas only and not on continents.

2. Setting up and engineering the algae based biofuel production requires high level of expertise/technology until the construction is completed.

3. Economically viable production necessitates the setting up of large scale facilities which may raise ecological and social concerns.

Select the correct answer using the code given below:

(a) 1 and 2 only

(b) 2 and 3 only

(c) 3 only

(d) 1, 2 and 3

Answer: b

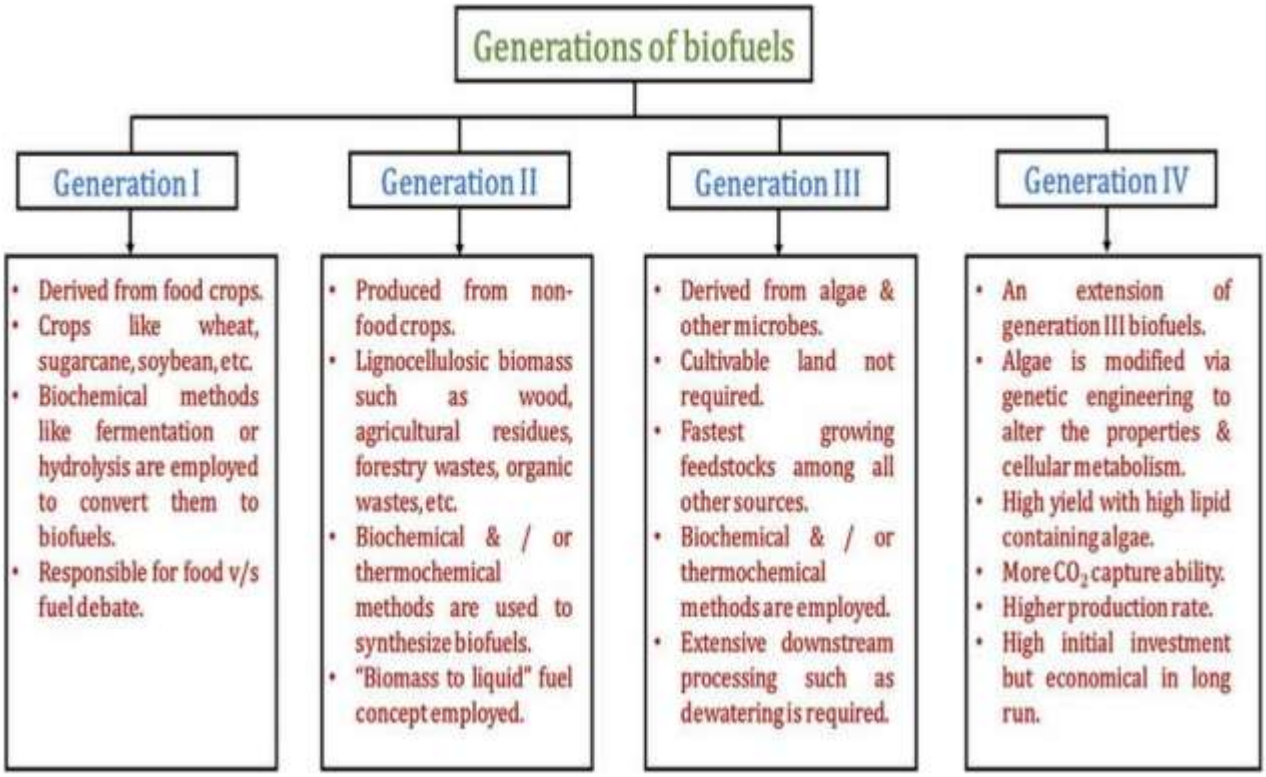
EXPLANATION

BIO FUELS

• A biofuel is a fuel that is produced through contemporary biological processes, such as agriculture and anaerobic digestion, rather than a fuel produced by geological processes such as those involved in the formation of fossil fuels (such as coal and petroleum) from prehistoric biological matter.

• Biofuels can be derived directly from plants (i.e. energy crops) and algae, or indirectly from agricultural, commercial, domestic, and/or industrial wastes.

• Biofuels are in theory carbon-neutral because the carbon dioxide that is absorbed by the plants is equal to the carbon dioxide that is released when the fuel is burned.

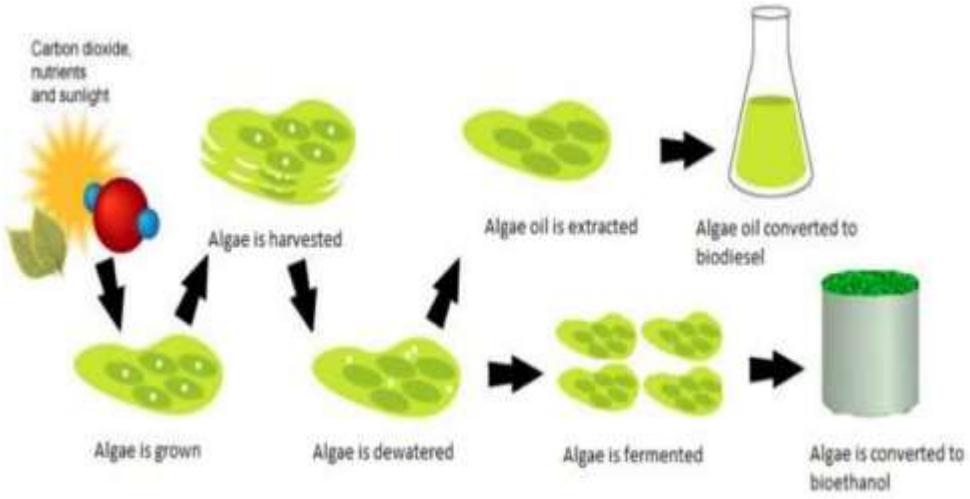


ALGAE BASED BIO FUELS

• Algae are a group of large number of aquatic plant like organisms which range from microscopic cyanobacteria to giant seaweeds.

• Algae grow much faster than food crops, and can produce hundreds of times more biofuel per unit area than conventional crops like sugarcane, jatropha etc.

• But for commercial production of these fuels, large scale algae cultivation is required. This requires investment in technical equipment and expertise for construction of algae farms.



QUESTION 10

Q. With reference to technologies for solar power production, consider the following statements : [2014 - I]

1. 'Photovoltaics' is a technology that generates electricity by direct conversion of light into electricity, while 'Solar Thermal' is a technology that utilizes the Sun's rays to generate heat which is further used in electricity generation process.

2. Photovoltaics generates Alternating Current (AC), while Solar Thermal generates Direct Current (DC).

3. India has manufacturing base for Solar Thermal technology, but not for Photovoltaics.

Which of the statements given above is/are correct?

(a) 1 only

(b) 2 and 3 only

(c) 1, 2 and 3

(d) None

Answer: a

EXPLANATION

SOLAR POWER

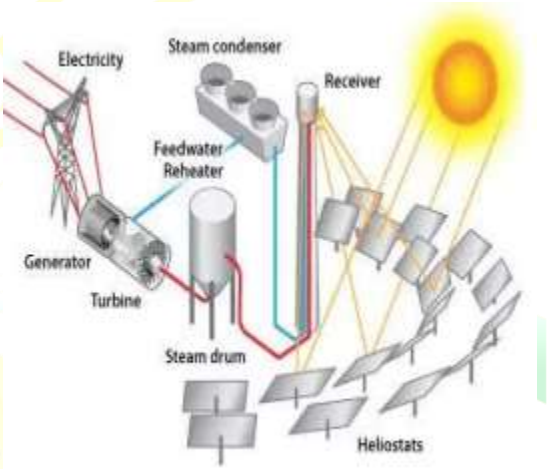
Solar power is the conversion of energy from sunlight into electricity, either directly using photovoltaics (PV), or indirectly using solar thermal power.

Solar Photovoltaics

• Solar Photovoltaics (PV) is the conversion of light directly into electricity using semiconducting materials in a photovoltaic cells.

• When photon (sunlight) strikes these cells, electric current is induced. This is known as Photovoltaic Effect.

• The electricity generated is in form of direct current.



Solar Thermal Power

• In this technology, solar light is concentrated in a small area to generate heat. Then this heat energy is used directly or converted into electricity using steam turbines.

• Therefore, this technology is also known as 'Concentrated solar power'.

• This techniques is used for solar water heating, solar cooking and power generation etc.

QUESTION 11

Q. Consider the following agricultural practices : [2012-I]

1. Contour bunding

2. Relay cropping

3. Zero tillage

In the context of global climate change, which of the above helps/help in carbon sequestration/storage in the soil?

(a) 1 and 2 only

(b) 3 only

(c) 1, 2 and 3

(d) None of them

Answer: c

EXPLANATION

CARBON SEQUESTRATION

• Atmospheric concentrations of carbon dioxide can be lowered either by reducing emissions or by taking carbon dioxide out of the atmosphere and storing in terrestrial, oceanic, or freshwater aquatic ecosystems.

• Carbon sequestration is the process involved in carbon capture and the long-term storage of atmospheric carbon dioxide in carbon sinks like subsurface saline aquifers, reservoirs, ocean water, aging oil fields and biological matter.

• Natural biogeochemical cycling of carbon between the atmosphere and reservoirs, such as by chemical weathering of rocks.

• It can be done through biological methods like forestation, algae blooms, soil carbon storage etc.

• It can also be done through physical methods like geological sequestration, ocean storage etc.

Soil Carbon Sequestration

• Improved agricultural practices can help mitigate climate change by reducing emissions from agriculture and other sources and by storing carbon in plant biomass and soils.

• The goal of agricultural carbon removal is to use the crop and its relation to the carbon cycle to permanently sequester carbon within the soil. This is done by selecting farming methods that return biomass to the soil.

• This can be accomplished through:

✓ Use cover crops such as grasses and weeds as temporary cover between planting seasons

✓ Relay cropping (the second crop is planted into the first crop before harvest) so that soil is never bare

✓ Adopt zero-till or minimal tilling

✓ Improving land and soil quality by checking erosion and degradation.

• Typically after 15 to 30 years of sequestration, soil becomes saturated and ceases to absorb carbon. This implies that there is a global limit to the amount of carbon that soil can hold.

IX. NATIONAL ENVIRONMENT LEGISLATIONS

QUESTION 1

Q. The National Green Tribunal Act, 2010 was enacted in consonance with which of the following provisions of the Constitution of India? [2012 - I]

1. Right to healthy environment, construed as a part of Right to life under Article 21

2. Provision of grants for raising the level of administration in the Scheduled Areas for the welfare of Scheduled Tribes under Article 275(1)

3. Powers and functions of Gram Sabha as mentioned under Article 243 (A)

Select the correct answer using the codes given below:

(a) 1 only

(b) 2 and 3 only

(c) 1 and 3 only

(d) 1, 2 and 3

Answer: a

EXPLANATION

NATIONAL GREEN TRIBUNAL

• National Green Tribunal is a specialised tribunal formed under the National Green Tribunal Act, 2010. It is a statutory body.

• The stated objective of the tribunal was to provide a specialized forum

for effective and speedy disposal of cases pertaining to

✓ environment protection

✓ conservation of forests

✓ for seeking compensation for damages caused to people or property due to violation of environmental laws or conditions specified while granting permissions.

• The Tribunal shall not be bound by the procedure laid down under the Code of Civil Procedure, 1908 and Indian Evidence Act, 1872, but shall be guided by principles of natural justice.

• The appeal against decisions of NGT lies directly before the Supreme Court of India.

Composition of National Green Tribunal

• The Principal Bench of the NGT has been established in the National Capital – New Delhi, with regional benches in Pune (Western Zone Bench), Bhopal (Central Zone Bench), Chennai (Southern Bench) and Kolkata (Eastern Bench).

• Each bench of the NGT will comprise of at least one Judicial Member and one Expert Member. Expert members should have a professional qualification and a minimum of 15 years' experience in the field of environment/forest conservation and related subjects.

• The Chairperson of the NGT is a retired Judge of the Supreme Court, Head Quartered in Delhi. Other Judicial members are retired Judges of High Courts.

Powers of National Green Tribunal

• The NGT has the power to hear all civil cases relating to environmental issues and questions that are linked to:

✓ The Water (Prevention and Control of Pollution) Act, 1974;

✓ The Water (Prevention and Control of Pollution) Cess Act, 1977;

✓ The Forest (Conservation) Act, 1980;

✓ The Air (Prevention and Control of Pollution) Act, 1981;

✓ The Environment (Protection) Act, 1986;

✓ The Public Liability Insurance Act, 1991;

The Biological Diversity Act, 2002.

QUESTION 2

Q. How is the National Green Tribunal (NGT) different from the Central Pollution Control Board (CPCB). [2018]

1. The NGT has been established by an Act whereas the CPCB has been created by an executive order of the Government.

2. The NGT provides environmental justice and helps reduce the burden of litigation in the higher courts whereas the CPCB promotes cleanliness of streams and wells and aims to improve the quality of air in the country.

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

Answer: b

EXPLANATION

CENTRAL POLLUTION CONTROL BOARD

• The Central Pollution Control Board (CPCB) of India is a statutory organisation under the Ministry of Environment, Forest and Climate Change (MoEF & CC).

• It was established in 1974 under the Water (Prevention and Control of Pollution) Act, 1974.

• The CPCB is also entrusted with the powers and functions under the Air (Prevention and Control of Pollution) Act, 1981.

Functions

• Implementation of legislation relating to prevention and control of environmental pollution.

• Checking and monitoring pollution in various forms including air, water, noise etc.

• Collaborating with State Pollution Control Boards and assisting them in their functions.

• Ecocity programmes to improve environment through implementation of identified environmental improvement projects in the selected towns and cities.

• Formulation of waste management rules like solid waste, plastic waster, electronic waste etc.

• CPCB maintains environmental data statistic in which air quality data and water quality data comes through.

QUESTION 3

Q. The Genetic Engineering Appraisal Committee, whose permission is required for cultivation of any genetically modified crop such as Bt Cotton in India, is under the Union Ministry of : [2003]

(a) Agriculture

(b) Environment and Forests

(c) Commerce and Industry

(d) Rural-Development

Answer: b

EXPLANATION

GENETIC ENGINEERING APPRAISAL COMMITTEE

• The Genetic Engineering Appraisal Committee (GEAC) was constituted under the Ministry of Environment, Forest and Climate Change (MoEFCC).

• It is the apex body under the 'Rules for Manufacture, Use, Import, Export and Storage of Hazardous Microorganisms/Genetically Engineered Organisms or Cells 1989' in accordance with the

Environment Protection Act, 1986

• The following are the core functions of the Genetic Engineering Appraisal Committee:

✓ To appraise activities involving the large-scale use of hazardous microorganisms and recombinants in research and industrial production from the environmental angle.

✓ To appraise proposals relating to release of genetically engineered organisms and products into the environment including experimental field trials.

✓ The committee or any persons authorized by it has powers to take punitive action under the Environment Protection Act.

QUESTION 4

Q. How does National Biodiversity Authority (NBA) help in protecting the Indian agriculture? [2012-I]

1. NBA checks the biopiracy and protects the indigenous and traditional genetic resources.

2. NBA directly monitors and supervises the scientific research on genetic modification of crop plants.

3. Application for Intellectual Property Rights related to genetic/biological resources cannot be made without the approval of NBA.

Which of the statements given above is /are correct?

(a) 1only

(b) 2 and 3 only

(c) 1 and 3 only

(d) 1, 2 and 3

Answer: c

EXPLANATION

NATIONAL BIODIVERSITY AUTHORITY

• The National Biodiversity Authority (NBA) was established in 2003 to implement India's Biological Diversity Act (2002).

• The NBA is a statutory Body and it performs facilitative, regulatory and advisory functions for the Government of India on issues of conservation, sustainable use of biological resources and fair and equitable sharing of benefits arising out of the use of biological resources.

• Its functions include:

✓ To advise the Central Government on matters relating to the conservation of biodiversity, sustainable use of its components and equitable sharing of benefits arising out of the utilization of biological resources

✓ To approve the grant of intellectual property rights, in any country outside India or in India, on any biological resource obtained from India or knowledge associated with such biological resource which is derived from India.

✓ To regulate access to biological resources and / or associated knowledge for research, bio-survey and bio-utilization, commercial utilization, obtaining Intellectual Property Rights, transfer of results of research and transfer of accessed biological resources.

QUESTION 5

Q. Which one of the following legislations does not deal with the protection of environment? [1999]

(a) The Water (Cess) Act, 1977

(b) The Forest (Conservation) Act, 1980

(c) The Public Liability Insurance Act, 1991

(d) The Port Laws Amendment Act, 1997

Answer: d

EXPLANATION

THE WATER (PREVENTION AND CONTROL OF POLLUTION) CESS ACT, 1977

• The Water (Prevention and Control of Pollution) Cess Act, 1977 aims to provide for the levy and collection of a cess on water consumed by persons carrying on certain industries and by local authorities, with a view to augment the resources of the Central Board and the State Boards for the prevention and control of water pollution constituted under the Water (Prevention and Control of Pollution) Act, 1974.

THE FOREST (CONSERVATION) ACT, 1980

• It was enacted for restricting the use of forest land for non-forest purposes and prevent clear felling of naturally grown trees.

• It restricts leasing of forest land to private individuals, authority, corporations not owned by the Government

THE PUBLIC LIABILITY INSURANCE ACT, 1991

• An Act to provide for public liability- insurance for the purpose of providing immediate relief to the persons affected by accident occurring while handling any hazardous substances.

THE PREVENTION OF CRUELTY TO ANIMAL ACT (PCA), 1960

• To prevent the infliction of unnecessary pain or suffering on animals.

• Animal Board of India was constituted under this act.

THE WILDLIFE PROTECTION ACT, 1972

• It was enacted for protection of wild animals, plants, birds etc.

• National Board for wildlife and National Tiger conservation authority are constituted under this act.

• National Parks sanctuaries, conservation reserves, community reserves, marine reserves etc. are constituted under this act.

THE ENVIRONMENT PROTECTION ACT, 1986

• To regulate environmental pollution, laying down procedures and standards for industrial waste, emissions, hazardous waste

• Environment Protection Authority, eco-sensitive zones constituted under this act

QUESTION 6

Q. Consider the following statements: [2014 - I]

1. Animal Welfare Board of India is established under the Environment (Protection) Act, 1986.

2. National Tiger Conservation Authority is a statutory body.

3. National Ganga River Basin Authority is chaired by the Prime Minister.

Which of the statements given above is/are correct?

(a) 1 only

(b) 2 and 3 only

(c) 2 only

(d) 1, 2 and 3

Answer: b

EXPLANATION

NATIONAL TIGER CONSERVATION AUTHORITY

• The National Tiger Conservation Authority was launched in 2005. It was given statutory status by 2006 amendment of the Wildlife Protection Act.

• Environment Minister is the Chairman of the NTCA. Below chairman are eight experts or professionals.

• NTCA is the overarching body for conservation of tigers in India. Its main administrative function is to approve the Tiger Conservation Plan prepared by the State Governments.

• Every year, the Central Government puts the annual report of the National Tiger Conservation Authority in each House of Parliament.

NATIONAL GANGA RIVER BASIN AUTHORITY

• It is a financing, planning, implementing, monitoring and coordinating authority for the Ganges River, functioning under the water resource ministry of India.

• It was established in 2009 under the Environment Protection Act, 1986.

• There are total of 23 members of the NGRBA. The Prime Minister is the chair of the Authority. Other members include chief ministers of states through which Ganga flows, select union cabinet ministers and some experts.

DO IT YOURSELF

QUESTION 7

Q. Which of the following are the key features of 'National Ganga River Basin Authority (NGRBA)'?

1. River basin is the unit of planning and management.

2. It spearheads the river conservation efforts at the national level.

3. One of the Chief Ministers of the States through which the Ganga flows becomes the Chairman of NGRBA on rotation basis.

Select the correct answer using the code given below.

(a) 1 and 2 only

(b) 2 and 3 only

(c) 1 and 3 only

(d) 1, 2 and 3

QUESTION 8

Q. With reference to 'Eco-Sensitive Zones', which of the following statements is/are correct? [2014 - I]

1. Eco-Sensitive Zones are the areas that are declared under the Wildlife (Protection) Act, 1972.

2. The purpose of the declaration of Eco-Sensitive Zones is to prohibit all kinds of human activities in those zones except agriculture.

Select the correct answer using the code given below.

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

Answer: d

EXPLANATION

ECO SENSITIVE ZONES

• Environment Protection Act, 1986 says that Central Government can restrict areas in which any industries, operations or processes shall not be carried out on the basis of considerations like

✓ the biological diversity of an area

✓ maximum allowable limits of concentration of pollutants for an area

✓ environmentally compatible land use

✓ proximity to protected areas.

• Thus, government has declared Eco-Sensitive Zones or Ecologically Fragile Areas (EFA). The MoEF (Ministry of Environment & Forests) has approved a comprehensive set of guidelines laying down parameters and criteria for declaring ESAs.

• Not all human activities are prohibited in these areas. It permits cottage industries, erection of telecom and electricity wires, tourism, hot-air balloons, agriculture and so on.

QUESTION 9

Q. With reference to Bombay Natural History Society (BNHS), consider the following statements:

[2014 - I]

1. It is an autonomous organization under the Ministry of Environment and Forests.

2. It strives to conserve nature through action-based research, education and public awareness.

3. It organizes and conducts nature trails and camps for the general public.

Which of the statements given above is/are correct?

(a) 1 and 3 only

(b) 2 only

(c) 2 and 3 only

(d) 1, 2 and 3

Answer: c

EXPLANATION

BOMBAY NATURAL HISTORY SOCIETY

• The Bombay Natural History Society, founded on 15 September 1883, is one of the largest non-governmental organisations in India engaged in conservation and biodiversity research.

• It supports many research efforts through grants and publishes the Journal of the Bombay Natural History Society.

• Many prominent naturalists, including the ornithologists Salim Ali and S. Dillon Ripley, have been associated with it.

• BNHS is the partner of Bird Life International in India. It has been designated as a 'Scientific and Industrial Research Organisation' by the Department of Science and Technology.

• Its headquarter is in Mumbai and has one regional centre at Wetland Research and Training Centre, near Chilka Lake, Odisha.

DO IT YOURSELF

QUESTION 10

Q. Gadgil Committee Report' and 'Kasturirangan Committee Report', sometimes seen in the news, are related to

(a) constitutional reforms

(b) Ganga Action Plan

(c) linking of rivers

(d) protection of Western Ghats

QUESTION 11

Q. With reference to India, consider the following Central Acts:

1. Import and Export (Control) Act, 1947

2. Mining and Mineral Development (Regulation) Act, 1957

3. Customs Act, 1962

4. Indian Forest Act, 1927

Which of the above Acts have relevance to/bearing on the biodiversity conservation in the country? [2011]

(a) 1 and 3 only

(b) 2,3 and 4 only

(c) 1,2,3 and 4

(d) None of the above Acts

Answer: c

EXPLANATION

CENTRAL ACTS AND RULES HAVING RELEVANCE TO BIODIVERSITY CONSERVATION

- Fisheries Act, 1897
- Destructive Insects and Pests Act, 1914
- The Indian Forest Act, 1927
- Agricultural Produce (Grading and Marketing) Act,1937
- Indian Coffee Act, 1942
- Mining and Mineral Development (Regulation) Act,1957
- Prevention of Cruelty to Animals Act, 1960
- Customs Act, 1962
- Cardamom Act, 1965
- Seeds Act, 1966
- The Patents Act, 1970
- Wildlife (Protection) Act, 1972
- Marine Products Export Development Authority Act,1972
- Water (Prevention and Control of Pollution) Act, 1974
- Territorial Water, Continental Shelf, Exclusive Economic Zone and other Maritime Zones Act, 1976

• Water (Prevention and Control of Pollution) Cess Act, 1977

• Maritime Zones of India (Regulation and Fishing by Foreign Vessels) Act. 1980

• Forest (Conservation) Act, 1980

• Air (Prevention and Control of Pollution) Act, 1981

• Agricultural and Processed Food Products Export Development Authority Act, 1985/1986

• Environment (Protection) Act, 1986

• Spices Board Act, 1986

• National Dairy Development Board, 1987

• Rules for the manufacture, use/import/export and storage of hazardous microorganisms/ genetically engineered organisms or cells, 1989

• Foreign Trade (Development and Regulation) Act, 1992 [Imports and Exports (Control) Act, 1947 got repealed with the enactment of Foreign Trade (Development and Regulation) Act, 1992.]

• Protection of Plant Varieties and Farmers' Rights (PPVFR) Act, 2001

• Biological Diversity Act, 2002

• Plant Quarantine (Regulation of Import into India) Order, 2003

• Biological Diversity Rules, 2004

• The Food Safety and Standards Act, 2006

• Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006.

QUESTION 12

Q. On which of the following can you find the Bureau of Energy Efficiency Star Label?

1. Ceiling fans

2. Electric geysers

3. Tubular fluorescent lamps

Select the correct answer using the code given below.

(a) 1 and 2 only

(b) 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

Answer: d

EXPLANATION

BUREAU OF ENERGY EFFICIENCY

The Bureau of Energy Efficiency is an agency of the Government of India, under the Ministry of Power created in March 2002 under the provisions of the nation's 2001 Energy Conservation Act.

Functions

• The agency's function is to develop programs which will increase the conservation and efficient use of energy in India.

• The mission of Bureau of Energy Efficiency is to "institutionalise" energy efficiency services, enable delivery mechanisms in the country and provide leadership to energy efficiency in all sectors of the country.

Energy Ratings

• Energy labels (or more explicitly called energy-efficiency labels) are informative labels affixed to manufactured products to indicate the product's energy performance.

• The energy parameters indicate quantitatively how much energy is consumed by the product or the energy efficiency rating of that product and/or, other related requirements.

QUESTION 13

Q. With reference to the Indian Renewable Energy Development Agency Limited (IREDA), which of the following statements is/are correct? [2015-I]

1. It is a Public Limited Government Company

2. It is a Non - Banking Financial Company.

Select the correct answer using the code given below.

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

Answer: c

EXPLANATION

INDIAN RENEWABLE ENERGY DEVELOPMENT AGENCY (IREDA)

• The Indian Renewable Energy Development Agency (IREDA) is a NonBanking Financial Institution under the administrative control of Ministry of New and Renewable Energy for providing term loans for renewable energy and energy efficiency projects.

INTERNATIONAL TREATIES/PROTOCOLS AND ORGANISATIONS

In this chapter, we will be analysing the Previous Year UPSC Prelims Questions asked in context of International treaties and organization. Let's go through the topic first.

UN EARTH SUMMITS

• The Earth Summits are decennial meetings of world leaders, organized since 1972 with help of the United Nations, to help defining ways to stimulate sustainable development at the global level.

• The first summit, United Nations Conference on the Human Environment, took place in Stockholm, Sweden in 1972. The second summit was in Nairobi, Kenya in 1982, the third in Rio de Janeiro (Brazil) in 1992 and the fourth in Johannesburg, South Africa in 2002.

• Last Earth Summit, called Rio+20, also took place in Rio de Janeiro in 2012.

RIO SUMMIT, 1992

• The United Nations Conference on Environment and Development (UNCED) (also known as Rio Summit) was the third UN earth summit held in Rio de Janeiro, Brazil from 3 to 14 June 1992.

• Earth Summit was held as a response for Member States to cooperate together internationally on environment and sustainable development issues.

• This summit resulted in various landmark international conventions and agreements to combat climate change, protect biodiversity and promote sustainable development.

• It was attended by 172 countries and many NGOs, scientists and other civil society groups.

OUTCOME OF RIO SUMMIT, 1992

• The Rio Declaration on Environment and Development

• The Convention on Biological Diversity:

legally binding agreement to protect

biodiversity

• The Framework Convention on Climate

Change: legally binding treaty to combat

climate change

• Principles of Forest Management: non-legally

binding document that makes

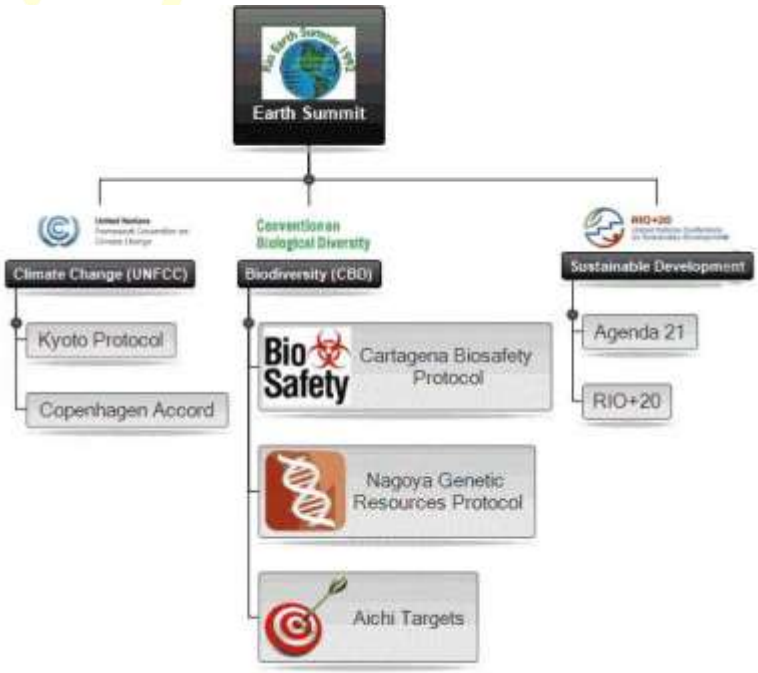
several recommendations for

conservation and sustainable

development forestry

• Agenda 21: a non-binding action plan for

sustainable development



• Convention to Combat Desertification:

legally binding convention to check desertification.

Johannesburg Summit, 2002

• The World Summit on Sustainable Development (WSSD), or Rio+10, was convened to discuss sustainable development by the United Nations.

• The Johannesburg Declaration on Sustainable Development was adopted

Rio Summit, 2012

• The United Nations Conference on Sustainable Development (UNCSD), also known as Rio 2012, Rio+20 was the third international conference on sustainable development.

• Major Outcome:

✓ Partnership for Action on Green Economy (PAGE), to assist interested countries in developing, adopting and implementing inclusive green economy policies and strategies

Now try to solve these questions which are based on summits.

QUESTION 1

Q. What is Rio+20 Conference, often mentioned in the news? [2015-I]

(a) It is the United Nations Conference on Sustainable Development

(b) It is a Ministerial Meeting of the World Trade Organization

(c) It is a Conference of the Inter-governmental Panel on Climate Change

(d) It is a Conference of the Member Countries of the Convention on Biological Diversity

Answer: a

QUESTION 2

Q. With reference to 'Agenda 21', sometimes seen in the news, consider the following statements : [2016]

1. It is a global action plan for sustainable development

2. It originated in the World Summit on Sustainable Development held in Johannesburg in 2002.

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

Answer: a

QUESTION 3

Q. The Partnership for Action on Green Economy (PAGE), a UN mechanism to assist countries transition towards greener and more inclusive economies, emerged at [2018]

(a) The Earth Summit on Sustainable Development 2002, Johannesburg

(b) The United Nations Conference on Sustainable Development 2012, Rio de Janeiro

(c) The United Nations Framework Convention on Climate Change 2015, Paris

(d) The World Sustainable Development Summit 2016, New Delhi

Answer: b

QUESTION 4

Q. What is/are the importance/importance of the 'United Nations Convention to Combat Desertification'?

1. It aims to promote effective action through innovative national programs and supportive international partnerships.

2. It has a special/particular focus on South Asia and North Africa regions, and its Secretariat facilitates the allocation of major portion of financial resources to these regions.

3. It is committed to bottom-up approach, encouraging the participation of local people in combating

the desertification.

Select the correct answer using the code given below. [2016]

(a) 1 only

(b) 2 and 3 only

(c) 1 and 3 only

(d) 1, 2 and 3

Answer: c

EXPLANATION

UNITED NATIONS CONVENTION TO COMBAT DESERTIFICATION (UNCCD)

• The Convention stemmed from a direct recommendation of the Rio Conference's Agenda 21, was adopted in Paris, France in 1994 and entered into force in 1996.

• UNCCD is a Convention to combat desertification and mitigate the effects of drought through national action programs (NAP) that incorporate long-term strategies supported by international cooperation and partnership arrangements.

It collaborates closely with Convention on Biodiversity.
• It does not allocate any financial resources to the regions concerned.

• The convention has established a Committee on Science and Technology (CST) with representatives competent in the fields of expertise relevant to combating desertification and mitigating the effects of drought.

• It is the only internationally legally binding framework set up to address the problem of desertification.

• To help publicize the Convention, 2006 was declared "International Year of Deserts and Desertification".

• The Conference of the Parties (COP) oversees the implementation of the Convention. It is held biennially. Last COP was COP 13 in Ordos City, China.

• The COP 14 will be held in 2019 in New Delhi.

QUESTION 5

Q. Consider the following statements: [2005]

1. Kyoto protocol came into force in the year 2005.

2. Kyoto protocol deals primarily with the depletion of the ozone layer.

3. Methane as a greenhouse gas is more harmful than carbon dioxide.

Which of the statements given above is/are correct?

(a) 1 and 2

(b) 1 and 3

(c) 1 only

(d) 3 only

Answer: b

EXPLANATION

UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE (UNFCCC)

• UNFCCC is negotiated at the United Nations Conference on Environment and Development (UNCED), 1992.

• UNFCCC provides a framework for negotiating specific international treaties (called "protocols") that aim to set binding limits on greenhouse gases.

• The parties to the convention have met annually from 1995 in Conferences of the Parties (COP) to assess progress in dealing with climate change.

• The first UN Climate Change Conference (COP 1) was held in 1995 in Berlin. Last COP (COP 24) was held in Katowice, Poland. The 25th session of the Conference of the Parties (COP 25) will be organized by Chile.

Kyoto Protocol

• The Kyoto Protocol was adopted in Kyoto, Japan, in 1997 (COP 3). There are currently 192 Parties.

• The Kyoto Protocol applies to the six greenhouse gases listed in Annex A:

✓ Carbon dioxide (CO_2)

✓ Methane (CH_4),

✓ Nitrous oxide (N_2O),

✓ Hydrofluorocarbons (HFCs),

✓ Perfluorocarbons (PFCs),

✓ Sulphur hexafluoride (SF_6).

Features of Kyoto Protocol

• Principle of common but differentiated responsibilities: it acknowledges that individual countries have different capabilities in combating climate change and therefore puts the obligation to reduce current emissions on developed countries on the basis that they are historically responsible for the current levels of greenhouse gases in the atmosphere.

• Two commitment periods: 2008-12 and 2013-2020 (Doha Amendment, COP 18). Each commitment period has its own binding targets set for developed countries to reduce their GHG emissions.

Classification of Parties and their commitments:

✓ Annex I: legally binding commitments to reduce emissions of greenhouse gases. Includes developed countries [US, UK, Russia etc.] + Economies in transition (EIT) [Ukraine, Turkey, some eastern European countries etc.]

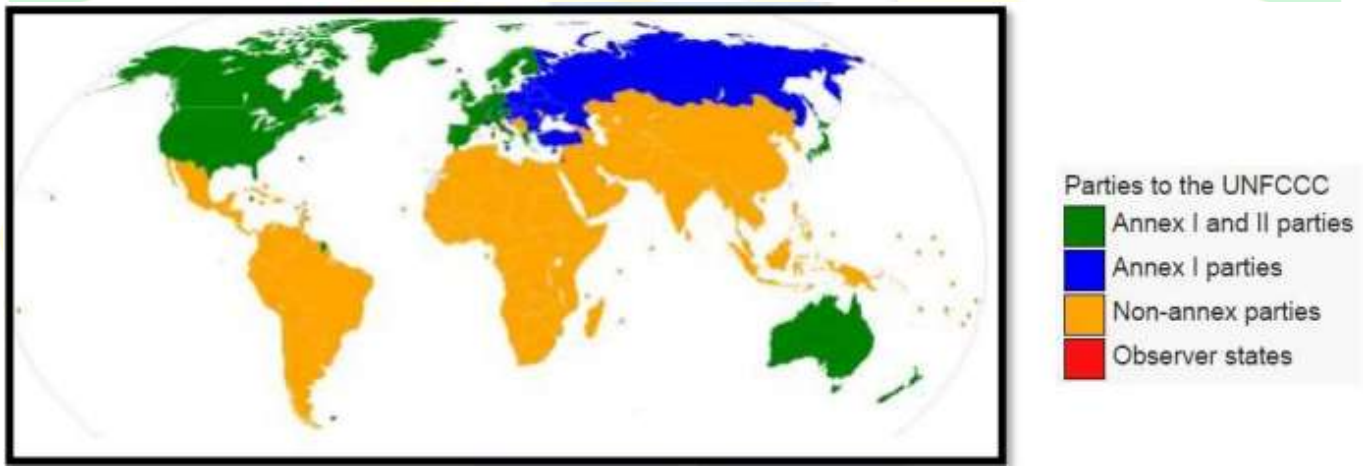
✓ Annex II: subset of Annex I. Countries required to provide financial and technical support to the EITs and developing countries to assist them in reducing their greenhouse gas emissions.

✓ Annex B: Annex I Parties with first or second-round Kyoto greenhouse gas emissions targets.

✓ Non-Annex I: No binding targets to reduce GHG emissions. Mostly low-income developing countries.

✓ LDCs: Least-developed countries. No binding targets to reduce GHG emissions.

• Developing countries may volunteer to become Annex I countries when they are sufficiently developed.



Flexible Market Mechanisms: Kyoto Protocol

• Countries bound to Kyoto targets have to meet them largely through domestic action— that is, to reduce their emissions onshore. But they can meet part of their targets through three "marketbased mechanisms" like:

1. Clean Development Mechanism (CDM): allows a country with an emission-reduction or emission-limitation commitment under the Kyoto Protocol (Annex B Party) to implement an emission-reduction project in developing countries.

2. Emission Trading:

✓ Trading of carbon credits. One credit gives the country or a company right to emit one tonne of CO_2.

✓ Carbon credits or carbon offsets can be acquired through afforestation, renewable energy, CO2 sequestration, methane capture, buying from an exchange (carbon credits trading) etc.

✓ Carbon credits are traded at various exchanges across the world. Multi-Commodity Exchange of India (MCX) launched futures trading in carbon credits in 2009.

✓ Offset trading: investing some amount of money in such green projects which will emit lesser amount of greenhouse gas in the atmosphere.

✓ Joint Implementation (JI): allows a country with an emission reduction commitment (Annex B Party) to earn emission reduction units (ERUs) from an emission-reduction project in another Annex B Party, each equivalent to one tonne of CO_2, which can be counted towards meeting its Kyoto target.

QUESTION 6

Q. Regarding "carbon credits'', which one of the following statements is not correct? [2011]

(a) The carbon credit system was ratified in conjunction with the Kyoto Protocol.

(b) Carbon credits are awarded to countries or groups that have reduced greenhouse gases below their emission quota.

(c) The goal of the carbon credit system is to limit the increase of carbon dioxide emission.

(d) Carbon credits are traded at a price fixed from time to time by the United Nations Environment Programme.

Answer: d

QUESTION 7

Q. With reference to the Agreement at the UNFCCC Meeting in Paris in 2015, which of the following statements is/are correct?

1. The Agreement was signed by all the member countries of the UN and it will go into effect in 2017.

2. The Agreement aims to limit the greenhouse gas emissions so that the rise in average global temperature by the end of this century does not exceed 2 °C or even 1.5 °C above pre-industrial levels.

3. Developed countries acknowledged their historical responsibility in global warming and committed to donate $ 1000 billion a year from 2020 to help developing countries to cope with climate change.

Select the correct answer using the code given below. [2016]

(a) 1 and 3 only

(b) 2 only

(c) 2 and 3 ony

(d) 1, 2 and 3

Answer: b

EXPLANATION

PARIS AGREEMENT

• It is an agreement within the United Nations Framework Convention on Climate Change (UNFCCC), dealing with greenhouse-gas-emissions mitigation, adaptation, and finance, starting in the year 2020.

• It was negotiated by representatives of 196 state parties at the COP 21 at Paris and was adopted by consensus in 2015.

• The Paris Agreement's long-term goal is to keep the increase in global average temperature to well below 2 °C above pre-industrial levels; and to limit the increase to 1.5 °C, since this would substantially reduce the risks and effects of climate change.

• Contributions each individual country should make to achieve the worldwide goal are determined by all countries individually and are called Intended nationally determined contributions (INDCs).

• Under the agreement, the developed countries reaffirmed the commitment to mobilize $100 billion a year in climate finance by 2020 and agreed to continue mobilizing finance at the level of $100

billion a year until 2025.

• As of February 2019, 194 states and the European Union have signed the Agreement. 184 states and the EU, representing more than 87% of global greenhouse gas emissions, have ratified or acceded to the Agreement, including China, the United States and India.

DO IT YOURSELF

QUESTION 8

Q. The term 'Intended Nationally Determined Contributions' is sometimes seen in the news in the context of [2016]

(a) pledges made by the European countries to rehabilitate refugees from the war-affected Middle East

(b) plan of action outlined by the countries of the world to combat climate change

(c) capital contributed by the member countries in the establishment of Asian Infrastructure Investment Bank

(d) plan of action outlined by the countries of the world regarding Sustainable Development Goals

QUESTION 9

Q. Consider the following pairs:

Terms sometimes seen in the news	**Their origin**
1. Annex I Countries	Cartagena Protocol
2. Certified Emissions Reductions	Nagoya Protocol
3. Clean Development Mechanism	Kyoto Protocol

Which of the pairs given above is/are correctly matched? [2016]

(a) 1 and 2 only

(b) 2 and 3 only

(c) 3 only

(d) 1, 2 and 3

QUESTION 10

Q. Consider the following international agreements: [2014 - I]

1. The International Treaty on Plant Genetic Resources for Food and Agriculture

2. The United Nations Convention to Combat Desertification

3. The World Heritage Convention

Which of the above has/have a bearing on the biodiversity?

(a) 1 and 2 only

(b) 3 only

(c) 1 and 3 only

(d) 1, 2 and 3

Answer: d

EXPLANATION

CONVENTION ON BIOLOGICAL DIVERSITY

• The historic Convention on Biological Diversity (Biodiversity Convention – a multilateral treaty) was opened for signature at the Earth Summit in Rio de Janeiro in 1992 and entered into force in 1993.

• The convention called upon all nations to take appropriate measures for conservation of biodiversity and sustainable utilisation of its benefits.

• The Convention has three main goals:

✓ conservation of biological diversity (or biodiversity);

✓ sustainable use of its components

✓ fair and equitable sharing of benefits arising from genetic resources.

• All UN member states—except for the United States—have ratified the treaty.

CARTAGENA PROTOCOL

• The Cartagena Protocol on Biosafety is an international treaty governing the movements of living modified organisms (LMOs) resulting from modern biotechnology from one country to another.

• It seeks to protect biological diversity from the potential risks posed by living modified organisms resulting from modern biotechnology.

• It was adopted in 2000 and entered into force on 11 September 2003.

THE NAGOYA PROTOCOL

• The Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization, also known as the Nagoya Protocol on Access and Benefit Sharing (ABS), is a 2010 supplementary agreement to the CBD.

• Its aim is the implementation of one of the three objectives of the CBD: the fair and equitable sharing of benefits arising out of the utilization of genetic resources, thereby contributing to the conservation and sustainable use of biodiversity.

INTERNATIONAL TREATY ON PLANT GENETIC RESOURCES FOR FOOD AND AGRICULTURE

• Popularly known as the International Seed Treaty. It is a comprehensive international agreement in harmony with the Convention on Biological Diversity.

• It aims at guaranteeing food security through the conservation, exchange and sustainable use of the world's plant genetic resources for food and agriculture (PGRFA), as well as the fair and equitable benefit sharing arising from its use.

QUESTION 11

Q. Consider the following statements:

1. The International Solar Alliance was launched at the United Nations Climate Change Conference in 2015.

2. The Alliance includes all the member countries of the United Nations.

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

Answer: a

EXPLANATION

INTERNATIONAL SOLAR ALLIANCE

• International Solar Alliance (ISA) is conceived as a coalition of solar resource rich countries to address their special energy needs and will provide a platform to collaborate on addressing the identified gaps through a common, agreed approach.

• The alliance is a treaty-based inter-governmental organization launched during the COP 21 to the UNFCCC at Paris, France in 2015.

• The ISA Framework Agreement was opened for signature during the CoP-22 at Marrakesh on 15th November 2016.

• Out of total of 122 prospective countries, 73 have signed the agreement and 55 countries have ratified it.

• It is now open to all UN member countries but focuses on the solar resource rich countries situated between the two tropics.

• It is headquartered in Gurugram, Haryana.

QUESTION 12

Q. Which one of the following is associated with the issue of control and phasing out of the use of ozone depleting substances? [2015-I]

(a) Bretton Woods Conference

(b) Montreal Protocol

(c) Kyoto Protocol

(d) Nagoya Protocol

Answer: b

EXPLANATION

MONTREAL PROTOCOL

• The Montreal Protocol on Substances that Deplete the Ozone Layer is a protocol to the Vienna Convention for the Protection of the Ozone Layer.

• It is an international treaty designed to protect the ozone layer by phasing out the production of numerous substances that are responsible for ozone depletion.

• It was agreed on 16 September 1987 and entered into force on 16 September 1989.

• The ozone treaty is the first universally ratified treaty in United Nations history.

QUESTION 13

Q. What is 'Greenhouse Gas Protocol'? [2016]

(a) It is an international accounting tool for government and business leaders to understand, quantify and manage greenhouse gas emissions

(b) It is an initiative of the United Nations to offer financial incentives to developing countries to reduce greenhouse gas emissions and to adopt eco-friendly technologies

(c) It is an inter-governmental agreement ratified by all the member countries of the United Nations to reduce greenhouse gas emissions to specified levels by the year 2022

(d) It is one of the multilateral REDD+ initiatives hosted by the World Bank

Answer: a

EXPLANATION

Greenhouse Gas Protocol

• The Greenhouse Gas (GHG) establishes comprehensive global standardized frameworks to measure and manage greenhouse gas (GHG) emissions from private and public sector operations, value chains and mitigation actions.

• It is developed by World Resources Institute (WRI) and World Business Council on Sustainable Development (WBCSD).

• Hundreds of companies and organizations around the world are using GHG Protocol standards and tools to manage their emissions and become more efficient, resilient, and prosperous organizations.

QUESTION 14

Q. Which of the following statements is/are correct?

Proper design and effective implementation of UNREDD+ Programme can significantly contribute

to

1. protection of biodiversity

2. resilience of forest ecosystems

3. poverty reduction

Select the correct answer using the code given below. [2016]

(a) 1 and 2 only

(b) 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

Answer: d

EXPLANATION

UNREDD

• The United Nations Programme on Reducing Emissions from Deforestation and Forest Degradation (or UN-REDD Programme) is a collaborative programme of the Food and Agriculture Organization of the United Nations (FAO), the United Nations Development Programme (UNDP) and the United Nations Environment Programme (UNEP), created in 2008.

• REDD originally referred to "reducing emissions from deforestation in developing countries" the title of the original document on REDD. It was superseded in the negotiations by REDD+

UNREDD+

• Reducing emissions from deforestation and forest degradation and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries (REDD+) was first negotiated under the United Nations Framework Convention on Climate Change (UNFCCC) in COP 13 at Bali, Indonesia.

• REDD+ goes beyond deforestation and forest degradation, and includes the role of conservation, sustainable management of forests and enhancement of forest carbon stocks.

• REDD+ has the potential to simultaneously contribute to climate change mitigation and poverty alleviation, whilst also conserving biodiversity and sustaining vital ecosystem services.

DO IT YOURSELF

QUESTION 15

Q. "Momentum for Change: Climate Neutral Now" is an initiative launched by [2018]

(a) The Intergovernmental Panel on Climate Change

(b) The UNEP Secretariat

(c) The UNFCCC Secretariat

(d) The World Meteorological Organisation

QUESTION 16

Q. Consider the following statements in respect of Trade Related Analysis of Fauna and Flora in Commerce (TRAFFIC):

1. TRAFFIC is a bureau under United Nations Environment Programme (UNEP).

2. The mission of TRAFFIC is to ensure that trade in wild plants and animals is not a threat to the conservation of nature.

Which of the above statements is/are correct? [2017]

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

Answer: b

QUESTION 17

Q. With reference to the International Union for Conservation of Nature and Natural Resources (IUCN) and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), which of the following statements is/are correct? [2015-I]

1. IUCN is an organ of the United Nations and CITES is an international agreement between governments.

2. IUCN runs thousands of field projects around the world to better manage natural environments.

3. CITES is legally binding on the States that have joined it, but this Convention does not take the place of national laws.

Select the correct answer using the code given below.

(a) 1 only

(b) 2 and 3 only

(c) 1 and 3 only

(d) 1, 2 and 3

Answer: b

EXPLANATION

TRAFFIC

• TRAFFIC, the Wildlife Trade Monitoring Network, is the leading nongovernmental organisation working globally on the trade of wild animals and plants in the context of both biodiversity and sustainable

development.

• It was founded in 1976 as a strategic alliance of the Worldwide Fund for Nature (WWF) and the International Union for the Conservation of Nature (IUCN).

• TRAFFIC's work involves research, publication of influential reports, projects, education, outreach and advocacy on the issue of wildlife trade.

WORLDWIDE FUND FOR NATURE

• The Worldwide Fund for Nature (WWF) is world's largest conservation nongovernmental organization working in more than 100 countries.

• It was founded in 1961, working in the field of the wilderness preservation, and the reduction of human impact on the environment.

• The Living Planet Report & Living Planet Index is published every two years by WWF.

• WWF has launched several notable worldwide campaigns including Earth Hour and Debt-for-Nature Swap, and its current work is organized around these six areas: food, climate, freshwater, wildlife, forests, and oceans.

IUCN

• International Union for Conservation of Nature and Natural Resources is an international organization working in the field of nature conservation and sustainable use of natural resources.

• IUCN was established on 5 October 1948, in Fontainebleau, France.

• It is involved in data gathering and analysis, research, field projects, advocacy, and education.

• IUCN has observer and consultative status at the United Nations and plays a role in the implementation of several international conventions on nature conservation and biodiversity.

• It was involved in establishing the Worldwide Fund for Nature and the World Conservation Monitoring Centre.

• It produces **the IUCN Red List of Threatened Species and the IUCN Red List of Ecosystems.**

CITES

• Convention on International Trade in Endangered Species of Wild Fauna and Flora, also known as the Washington Convention, is a multilateral treaty to protect endangered plants and animals.

• The convention was opened for signature in 1973 and CITES entered into force on 1 July 1975.

• Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten the survival of the species in the wild, and it accords varying degrees of protection to more than 35,000 species of animals and plants.

DO IT YOURSELF

QUESTION 18

Q. Consider the following statements regarding 'Earth Hour': [2014 - I]

1. It is an initiative of UNEP and UNESCO.

2. It is a movement in which the participants switch off the lights for one hour on a certain day every year.

3. It is a movement to raise the awareness about the climate change and the need to save the planet.

Which of the statements given above is/are correct?

(a) 1 and 3 only

(b) 2 only

(c) 2 and 3 only

(d) 1, 2 and 3

QUESTION 19

Q. With reference to an organization known as 'Birdlife International', which of the following statements is/are correct? [2015-I]

1. It is a Global Partnership of Conservation Organizations.

2. The concept of 'biodiversity hotspots' originated from this organization.

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

Select the correct answer using the code given below.

(a) 1 only

(b) 2 and 3 only

(c) 1 and 3 only

(d) 1, 2 and 3

Answer: c

EXPLANATION

BIRDLIFE INTERNATIONAL

• Birdlife International (formerly the International Council for Bird Preservation) is a global partnership of conservation organisations that strives to conserve birds, their

habitats, and global biodiversity, working with people towards sustainability in the use of natural resources.

• It is the world's largest partnership of conservation organisations, with over 120 partner organisations

• Birdlife International is the official Red List authority for birds, for the International Union for Conservation of Nature.

• Birdlife International has identified more than 1,000 bird species threatened with extinction and has developed conservation strategies for each of them.

• Important Bird and Biodiversity Areas Programme is the flagship programme of the organisation.

• Bombay Natural History Society is the partner organisation in India.

QUESTION 20

Q. Bio Carbon Fund Initiative for Sustainable Forest Landscapes' is managed by the [2015-I]

(a) Asian Development Bank

(b) International Monetary Fund

(c) United Nations Environment Programme

(d) World Bank

Answer: d

QUESTION 21

Q. With reference to 'Global Environment Facility'', which of the following statements is/are correct? [2014]

(a) It serves as financial mechanism for 'Convention on Biological Diversity' and 'United Nations

Framework Convention on Climate Change'

(b) It undertakes scientific research on environmental issues at global level

(c) It is an agency under OECD to facilitate the transfer of technology and funds to underdeveloped countries with specific aim to protect their environment

(d) Both (a) and (b)

Answer: a

QUESTION 22

Q. Which of the following statements regarding 'Green Climate Fund' is/are correct? [2015-I]

1. It is intended to assist the developing countries in adaptation and mitigation practices to counter climate change.

2. It is founded under the aegis of UNEP, OECD, Asian Development Bank and World Bank.

Select the correct answer using the code given below.

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

Answer: a

EXPLANATION

GLOBAL ENVIRONMENT FACILITY

• The Global Environment Facility (GEF) was established on the eve of the 1992 Rio Earth Summit to help tackle our planet's most pressing

environmental problems.

• The GEF unites 183 countries in partnership with international institutions, civil society organizations (CSOs), and the private sector to address global environmental issues

• GEF provides grants for projects related to biodiversity, climate change, international waters, land degradation, the ozone layer, persistent organic pollutants (POPs), mercury, sustainable forest management, food security, sustainable cities.

• The GEF also serves as financial mechanism for the following conventions:

✓ Convention on Biological Diversity

✓ United Nations Framework Convention on Climate Change (UNFCCC)

✓ UN Convention to Combat Desertification (UNCCD)

✓ Stockholm Convention on Persistent Organic Pollutants (POPs)

✓ Minamata Convention on Mercury

MONTREAL PROTOCOL ON SUBSTANCES THAT DEPLETE THE OZONE LAYER

Green Climate Fund

• The Green Climate Fund (GCF) is a fund established within the framework of the UNFCCC as an operating entity of the Financial Mechanism to assist developing countries in adaptation and mitigation practices to counter climate change.

• The GCF is based in Incheon, South Korea. It is governed by a Board of 24 members and supported by a Secretariat.

Bio Carbon Fund

• The Biocarbon Fund Initiative for Sustainable Forest Landscapes (ISFL) is a multilateral fund,

supported by donor governments (Germany, Norway, UK, USA) and managed by the World Bank.

• It promotes reducing greenhouse gas emissions from the land sector, from deforestation and forest degradation in developing countries (REDD+), and from sustainable agriculture, as well as smarter land-use planning, policies and practices.

QUESTION 23

Q. Consider the following statements:

1. Climate and Clean Air Coalition (CCAC) to reduce Short Lived Climate Pollutants is a unique

initiative of G20 group of countries.

2. The CCAC focuses on methane, black carbon and hydrofluorocarbons.

Which of the statements given above is/are correct? [2017]

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

Answer: b

EXPLANATION

THE CLIMATE & CLEAN AIR COALITION

• The Climate & Clean Air Coalition is the global effort that unites governments, civil society and private sector, committed to improving air quality and protecting the climate in next few decades by reducing short-lived climate pollutants (SLCP) across sectors.

• The Coalition's objective is to address short-lived climate pollutants. Its initial focus is on methane, black carbon, and HFCs.

• Recognising that mitigating the impacts of short-lived climate pollutants is critical for addressing near-term climate change, the governments of Bangladesh, Canada, Ghana, Mexico, Sweden and the United States, along with the United Nations Environment Programme (UNEP), came together to initiate the first effort to treat these pollutants as a collective challenge.

DO IT YOURSELF

QUESTION 24

Q. Consider the following statements:

1. The Sustainable Development Goals were first proposed in 1972 by a global think tank called the

'Club of Rome'.

2. The Sustainable Development Goals have to be achieved by 2030.

Which of the statements given above is/are correct? [2016]

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

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