Nalanda Open University

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E-CONTENT 3

for

Part-I Examination, 2020

SHORT DESCRIPTION OF THE SUGGESTED TOPICS

PAPER – I

(FUNDAMENTALS OF ENVIRONMENTAL SCIENCE & ECOLOGY)

1. Introductory remarks on Environment and Environmental Science. Description of factors which influence Environment.

Introductory remarks on Environment and Environmental Science:

Environment: Everything that surrounds us and influences us directly or indirectly is collectively termed our environment. It includes all living and non-living things. The living components include plants, animals, human being and micro-organism and are called the biotic or biological components of the environment. The non-living components include sunlight, air, water and soil and are called the abiotic or physical components of the environment.

Natural Environment & Social Environment:

Natural Environment: The living and non-living world in nature which influence our life make up the natural environment. Each part of the environment is called Environment Factor or Environment Component which is not the same everywhere. This makes the natural environment of one place different from the natural environment of another place.

Social Environment: Man is the most evolved creature on our planet. By virtue of his intelligence and ability to change the natural surroundings (environment), man has created an environment of his choice and need. This is known as the social or man-made environment. Roads, Buildings, Factories, Bridges, Railway lines, Aeroplanes etc. are components of the social environment.

Environmental Science: Environmental Science deals with the study of life and life's environment. To be more precise, it deals with the study of atmosphere, the land, the oceans, and the great chemical cycles that flow through the physical and biological systems. The modern environmental science is increasingly becoming

interdisciplinary preparing people for global citizenship and training them to be flexible, yet competent analytic and decision takers.

Factors which influence Environment: The biotic and abiotic components of the environment keep on interacting with one another. This interdependence and interaction with one another provide natural balance and stability to the environment. This natural balance in environment is dynamic in nature and is affected both by abiotic factors as well as biotic factors.

Abiotic factors include temperature, pressure, light, humidity, precipitation, soil, water and air.

The biotic factors include plants, animals including human beings and microorganism which interact with one another in various manners benefitting one another (known by the term symbiosis) or harming one another (known by the term Antagonism)}.

Note – Further elaboration is required.

2. Description of the structure and composition of Atmosphere.

Composition of Atmosphere:

The atmosphere is the protective blanket of gases (called air) surrounding the earth, which saves life on the earth by shielding and protecting it from the harmful effects of cosmic rays coming from the sun and other stars.

The atmosphere has broadly speaking three categories of constituent gases- Major, Minor and Trace. For pollution free air at ground level the components may be expressed as percent (approximate) by volume as follows:

Major Components	:	Nitrogen(78%), Oxygen(21%), Water Vapor
Minor Components	:	Argon(0.93%), Water vapor(0.04%), Carbon dioxide(0.033%)
Common Trace elements include	:	Neon, Helium, Methane, Ozone, Krypton, Xenon, Hydrogen etc.

The volume percent of the four major gases in the dry atmosphere (Nitrogen, Oxygen, Carbon dioxide and Argon) remains relatively constant up to an altitude of about 80 Km. After this altitude the composition of air begins to change. Being a gaseous mixture, the atmosphere is mobile, elastic and compressible as well as expansible.

Structure (layers) of Atmosphere

The atmosphere is broadly divided into four major regions.

These are:

- Troposphere
- Stratosphere
- Mesosphere and
- Thermosphere.

If extends up to 500 Km. with temperatures varying from a minimum of -92^{o}C to a maximum of 1200^{o}C.

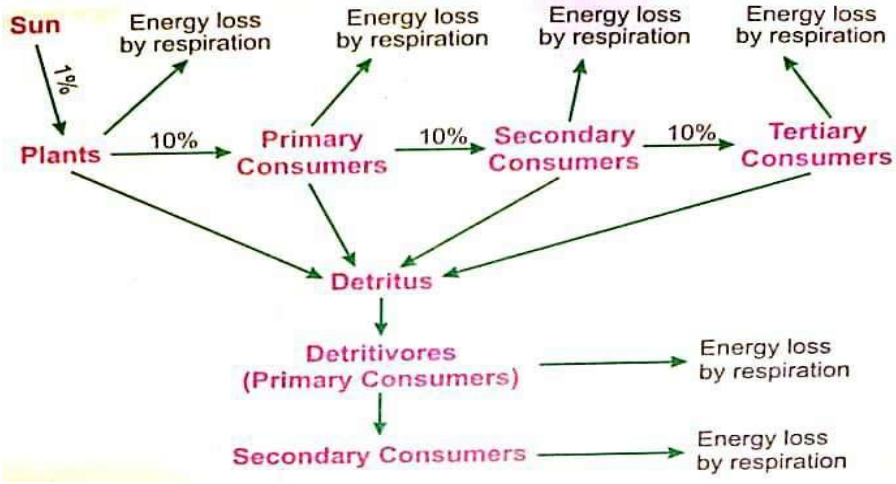
NOTE: Further elaboration is required.

3. **Energy sources and their flow in an ecosystem**.

Energy is defined as the capacity of all animate species and inanimate materials to do work. Energy is the single most essential requirement responsible for running the machinery of life of all living organisms.

Sun is the ultimate source of energy for all ecosystems (the term ecosystem used be elaborated later in topic no. 5). Of the solar energy (radiation) that falls on the earth, only 1-5 percent is captured by the producers (green leafy plants) and stored as chemical energy in the food they manufacture through photosynthesis. The bulk of the unutilized solar radiation is dissipated mostly as heat. This is how the energy from the sun enters the living world for running life processes.

A part of the energy stored by plants as food is utilized by them for their own metabolic activities. A small part of the energy stored in producers is transferred to the next trophic level of the ecosystem – herbivores - when they consume plants as food. From herbivores (primary consumers) energy flows to other trophic levels (secondary consumers and tertiary consumers) through 10% law. When the producers and consumers die, their remains i.e. unutilized biomass serve as food (energy source) to decomposers. Flow of energy in an ecosystem has diagrammatically been shown in the diagram below:



The energy flow in an ecosystem follows the two basic laws of thermodynamics - The First Law and the Second Law of thermodynamics.

NOTE - Further elaboration is required

4. **Origin and classification of Lakes. Description of transport phenomenon of fresh water bodies.**

Introduction:

There are two main types of fresh water ecosystems. They are:

i. Still Water ecosystems called lentic ecosystems, and
ii. Flowing Water ecosystems called lotic ecosystems.

Ponds and lakes are the example of Lentic ecosystems. Lakes are often larger and deeper than ponds and have water throughout the year. Lakes may be as deep as 100

meters or so and are spread over an area of few kilometers. Thus, a lake ecosystem functions like a giant, permanent pond system. Lakes occupy about 1.8% of the earth's surface.

Origin of Lakes:

Different natural and anthropogenic processes are responsible for origin of lakes:

Natural lakes are formed:

- By Glaciers
- By the Ice Scour
- By movement of Earth Crust
- By Volcanic Eruption
- By Rivers etc.

Artificial lakes are constructed for industrial or agricultural uses for hydroelectric power generation or domestic water supply, or for aesthetic, recreational purpose, or other activities.

Classification of Lakes:

Lakes have been classified in a number of ways based on their origin (i.e. mode of formation), thermal characteristics, thermal stratification etc.

I. Class of lakes based on the mode of formation (i.e. origin).

i. Lakes formed by Earth movement

This class includes

- Tectonic Lakes and
- Rift Valley Lakes

ii. Lakes formed by Glaciation

This class includes

- Cirque Lakes or Tarns
- Rock hollow Lakes and
- Lakes due to morainic damming of valleys

iii. Lakes formed by Volcanic Activity

This class includes

- Crater and
- Caldera Lakes

iv. Lakes formed by Erosion

This class includes

- Karst Lakes and
- Wind deflated Lakes

v. Lakes formed by Deposition

This class includes

- Lakes due to river deposits
- Lakes due to marine deposits

- Lakes due to damming of water
- Man-made Lakes

II. Classification based on Thermal Characteristics

This class of lakes include

i. Tropical Lakes
ii. Temperate Lakes

III. Classification based on Thermal stratification

This class of lakes include

i. Amictic Lakes
ii. Monomictic Lakes which include
    - Cold Monomictic Lakes
    - Warm Monomictic lakes
iii. Polymictic Lakes
iv. Oligomictic Lakes

One simple way of classification of lakes include

i. Temporary Lakes
ii. Permanent Lakes
iii. Fresh Water Lakes
iv. Saline Lakes

NOTE: Brief description of each type of Lakes (1-2 lines for each class) is required to be included in your answer.

5. Introductory description of the terms Ecology, Autecology and Synecology.

Ecology : Ecology is a discipline of science (more correctly a branch of Biology) which studies the interactions and interrelationship of living organism with one another and with their physical environment.

Ecology and Environmental Science: Environmental Science is basically interdisciplinary in nature incorporating at least three branches of study – Earth Science, Life Science and Social Science. It aims to prepare people for global citizenship who would apply knowledge from various disciplines for the study and management the environment – local, regional as well as global. Thus Ecology is one of the disciplines of Environmental Science.

Autecology : It is an approach in ecology which emphasizes on species specific adaptations of individual animals, plants or other organisms with one another and with their physical environment.

Synecology : It is an approach in ecology which studies group of organisms of different species which are associated together as a unit in form of a community. In other words Synecology is the study of ecology at level of the community. For this reason Synecology is also known as Community Ecology.

Note – Further elaboration is required.

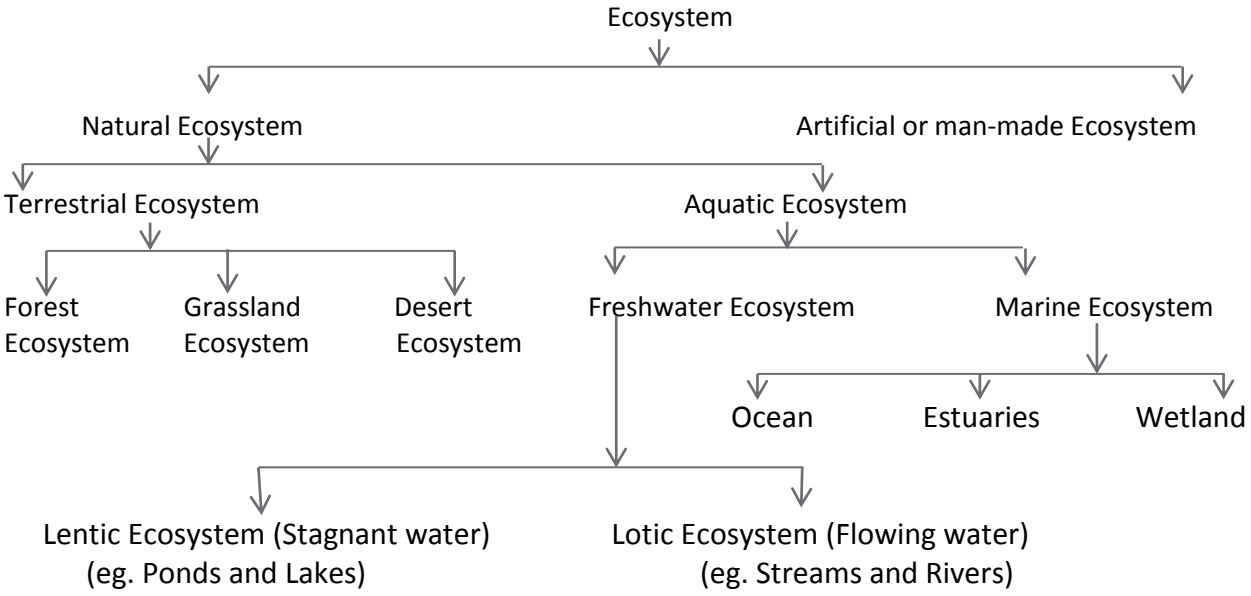
6. Definition and types of Ecosystem with suitable examples.

Biosphere is the part of the earth which houses the entire living organism on our planet. It includes all the three components on the earth: the lithosphere, the hydrosphere and the atmosphere with all their biotic as well as abiotic components. An organism cannot live and survive in isolation. Every organism in the biosphere is influenced by and in turn influences the biotic (living) and abiotic (nonliving) components of the biosphere through numerous modes of interaction. The biosphere consists of a number of smaller functional units with a specific and recognizable landscape form called Ecological System or Ecosystem. Thus, an Ecosystem is a closed and dynamic unit of biosphere which is self-regulating both in structure and function. The biological communities in an ecosystem are inseparably interrelated with one another and with physical environment through exchange of matter and energy.

An ecosystem may be as small as a little water in a petrydish and as large as forest or an ocean. The biosphere is itself the example of a large ecosystem. In fact, it is the largest ecosystem or the biological system of our planet.

In nature, two broad types of ecosystems may be recognized. They are terrestrial ecosystems and aquatic ecosystems. Moreover, human activities may bring about changes or modification in natural ecosystems for their own benefit. They are then called Man-modified ecosystems or Artificial ecosystems. A dam to store water, a spacecraft, agricultural land etc. are the examples of man-made ecosystems.

Types of Ecosystem have been shown diagrammatically in the figure below:



Note : Further elaboration on some common ecosystems eg. forest ecosystem, lentic ecosystem, ocean ecosystem and estuaries are required.

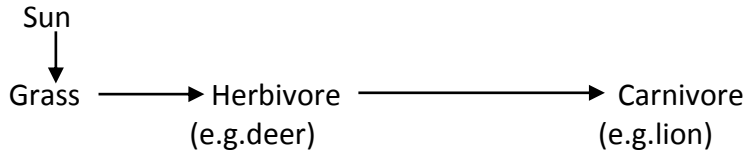
7. Descriptive notes on Trophic level, Food Chain and Food web.

Trophic level: In an ecosystem the living organism are distinguished on the basis of their nutritional relationship. The trophic (i. e. nutritional) structure of an ecosystem is one kind of producer-consumer arrangement, where each "food level" is known as Trophic level.

Food Chain: A food chain is the feeding relationship (eating and being eaten) between biotic components of an ecosystem. All trophic levels in an ecosystem are connected to each other by the transfer of food and energy. In other words, the transfer of energy and materials from one trophic to the next in an ecosystem occurs through food chains. The shorter the food chain the greater is the energy available to the terminal trophic level. A food chain proceeds with one organism per trophic level. In nature, two types of food chain can be distinguished. They are Grazing food chain and Detritus food chain.

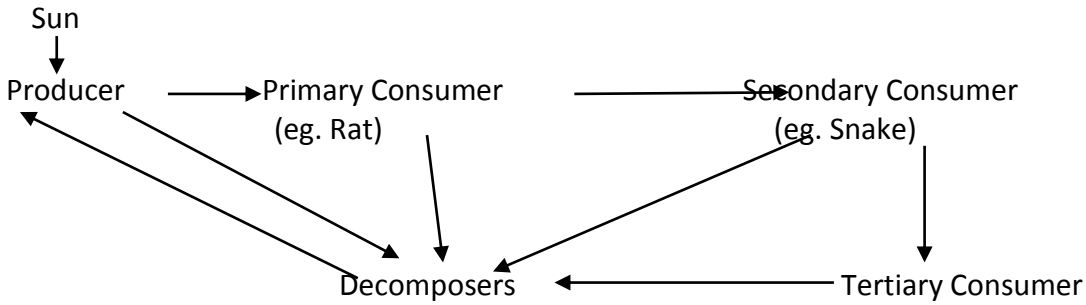
Grazing food chain:-

In a grazing food chain; the sun is the primary source of energy. The chain usually starts with a producer (plant) and ends with a predator (is tertiary carnivore).



Detritus Food Chain:-

Dead plants and animal remains are called detritus. A detritus food chain begins with dead plants and animals, which are its primary energy source. Primary consumers are detritivores (detritus eating microorganisms) which include bacteria, fungi and protozoa. The detritivores are eaten by secondary consumers which include larvae and nematodes. The chain terminates with large carnivores.



Detritus food chains are indispensable because they recycle the organic matter of grazing food chain and return it to nature in the form of simple inorganic substances.

Food Web

Food Chains with only linear steps occur very rarely. Manly animals have more than one food source. They are members of different food chains and many occupy different tropic levels in different food chains. Thus these animals are links between food chains. Different food chains in an ecosystem are inter-connected in this manner

and the complex network that results is called a food web. A food web shows all the feeding relationship in an ecosystem. Food web allows alternatives pathways for food availability and energy flow. This provides more stability and sustenance to an ecosystem. Converse of it, the shortening of food chain or shortening of food web due to human activities leads to imbalance in the functioning and stability of an ecosystem.

NOTE: Further elaboration is required.

8. Introduction of Biogeochemical Cycles. Description of at least two gaseous and one sedimentary biogeochemical cycles.

For growth and development every living organism essentially requires certain nutrients. These nutrients include carbohydrates, proteins, fats and minerals which are made up of chemical elements like carbon, hydrogen, oxygen, nitrogen, sulphur and phosphorus. The natural source of most of these elements is rocks, air and water. Hence they are called geochemical (geo - rocks, air and water).

Some nutrients are required in greater quantities and are, therefore, called macronutrients. The macronutrients include carbon, hydrogen, oxygen, nitrogen, phosphorus sulphur, potassium, calcium, magnesium and silicon. Other nutrients such as iron, zinc, copper, manganese, boron, molybdenum and chlorine which are required in very small amounts are called micronutrients.

Plants photosynthesise carbohydrates using carbon, hydrogen and oxygen obtained from carbon dioxide and water in presence of sunlight. However, for synthesis of more complex materials such as proteins and fats, plant roots absorb other essential geochemicals and using sunlight as energy source convert them into essential nutrients. These nutrients in plant bodies are called biochemicals (bio: living organism).

When plants and animals die, microorganisms (decomposers) decompose the bio-chemicals back into single inorganic compounds as carbon dioxide, nitrogen, oxygen water and carbon. These geo-chemicals re-inter the earth and are absorbed again by plants thus, the next cycle begins. This natural cycle of conversion of geo-chemicals into bio-chemicals and back to geo-chemicals which goes on continuously is called bio-geochemical cycle or nutrients cycle.

Biogeochemical cycles maintain the nutrient balance in nature. Through those cycles, every living organism receives its share of nutrients for carrying out its life cycle. In the well-ordered process of nutrients cycling a number of micro and macro organisms as well as some natural physicochemical process are involved.

Gaseous and Sedimentary Biogeochemical Cycles

The bio-geochemical cycles or nutrients cycles are of two types:-

i. Gaseous Cycles, and
ii. Sedimentary Cycles.

It may be noted that the major mass of nutrients are stored in abiotic reservoirs in practically inactive state only a smaller active form of nutrients is involved in cycling.

i. Gaseous Bio-geochemical Cycles:

In gaseous cycle, the nutrient elements are located in the atmosphere (air) or the hydrosphere (water). The well-known gaseous biogeochemical are:-

(a). Carbon Cycle, (b). Nitrogen Cycle and (c) .Oxygen Cycle

These gaseous cycles are fast and the elements remain almost uniformly in the cyclic pool.

ii. Sedimentary Bio-geochemical Cycles:

In sedimentary cycles the reservoirs of the nutrient elements exist in the sediments of the earth (i.e. in the earth crust). The well-known examples of sedimentary bio-geochemical cycles are

(a) Phosphorus Cycle and (b) Sulphur Cycle

Sedimentary cycles are very slow in action.

NOTE: Detailed description of common Gaseous and Sedimentary biogeochemical cycles are required to be prepared by the examinees.