B.Sc Ist Year Environment and Water Management (Semester-I)

Unit 1. Concept of Environment

Environment; Concept importance and major components

The term Environment can be broadly defined as one's surroundings. To be more specific we can say that it is the physical and biological habitat that surrounds us, which can be felt by our physical faculties (seen, heard, touched, smelled and tasted).

The word Environment is derived from the French word "Environ" which means "surrounding". Our surrounding includes biotic factors like human beings, Plants, animals, microbes, etc and abiotic factors such as light, air, water, soil, etc. Environment is a complex of many variables, which surrounds man as well as the living organisms. Environment includes water, air and land and the interrelation ships which exist among and between water, air and land and human beings and other living creatures such as plants, animals and microorganisms. Environment consists of an inseparable whole system constituted by physical, chemical, biological, social and cultural elements, which are interlinked individually and collectively in myriad ways. The natural environment consist of four interlinking systems namely, the atmosphere, the hydrosphere, the lithosphere and the biosphere. These four systems are in constant change and such changes are affected by human activities and vice versa (Kumarasamy et al., 2004). Components of Environment our environment has been classified into four major components:

The two major classifications of environment are :(A) Physical Environment: External physical factors like Air, Water, and Land etc. This is also called the Abiotic Environment. (B) Living Environment: All living organisms around us viz. plants, animals, and microorganisms. This is also called the Biotic Environment**.**

Components of Environment

Earth's environment can be further subdivided into the following four segments: (1) Lithosphere (2) Hydrosphere (3) Atmosphere (4) Biosphere.

Lithosphere-The earth's crust consisting of the soil and rocks is the lithosphere. The soil is made up of inorganic and organic matter and water. The main mineral constituents are compounds or mixtures derived from the elements of Si, Ca, K, Al, Fe, Mn, Ti, O etc. (Oxides, Silicates, and Carbonates). The organic constituents are mainly polysaccharides, organo

compounds of N, P and S. The organic constituents even though form only around 4% – 6% of the lithosphere, they are responsible for the fertility of the soil and hence its productivity

Hydrosphere- Hydrosphere includes all water bodies such as lakes, ponds, rivers, streams and ocean etc. Hydrosphere functions in a cyclic nature, which is termed as hydrological cycle or water cycle.

Atmosphere- The cover of the air, that envelopes the earth is known as the atmosphere. Atmosphere is a thin layer which contains gases like oxygen, carbon dioxide etc. and which protects the solid earth and human beings from the harmful radiations of the sun. There are five concentric layers within the atmosphere, which can be differentiated on the basis of temperature and each layer has its own characteristics. These include the troposphere, the stratosphere, the mesosphere, the thermosphere and the exosphere.

Biosphere- The biosphere is a capsule encircling the earth's surface wherein all the living things exist. This portion extends from 10000 m below sea level to 6000 m above sea level. Life forms do not exist outside this zone. The biosphere covers parts of other segments of the environment viz. Lithosphere, Hydrosphere and Atmosphere. Life sustaining resources like food, water and oxygen present in the biosphere are being withdrawn and waste products in increasing quantities are being dumped. The biosphere has been absorbing this and assimilating them. However the rate of waste dumping has gone beyond the assimilating capability of the biosphere and signals of this stress is becoming evident. The richness of biosphere depends upon a number of factors like rainfall, temperature, geographical reference etc.

Apart from the physical environmental factors, the man made environment includes human groups, the material infrastructures built by man, the production relationships and institutional systems that he has devised. The social environment shows the way in which human societies have organized themselves and how they function in order to satisfy their needs.

Structure and Composition of Atmosphere

Atmosphere is a mixture of different gases and it envelopes the earth all round. It contains life-giving gases like oxygen for humans and animals and carbon dioxide for plants. The air is an integral part of the earth's mass and 99 per cent of the total mass of the atmosphere is confined to the height of 32 km from the earth's surface. The air is colourless and odourless and can be felt only when it blows as wind.

COMPOSITION OF THE ATMOSPHERE

The atmosphere is composed of gases, water vapour and dust particles. Table 8.1 shows details of various gases in the air, particularly in the lower atmosphere. The proportion of gases changes in the higher layers of the atmosphere in such a way that oxygen will be almost in negligible quantity at the height of 120 km. Similarly, carbon dioxide and water vapour are found only up to 90 km from the surface of the earth.

Table 1: Permanent Gases of the Atmosphere

Constituent	*Formula*	*Percentage by Volume*
Nitrogen	N_2	78.08
Oxygen	O_2	20.95
Argon	Ar	0.93
Carbon dioxide	CO_2	0.036
Neon	Ne	0.002
Helium	He	0.0005
Krypto	Kr	0.001
Xenon	Xe	0.00009
Hydrogen	H_2	0.00005

Carbon dioxide

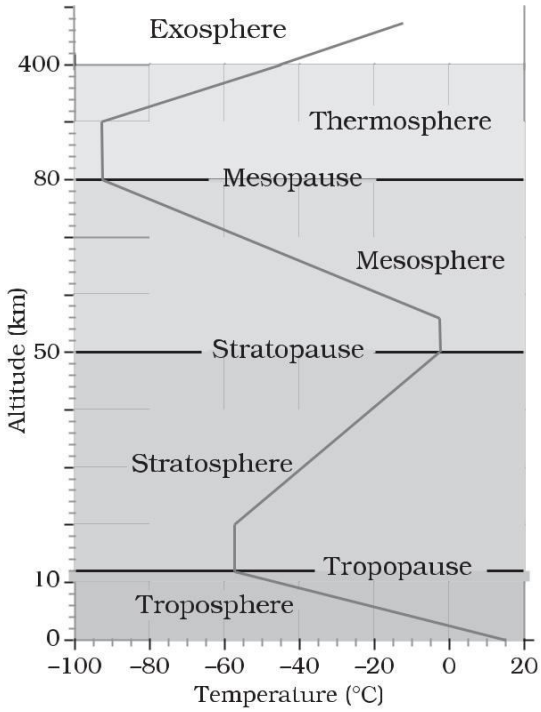
Carbon dioxide is meteorologically a very important gas as it is transparent to the incoming solar radiation but opaque to the outgoing terrestrial radiation. It absorbs a part of terrestrial radiation and reflects back some part of it towards the earth's surface. It is largely responsible for the green house effect. The volume of other gases is constant but the volume of carbon dioxide has been rising in the past few decades mainly because of the burning of fossil fuels. This has also increased the temperature of the air. Ozone is another important component of the atmosphere found between 10 and 50 km above the earth's surface and acts as a filter and absorbs the ultra-violet rays radiating from the sun and prevents them from reaching the surface of the earth.

Water Vapour

Water vapour is also a variable gas in the atmosphere, which decreases with altitude. In the warm and wet tropics, it may account for four per cent of the air by volume, while in the dry and cold areas of desert and polar regions, it may be less than one per cent of the air. Water vapour also decreases from the equator towards the poles. It also absorbs parts of the insolation from the sun and preserves the earth's radiated heat. It thus, acts like a blanket allowing the earth neither to become too cold nor too hot. Water vapour also contributes to the stability and instability in the air.

Dust Particles

Atmosphere has a sufficient capacity to keep small solid particles, which may originate from different sources and include sea salts, fine soil, smoke-soot, ash, pollen, dust and disintegrated particles of meteors. Dust particles are generally concentrated in the lower layers of the atmosphere; yet, convectional air currents may transport them to great heights. The higher concentration of dust particles is found in subtropical and temperate regions due to dry winds in comparison to equatorial and polar regions. Dust and salt particles act as hygroscopic nuclei around which water vapour condenses to produce clouds.



Structure of the atmosphere

The atmosphere consists of different layers with varying density and temperature. Density is highest near the surface of the earth and decreases with increasing altitude. The column of atmosphere is divided into five different layers depending upon the temperature varying density and temperature. Density is condition. They are: troposphere, stratosphere, mesosphere and exosphere. *The* ***troposphere*** is the lowermost layer of the atmosphere. Its average height is 13 km and extends roughly to a height of 8 km near the poles and about 18 Km at the equator. Thickness of the tro posphere is greatest at the equator because heat is transported to great heights by strong

convectional currents. This layer contains dust particles and water vapour. All changes in climate and weather take place in this layer. The temperature in this layer decreases at the rate of 1°C for every 165 m of height. This is the most important layer for all biological activity. The zone separating the tropsophere from stratosphere is known as the *tropopause*. The air temperature at the tropopause is about minus 80^0C over the equator and about minus 45°C over the poles. The temperature here is nearly constant, and hence, it is called the tropopause. *The **stratosphere*** is found above the tropopause and extends upto a height of 50 km. One important feature of the stratosphere is that it contains the ozone layer. This layer absorbs ultra-violet radiation and shields life on the earth from intense, harmful form of energy. The ***mesosphere*** lies above the stratosphere, which extends up to a heigh t of 80 km. In this layer, once again, temperature starts decreasing with the increase in altitude and reaches up to minus 100°C at the height of 80 km. The upper limit of mesosphere is known as the *mesopause*. *The **ionosphere*** is located between 80 and 400 km a over the *mesopause*. It contains electrically charged particles known as ions, and hence, it is known as ionosphere. Radio waves transmitted from the earth are reflected back to the earth by this layer. Temperature here starts increasing with height. The uppermost layer of the atmosphere above the thermosphere is known as the ***exosphere.*** This is the highest layer but very little is known about it. Whatever contents are there, these are extremely rarefied in this layer, and it gradually merges with the outer space.

Hydrosphere: Global water resource and distribution

The total volume of water in the global water cycle is estimated at about 1.384 million km^2. Depending on the salt concentration or salinity, this water could be categorized into fresh water, and salt or saline water. [Salinity is a measure of the total concentration of all salts (principally sodium and chloride). The salt concentration is usually given the symbol %o (parts per thousand)]. In the seawater, the salinity varies from, 33%o − 37%o. The mean salinity of seawater is 35%o. For freshwater the salinity is always less than 0.5%o.

At any point in time, around 97.6% of the world's water is saline or in other words, saltwater. Most of the water is found in the oceans, which clearly play an important role in the global water cycle. The remainder of the saltwater makes up the salt lakes. This means that only 2.5% of the volume of water in the world is actually fresh water. Some 75% of this fresh water is locked up as polar ice caps and glaciers with a further 24% located

underground as groundwater. This means that less than 1% of the total freshwater is found in lakes, rivers and the soil.

Nearly 0.01% of the world water budget is present in lakes and rivers, another 0.01% is present as soil moisture, which is unavailable to human supply. So while there appears to be lots of water in the world, there is in reality very little, which is readily available for the maintenance of terrestrial life on Earth (Table. 4.1).

Table 4.1: Major global reservoirs of water

Storage component	Volume ($km^3 \times 10^3$)	Total percentage of water
Oceans	1 350 400	97.6
Saline lakes and inland seas	105	0.008
Ice caps and glaciers	26000	1.9
Groundwater	7000	0.5
Soil moisture	150	0.01
Lakes	125	0.009
Freshwater rivers	2	0.0001
Atmosphere	13	0.0009
Total	1384000	

All figures are approximate estimates and rounded off