CONCEPTS AND COMPONENTS OF ENVIRONMENT.

Everything that surrounds or affects an organism during its life time is collectively known as its environment or simply put everything surrounding a living organism like people; place and things constitute its environment which can be either natural or man-made. The word environment has been derived from a French word **'environner'** meaning to encircle or to surround. In the beginning, environment of early man consisted of only physical aspects of the planet earth such as land (lithosphere), air (atmosphere) and water (hydrosphere) along with biotic communities but, with the passage of time and advancement of society man extended his environment to include his social, economic and political functions too. At the organismic level it is essentially physiological interaction which tries to understand that how different organisms are adapted to their environment in terms of not only survival but also reproduction and propagation of their population. All organisms (from virus to man) are obligatorily dependent on the environment for various essential needs such as food, shelter, water, oxygen etc. The surrounding that affects an organism during its lifetime is collectively known as its environment. In another words "Environment is sum total of water, air and land inter-relationships among themselves and also with the human being, other living organisms and material goods". It comprises all the physical and biological surrounding and their connections. Environmental studies give an approach towards understanding the environment of our globe and the impact of human life upon the environment and vice-versa. Thus environment is actually universal in nature and it is a multidisciplinary subject counting physics, chemistry, geology, geography, history, economics, physiology, biotechnology, remote sensing, geophysics, soil science and hydrology etc.

Environment belongs to all the biotic and abiotic components and therefore is, vital for all. Consequently, everyone is affected by environmental issues like global warming, depletion of ozone layer, dwindling forest, depleting energy resources, loss of biodiversity etc. Environment also deals with the analysis of the processes in hydrosphere, atmosphere, lithosphere, and organisms which leads to pollute biosphere. Environment helps us for setting benchmark for safe and healthy natural ecosystem.

TYPES OF ENVIRONMENT: -

On the basis of basic structure, the environment may be divided into

- Physical/abiotic environment
- Biotic environment
- Cultural environment

PHYSICAL/ABIOTIC ENVIRONMENT: - on the basis of physical characteristics and state, abiotic or physical environment is subdivided into:

i. Solid i.e. lithosphere (solid earth)
ii. Liquid i.e. hydrosphere (water component)
iii. Gas i.e. atmosphere (gaseous component)

These environments can be termed as lithospheric, hydrospheric, atmospheric environment which can be further broken into smaller units based on different spatial scales like mountain environment, plateau, plain, lake, river maritime, glacier, desert environment etc. The physical environment may also be viewed in terms of climatic conditions providing certain suits of habitat for biological communities like tropical, temperate and polar environment etc.

BIOTIC ENVIRONMENT-: biotic environment consists of flora and fauna including man as an important factor. Thus the biotic environment may be divided into:

iv. Floral environment
v. Faunal environment

Further all the organisms work to form their social groups and organizations at several levels and thus is formed social environment, where in, the organisms work to derive matter from the physical environment for their sustenance and development. This process generates economic environment. It may be pointed out that of all the organisms man is the most skilled and civilize4d and hence his social organization is most systematic. It is significant to note that three aspects of man, physical, social and economic have different characteristics and functions in the biotic environment. As 'physical man' is one of the organismic populations or biological community and thus requires basic elements of physical environment (habitat, air, water, food etc.) like other biological populations and releases wastes into the ecosystem; 'social man' establishes social institutions forms social organizations, formulates laws and policies to safeguard his existence, interest and social welfare and 'economic man' derives and utilizes resource from the physical and biotic environments with his skills and technologies. These may be termed as physical, social and economic functions of man. It is the third function which makes the man and environmental process because he transports matter and energy from one component of the ecosystem to the other.

COMPONENTS OF ENVIRONMENT: -

The basic components of the environment are atmosphere or the air, lithosphere or the rocks and soil, hydrosphere or the water, and the living component of the environment or the biosphere.

ATMOSPHERE: -

- The thick gaseous layer surrounding the earth.
- It spreads up to 300 km. above the earth's surface.
- Apart from gases there are water vapor, industrial gases, dust and smoke particles in suspended state, microorganism etc.

LITHOSPHERE: -

The word lithosphere originated from a Greek word mean "rocky" + "sphere" i.e. the solid outmost shield of the rocky planet. The Earth is an oblate spheroid. It is composed of a number of different layers. These layers are:

- The Core which is around 7000 kilometers in diameter (3500 kilometers in radius) and is situated at the Earth's center.
- The Mantle which environs the core and has a thickness of 2900 kilometers.
- The Crust floats on top of the mantle and is composed of basalt rich oceanic crust and granitic rich continental crust.

HYDROSPHERE: -

- The hydrosphere includes all water on or near earth surface and includes oceans, lakes, rivers, wetlands, icecaps, clouds, soils, rock layers beneath surface etc.
- water exist in all three states: solid (ice), liquid (water), and gas (water vapor)
- 71%of planet surface is covered with water
- Freshwater- 2.53%

- Freshwater in glaciers-1.74%
- Water as water vapor in atmosphere-12,900 km^3
- living organism contain- 1100 km^3

Since the environment includes both physical and biological concept, it embraces both the abiotic (non-living) and biotic (living) components of planet earth. Thus, on account of basic structure the components of environment may be classified into two basic types:

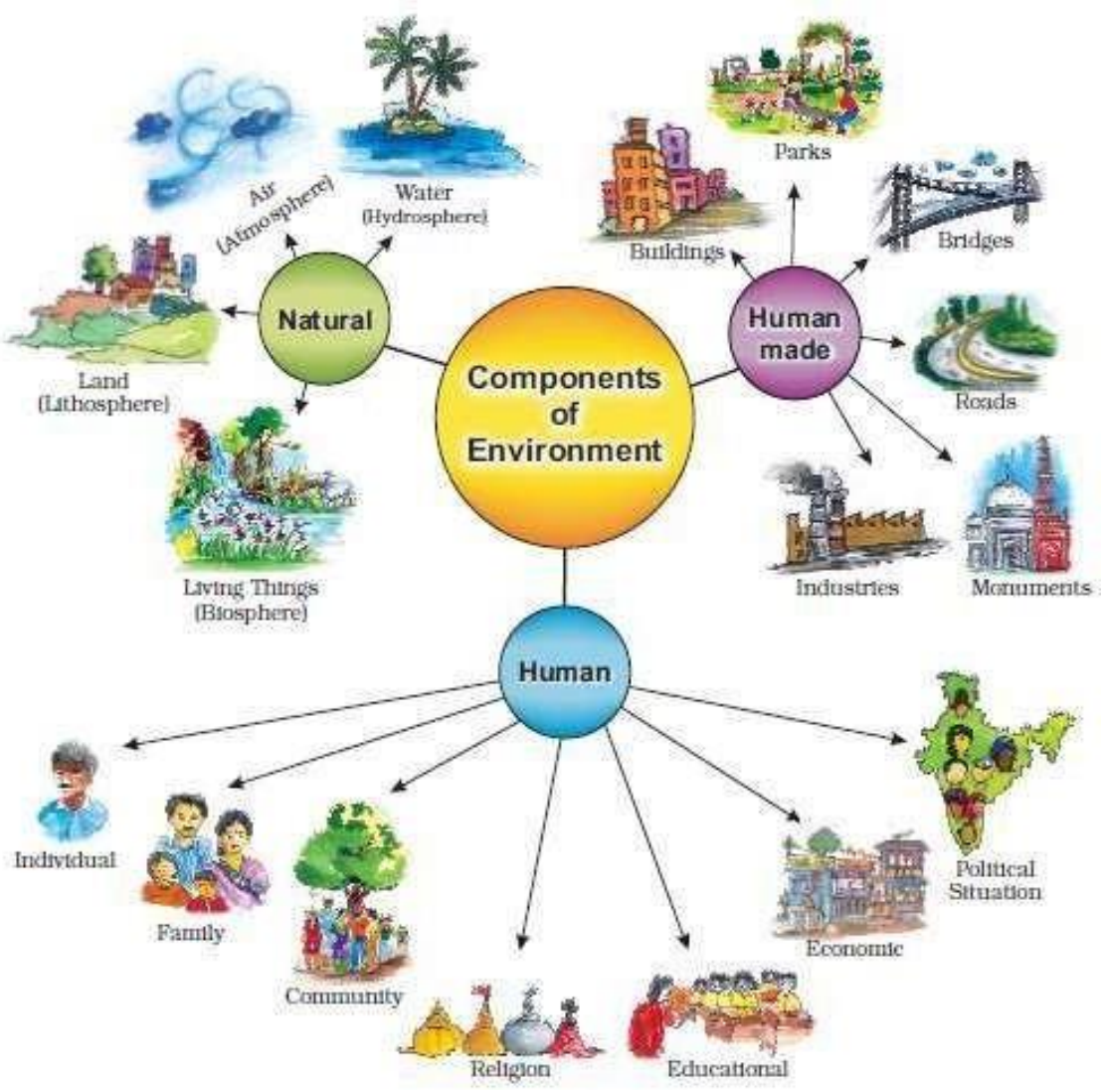

Fig. 1 Components of Environment.

ABIOTIC COMPONENTS (NON-LIVING): - these are the most important determining factor of where and how well an organism exists in the environment. Although these factors interact with each other, one single factor can limit the range of an organism thus acting as the limiting factor. These factors can be categorized into following groups:

PHYSICAL FACTORS: - the major components are temperature, Water (Rainfall), Light (Energy), Soil, Atmospheric pressure.

TEMPERATURE: - Temperature is the most ecologically germane environmental factor. It's a very well-known and an established fact that the average temperature on land varies seasonally, decreasing progressively from the equator towards the poles and from plains to the top of mountains ranging from sub-zero levels to >50˚C in polar areas/high altitudes and tropical deserts in summer respectively. There are, however, unique habitats like thermal springs and deep-sea hydrothermal vents where average temperatures exceed 100˚C. It is commonly known fact that mango trees do not and cannot grow in temperate countries like Canada and Germany, snow leopards are not found in Kerala forests and tuna fish are rarely caught beyond tropical latitudes in the ocean. A few organisms can tolerate and thrive in a wide range of temperatures without having effect on their internal environment (they are called eurythermal), but, a vast majority of them operate within a narrow range of temperatures (such organisms are called stenothermal).

WATER (RAINFALL): - Subsequent to temperature, water is another most important factor influencing the life of organisms. In fact, genesis of life on earth is attributed to water without which life is unsustainable. Its availability is too scarce in deserts. Due to this scarcity only special adaptations by plants and animals of this region make it possible to survive there in such an unusual living conditions. The productivity and distribution of plants is also profoundly dependent on water. One might believe that organisms living in oceans, lakes, rivers and other water bodies should not face any water-related problems, but it doesn't hold true. For aquatic organisms the quality (chemical composition, pH) of water becomes crucial and one of the most determining factor for their survival. The saline concentration (measured as salinity in parts per thousand), is less than 5 % in inland waters, 30-35 % in the sea and >100 % in some hyper saline lagoons. Some organisms are tolerant to a wide range of salinity

(Referred as euryhaline) while others are restricted to a much narrow range of salinity (referred as stenohaline). Many freshwater animals cannot survive for long in sea water and vice versa because of the osmotic problems which would subsequently lead to their death.

LIGHT (ENERGY): - One can quickly and easily understand the importance of light/energy for living organisms, particularly autotrophs since they produce/manufacture food through photosynthesis, a specialized process which is only possible with the availability of sunlight as a source of energy. Many plants are also dependent on sunlight to meet their photoperiodic requirement for flowering. For many animals too, light is essential as they use the diurnal and seasonal variations in light intensity and duration (photoperiod) as cues for timing their searching food, reproductive and migratory activities. The availability of light on land is in close association with that of temperature since the sun is the source for both. But, deep (>500m) in the oceans, the environment is perpetually dark and its inhabitants are unaware of the existence of a celestial source of energy called Sun.

SOIL: - The nature and properties of soil in various places vary to a great extent depending upon the climate which includes temperature and humidity, the weathering process, whether soil is transported or sedimentary and how soil development occurred. Various physical characteristics of the soil such as soil composition, grain size and aggregation determine the percolation and water holding capacity of the soil. These features along with chemical parameters such as pH, mineral composition and also topography determine to a large extent the vegetation in any area. This in turn indicates or rather determines the type of animals that can be supported on a particular soil area. Similarly, in an aquatic environment, the sediment-characteristics often determine the type of benthic animals that can thrive there optimally.

RESPONSES TO CHANGE IN ABIOTIC FACTORS: -

Abiotic conditions of many habitats may vary drastically in time, which raises an essential question –how do the organisms living in such changing habitats adapt themselves with stressful conditions? But, prior to delving into answering this inevitable question, one should perhaps ask first why a highly variable and ever changing external environment should create an inconvenience to an organism after

all. One would expect that during the course of millions of years of their existence, many species would have evolved a relatively constant internal (within the body) environment that enables all biochemical reactions and physiological functions to progress with maximal efficiency and thus, enhance the overall 'fitness' of the species.

REGULATE: - Some organisms are able to achieve and stabilize homeostasis by physiological (sometimes behavioral also) means which ensures constant body temperature, constant osmotic concentration, etc. All birds and mammals, and a very few lower vertebrate and invertebrate species are indeed capable of such regulation (thermoregulation and osmoregulation). Evolutionary biologists are of the opinion that the mammalian success is largely owing to their ability to adhere to a constant body temperature and thrive successfully whether they live in frigid Antarctica or in the blazing Sahara Desert. The mechanisms used by most mammals to regulate or stabilize their body temperature are similar to those of human beings. We, the humans, maintain a constant body temperature of 37˚C. In summer, when external temperature is more than our body temperature, we sweat profusely resulting in evaporation which leads to external body cooling thus lowering the overall body temperature. Likewise, in winter when the temperature is much lower than 37˚C, we start to shiver, leading to heat generation and thus raising the body temperature and thereby maintaining homeostasis around 37˚C. Plants, on the other hand, do not possess such mechanisms to maintain internal temperatures and are thus unable to regulate homeostasis.

CONFORM: - In literal English term it means to obey or agree to something. An overwhelming majority (99%) of animals and nearly all plants are unable to maintain a constant internal environment, thus inefficient in maintaining homeostasis. Their body temperature varies with the ambient temperature, rise with increasing temperature and fall with decreasing temperature most of the times. In aquatic animals, the osmotic concentrations of the body fluids change with that of the ambient water osmolality which itself depends upon the salinity of the surrounding water. Such animals and plants are simply conformers, meaning thereby that they just agree to the surrounding conditions rather than adopting any mechanism to stabilize their internal environment.

MIGRATE: - The organisms can shift away temporarily from the stressful habitat to a more hospitable area and return when stressful period is over. In human analogy, this strategy is like a person moving from Delhi to Shimla for the duration of summer to avoid the stressful conditions of severe heat and return back to Delhi when temperature is more comfortable. Likewise, many animals, particularly birds, during winter undertake long-distance migrations to more hospitable areas and avoid the frigid conditions of their true environment. Every winter the famed Keoladeo National Park (Bharatpur) in Rajasthan host thousands of migratory birds coming from Siberia and other extremely cold northern regions which become temporarily inhospitable for them. Thus migration is a form of temporary shift of organism from its true habitat to an ecologically friendlier habitat due to more stressful conditions of true habitat.

SUSPEND: - In bacteria, fungi and lower plants, various types of thick walled spores are formed which help them to survive unfavorable/extreme conditions – which subsequently germinate on availability of suitable environment. In higher plants, seeds and some other vegetative reproductive structures serve as means to resist the periods of stress besides helping in its dispersal – they germinate to form new plants under favorable moisture and temperature conditions. They do so by reducing their metabolic activity and going into a stage of 'dormancy'.

In animals, the organism, if unable to migrate, might avoid the stress by escaping in time through the two phenomenon. The familiar case of bears going into hibernation during winter is an example of escape in time to avoid extreme of cold.

Some snails and fish go into aestivation **(**a state of animal dormancy characterized by inactivity and a lowered metabolic rate**)** to avoid extreme summer heat and desiccation.

Similarly, under unfavorable conditions many zooplankton species in lakes and ponds are known to enter diapause, (a stage of suspended/deferred development). Diapause, when referencing animal dormancy, is the delay in development in response to regularly and recurring periods of adverse environmental conditions

INORGANIC AND ORGANIC SUBSTANCES: - Water, Oxygen, Carbon, Nitrogen, Sulphur, Nitrates, Phosphates and ions of various metals etc. are inorganic substances essential

for organisms to survive while proteins, Carbohydrates, Lipids etc. are essential Organic substances:

BIOTIC COMPONENTS (LIVING): - It consists of the living parts of the environment, including the association of a lot of interrelated populations that belong to different species inhabiting a common environment. The populations are those of the animal community, the plant community and the microbial community.

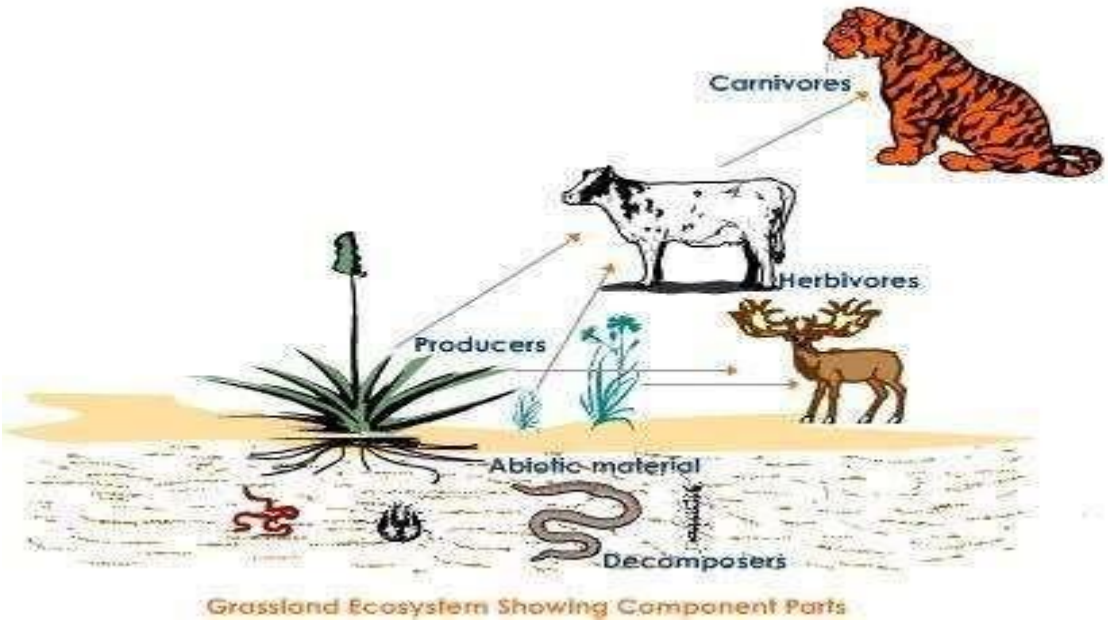

Fig. 2 Components of biotic community.

The biotic community is divided into:

a. Autotrophs,

b. Saprotrophs, and

c. Heterotrophs

AUTOTROPHS (derive from Greek word: auto - self, trophos - feeder) are called producers, transducers or convertors, as well. Those are photosynthetic plants, normally chlorophyll bearing, which synthesize a high-energy complex organic compound (food) from the inorganic raw materials utilizing the aid of the sun, and this process is called photosynthesis. Autotrophs form the core of all biotic systems. In terrestrial ecosystems, autotrophs are usually rooted plants. In

the aquatic ecosystems, the floating plants referred to as phytoplankton and the shallow water rooted plants – macrophytes - are the main producers.

HETEROTROPHS (from Greek: heteros - other; trophs - feeder) are the consumers, normally animals that feed on the other organisms. Consumers are also referred to as phagotrophs (phago - to swallow or ingest) while macro consumers are normally herbivores and carnivores. Herbivores are called First order or primary consumers, for they feed directly on green plants. For example, Terrestrial ecosystem consumers are cattle, deer, grass hopper, rabbit, etc. Aquatic ecosystem consumers are protozoans, crustaceans, etc.

Carnivores are animals that prey or feed on other animals. Second order consumers or Primary carnivores include those animals that feed on herbivorous animals. For example, fox, frog, smaller fishes, predatory birds, snakes, etc.

Third order consumers or Secondary carnivores are the animals that feed on primary carnivores. For example, wolf, owl, peacock, etc. Some larger carnivores prey on Secondary carnivores. Quaternary consumers or Tertiary carnivores include those animals which feed upon secondary carnivores. For example, the lion, the tiger, etc. Those are not eaten by any other animal. The larger carnivores which cannot be preyed on further are also called the top carnivores.

SAPROTROPHS (from Greek again: sapros - rotten; trophos - feeder) are called the reducers or decomposers. They break the complex organic compounds in dead matter down (dead plants and animals). Decomposers don’t ingest the food. Instead they secrete a digestive enzyme into the dead, decaying plant or animal remains and digest this organic material. The enzymes act on the complex organic compounds in the dead matter. Decomposers absorb a bit of the decomposition products to provide themselves with nourishment. The remaining substance is added as minerals in the process of mineralization to the substratum. Released minerals are utilized or reused as nutrients by plants - the producers.