MULTIDISCIPLINARY NATURE OF ENVIRONMENTAL STUDIES

Unit-1 Date: 16/07/19

DEFINITION

The word 'environment' is derived from the french word 'environner', means to encircle or surround. Environment is the sum of all social, economical, Biological, physical or chemical factors, which constitute the surroundings of living organism, who is both creator and moulder of this environment.

The science of the environment studies is a multidisciplinary science because it depends on various disciplines like:-

1. physics
2. chemistry
3. Medical Science
4. Environmental science

This is not only depends on scientific studies otherwise it also depend on the non-scientific studies like:

1. Laws
2. Social science
3. Economic

SCOPE & IMPORTANCE

Environment consists of all living organism or non-living organism, which surround us.

Therefore the basic components of environment are:-

1. Atmosphere or the air
2. Hydrosphere or the water
3. Lithosphere or the rocks & soil
4. Biosphere

Atmosphere

The atmosphere forms a distinctive protective layer about 100 kilometres thik around the earth. A blanket of gases called atmosphere, surrounds the earth and protects the surface of the earth, From the sun's harmful UV rays. The atmosphere is composed of nitrogen (N_2) and oxygen (O_2) besides argon, carbon dioxide (CO_2) and other gases.

Atmosphere has a marked effect on the energy balance at the surface of the earth.

It absorbs most of the cosmic rays from outer space and major portion of the

electro magnetic radiation from the sun.

→ It transmit only ultraviolet, visible, infrared radiation and radio waves.

Date:- 17/07/19

Hydrosphere

The hydrosphere comprises all types of water resources :- ocean, seas, Lakes, Rivers, streams, ground water.

→ Ocean represents 97% of earth's water and about 2% of water resources is locked in the polar icecaps and glaciers, 1% available as fresh water as surface water. In rivers, Lakes, streams and as ground water for human use.

Lithosphere

Lithosphere is the outer layer of the solid earth. It consists of minerals accuring in the crusts and soil. Ex :- Minerals, organic matter.

Biosphere

Biosphere indicates the realm of living organism and their interaction with environment, atmosphere, hydrosphere and Lithosphere.

Date:- 18/07/20

The scope of environmental studie is very wide and it deals with ma areas like:

1. conservation of natural resources
2. Ecological aspects
3. pollutions of surrounding natura resources
4. controlling the pollution

IMPORTANCE OF ENVIRONMENTAL STUDI

The environmental studies make es aware about importance of practiction and conservation of ou resources and about the destruction due to the release of pollution into the environment.

Environment studies have become significant for the following reaso

1. Environmental Issues are being Global: It has being recognise that environment issues like glob warming and ozone depletion, acid rain, marine pollution and biodiversity are not national issues but are global issue and hence require international effect and

co-operation to solve them.

② Development and environment:

Development leads to urbanisation, industrial growth, tele-communication and transpation system agriculture and howing etc.

It has become phased out in the developed world. Development rich countries of the world has undesirable effects on the environment of entairs world.

Date:- 19/07/2019

③ Explosive Increases in pollution

World census reflects that one in every seven persons in this planet leaves in india. Evidently with 16% of world population & 2.4% of its land area there is heavy pressure on the natural resources including land.

Need for alternative solution

It is essential special for developing countries to find alternatives paths to an alternative goals

(5) Needs for public Awarness

- Increasing population, urbanisation and poverty have generated pressure on the natural resources and lead to degradation of the environment.
- To prevent the environment from further degradation the supreme court has ordered and initiated environmental protection awarness through government and non-government agencies,
- To take part in protecting our environment.
- Environment pollution can not prevented by laws alone public participation is equally important with regard to environmental protection.
- Both formal and informal education on the environment will give the intrested individual knowledge values, skills and tools needed to face the environmental changes on

local and global level.

7) Environmental education is a process of learning by giving an over all perspective of knowledge and awareness of the environment.

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Unit-2 NATURAL RESOURCES Date:- 24/07/2017

RENEWABLE AND NON-RENEWABLE RESOURCES

The resources found in the natural environment that are developed without intervention of humans are called natural resources.

Ex:- Air, sun light, water, soil, stone, plants, animals and fossil fuels, etc.

Based on availability their are two type of natural resources:-

① Renewable Resources

② Non-renewable Resources.

① Renewable Resources:- The resources that are available in infinite quantity and can be used repeatately are called renewable resources.

Ex:- Air, water, forest, etc.

② Non-renewable Resources:- There are resources that are limited in measure due to non-renewable property and with extint in the future are called non-renewable

resources. Ex:- Fossil fuels, minerals, etc.

Renewable Resources	Non-renewable Resources
(i) It can be renewed as it is available in infinite quantity.	(i) Ones completely consumed it can't be renewed due to limited stock.
(ii) Low cost and environment friendly.	(ii) High cost and less environment friendly.
(iii) Ex:- Forest, Water, wind, etc.	(iii) Ex:- Fossil fuels, Minerals, etc.

Date:- 25/07/2019

Forest Resources

Forest is important renewable resources, plants along with tress cover with large areas produce varity of product and provide food for living organism and also important to save the environment.

→ Forest are among the most important and widespread ecosystem on the earth and having many function:

They provide timber and other forest product.

→ India is one of the country commanding 7% of worlds biodiversity and supporting 16% of measure forest.

→ It is estimated that about 30% of World area is covered with forest.

Uses OF Forest

→ Forest can provide wood, food, fiber, edible oils and drugs.

→ Forest lands are also used for agriculture and grazing.

→ Forest is important source of dams, recreation and mining.

Deforestation :- The clearing or cleaning of forest by human in practice of clear cutting all the trees are remove from land which completely destroy the forest.

Major causes of Deforestation :-

(i) Expansion of Agriculture
(ii) Extension of cultivation on hill slopes.
(iii) Cattle ranching
(iv) Firewood collection
(v) Shifting collection.

Controlling Deforestation

① Farming:- New method that are being developed to farm more food crops on less farm land such as hybrid crops, green house, autonomus building garden.

→ Cyclic agriculture actually increases the fertility of the soil.

② Forest Management:- Efforts to stop slow deforestation have been attemed by many countries because it has been known deforestation can cause environmental damage sufficient in some cases.

Date :- 30/07/2019

Water Resources

Water is a crucial natural resources. It is a vital think for

all living beings. It is a renewable resources.

→ We need water to growth food, keep clean, generate electricity control fire, we need it to stay alide.

→ World ocean water covers about 75% of the surface of the earth with water in form of ocean, seas, rivers, lakes, etc. Therefore the earth is called water planet. Ocean water is saline and not fit for human consumption.

→ Fresh water is about 2.7% of the total water.

USE OF WATER RESOURCES

Water resources are used for agricultural, industrial, domestic and environmental activities. Measurety of uses required fresh water.

→ A little over two-third of the available fresh water is frozen in glaciers and polar icecaps. The remaining fresh water is found

mainly as ground water and negligible portion of it is present on the ground or in the earth.

(i) Agricultural Use :- Agriculture accounts for 69% of all waters conjections basically in agricultural economics like india.

(ii) Industrial use :- water is the life blood of the industry. It is used as a row of material coolant, a solvent and as a source of energy.

(iii) Domestic use :- It includes drinking, cleaning, garden care, cooking, washing of clothes, dishes, vehicles, etc.

Date :- 31/07/2019

Timber Extraction

There are unlimited exploitation of timber for commercial use. Due to increased industrial demand timber extraction has significant effect on forest and trible people.

Mining :-

(i) Mining is the extraction of valuable minerals or other geological material from the earth, usually from an ore body.

(ii) Materials are recovered by mining include bauxite, coal, diamonds, iron, precious metals, lead, limestone, nickel, phosphate, rock salt, tin, uranium, etc.

(iii) Mining in a wider sence can also includes extraction of petroleum, natural gas and even water also.

Effect of dams on forest or tribal people :-

(i) India has more than 1550 large dams, the maximum being in the state of maharastra (more than 600), followed by gujarat (more than 250) and madhya pradesh (about 130).

(ii) These dams are also responsible for the destruction of forest.

(iii) These are responsible for increase

of water born deseases, disterbance in forest ecosystem.

Floods :- A flood is an overflow of water, whenever, the magnitude of flow of water exceeds the carrying capacities of the channel within its banks.

Causes OF Floods :-

(i) Heavy rainfall, melting of snow or ice, sudden release of water from dams often causes Floods.

(ii) Reduction of carrying capacity of river channels due to accumulation of sediments on flood ways.

(iii) Deforestation, over grazing, mining increases the run-off from rain causing flood.

Effect of floods :-

Due to floods :-

(i) Water spreads in the surrounding areas.

(ii) Plane surface get eroded and silted with mud and sand, thereby affecting cultivable land areas.

Drought

Drought is scarcity of waters.
Drought occurs due to :-

(i) Inadequate rainfall
(ii) Late arrival of rain
(iii) Excessive withdrawl of ground water.

Types of drought :-

(i) Metrological drought
(ii) Hydrological drought
(iii) Agricultural drought
(iv) Socia-economic drought.

Effect of drought :-

(i) Drought causes hunger, malnutrition and scarcity of drinking water.
(ii) It also degrades the quality of drinking water.
(iii) Drought accelerates degradation of

natural resources.

(iv) Drought needs to large scale migration to organ areas.

→ Due to deficient rainfall 150 districts are drought prone in india. out of above 7 districts of punjab, haryana, rajasthan, gujarat, tamil nadu, uttar pradesh, Maharashtra, Karnataka and andhra pradesh are provided with irrigation. Among states West bengal, Madhya pradesh, andhra pradesh, bihar, jharkhand and orissa are suffering from high frequency of droughts.

→ Food production in india being marginal, drought poses many problems. Irrigation facilities available in this country are also limited and, therefore, when droughts occur, they cause partial or complete crop failure. If failures occur in consecutive years, it becomes a national calamity, putting great strain on the economy of the country.

According to the practice followed by the indian meteorological department, drought is taken to have occurred over an area where the annual rainfall is less than 75 percent of the normal. When the annual rainfall is less than 50 percent of the normal, it is called Sever drought. Drought can occur anywhere in india, depending upon the distribution of rainfall.

Over Exploitation of Water

→ The exploitation of groundwater resources more than its annual replenishment has caused the continue declining of water levels, declining of well yield, drying of shallow wells, deterioration of ground water quality, sea water intrusion into coastal aquifers and high cost of energy required to lift the water from great depths which becomes uneconomical for poor farmers to continue agriculture.

→ Though India is blessed with a good water resources, but its distribution over the country is not uniform/proper. Even in the high rainfall areas like meghalaya and Kerala water scarcity is felt in summer months due to over exploitation of water and mis-management. There is large amount of rainfall annually flowing out as runoff to sea. The annual replenishment to groundwater resource is getting reduced due to reduction in natural recharge mechanism by man's interaction desides recurring droughts.

→ There is uneven distribution of water resources coupled with over utilization of groundwater resources has resulted in imbalance between recharge and development. There exists gap between available utilizable water resources and future need of water for the country. Due to over utilization of water, Punjab,

haryana, tamilnadu and gujarat and the states where the water tables have declined steeply. In gujarat more than 90% wells water table dropped by 0.5 meters to 9.5 meters (CGWB). In haryana, the average depth of ground water is fallen by 1 to 33 cm annually in different parts of the state.

Conflects over water

(i) Urban water demands are concentrated in space, therefore, pose serious ploblems at local levels. Water demands in mega cities are growing much faster than envisaged and are putting heavy strain on water resources. It is creating difficult problem for the surrounding rural areas, leading to serious conflicts.

(ii) Since the urban water supply are met from surface (river) flows, there will be conflict with upstream users, specially farmers, over the quantum of withdrawls, while the down stream users will be affected

by the polluted waste waters received by urban areas. Such conflicts already exists: between delhi and haryana, and between chennai and the farmers in drought prone districts of andhra pradesh.

Date:-06/08/2019

Mineral Resources

Mineral place vital role for industrialisation and overall development of nation. Minerals are generally known as "Stock" and these are non-renewable resources. Minerals are formed in solid or liquid and these are made up of the combine form of organic or inorganic substances.

The Metals like iron, steel, zinc, copper, lead, gold, silver, etc are extracted from the minerals but now several metals like bauxite, building materials, iron ore, manganese ore, petroleum, natural gas, etc are produced from minerals in india.

Types of Minerals

Minerals available in the earth crust are divided into 3 types:-

① Metalic Minerals
② Non-metalic Minerals
③ Mineral fuels

① **Metalic Minerals:-** The minerals can not be extracted from the minerals directly. For which minerals are followed some procedure before extracting. According to the availability of metals, metalic minerals are divide into 3 types:-

(a) **Ferroes alloys:-** These metal is commonly known as iron. Other examples of ferroes alloys are calcminicum, gold, lead, zinc, copper. The ferroes alloys are in combined state.

(b) **Non-ferroes alloys:-** The minerals of this type contain the metal like titanium, antimony, arsenic, berylliem, copper, etc.

(c) The minerals/alloys containing very least quantity of metals. whose extraction is very costlier and these

metals are used in jewellary e.g. gold, platinum, silver, iridium, etc.

(2) Non-Metalic Minerals:- Minerals, whose extracted products other than metals are known as non-metals. Examples:- graphite, pyrolusite, dolomite quartz, Kaoline, fire clay, felspar, mica, borax, asbestos, gypsom, fluorite, lime stone, phosphorite, sand stone, dymond, ruby, etc.

(3) Mineral Fuels:- These minerals are used for energy. Example:- Coal, natural gas, fossils fuels and petroleum.

Coal is the most commonly available fuel which is used as domestic as well as industrial fuel. It is different types i.e. Anthracite, bituminuous, Lignite. The type and quantity of the coal depend upon percentage of carbon present in it. Coal is used in various ways in different industries like cement, glass, railways, textile, sugar, paper, steel, etc. USA, China, Britain, Germany,

South Africa, Australia are the richest coal containing countries in this world.

petroleum is used in the manufacture of large number of petrochemicals. It is drilled out from the sources & the form of crude oil. Crude oil is refined before use as petrol, diesel, kerosine, etc.

Date:- 07/08/2019

Minerals in nature

The formation of minerals in very slow by the help of geo-chemical and biological process in the earth crust to deposite is takes millions of years. There are number of ways by which minerals deposite are formed.

(1) Molten rock materials, which is a complex collection of a number of substance, when cooled. The crystallization of different minerals takes at different temperatures. These are settled in different bonds giving the mineral deposite.

(2) Sodium chloride, gypsom, salt peter, etc Water soluble minerals are obtained by evaporation of lake/sea water. The compounds of iron & manganese as chemical sediments are also formed by precipitation from lake or sea water.

(3) Deposits of minerals like asbestos, talc, graphite, etc are formed by intense heat & pressures inside earth's crust.

(4) When the pH, temperature, solubilities are changes, the rock materials in solution/suspension are deposited in sufficient amounts to form mineral deposits as water current slow down.

(5) Mineral deposits are also formed by oxidation and reduction reactions.

(6) Formation of mineral deposits are also take place by micro-organism. It is mainly autotrophic bacteria which are involved in mineralization reactions.

There are also views for formation of mineral deposits when the plants dead animals wild life and other eco-systems are accumulated below in earth biological process convert them into mineral deposits.

Date:- 08/08/2019

Environmental effects of extracting & using mineral resources

The environment means the surrounding. The component of environment include soil, water, air, land and living creatures. The environment as well as the human health is gradually damaging by open cast mining than underground mining. Over exploitation causes the wastage of mineral wealth and degradation of land. Mineral deposits should not be over exploited as it is the non-renewable resources.

The land which is permanent damage and not useful for agriculture By which the effects on environment

-due to mining:-

(i) Land degradation due to lowering of the surface levels at some places.

(ii) Deforestation in the mining areas that is the loss of valuable soil cover results, possibility of enhancement of soil-erosion.

(iii) The adverse effect on ground water table is due to the local water table is lowered as a result of opencast mining.

(iv) Due to increased discharge of rain water passing to the underground, distrubeted by surface mining, the local drainage system is polluted.

(v) Due to lowering of ground water level, the soil-erosion as well as lands line are occured.

(vi) The heavy earth-moving machinery and blasting causes problems of noise, vibration as well as release of noxious gases to the atmosphere.

(vii) Fumes from smelters damage forests and spread pollution over large area.

(viii) Mining causes reduction of forests. Thus flora & fauna are also destroyed wild life also affected which results land becomes barren increases incidents of land slides.

(ix) people related to the mining & extraction affected by polluted environment which leads to the skin and lung diseases.

(x) Deforestation & climatic change results poor rainfall & affects flora & fauna.

Mineral Resources in india

India has sufficient quantities of iron, aluminium, titanium, copper, Lead, zinc ores. India ranks 5th position among the aluminium rich countries in the world. zinc, Lead ores reserves in india are estimated to be about 390 millions tons about

two third of its iron deposites lies in a belt along orissa & bihar border. Haematite deposists are found in madhya pradesh, Karnataka, Goa and Maharashtra. Magnetite iron-ore is found in tamilnadu, bihar and himachal.

India has the world's largest deposits of coal. Bituminous coal is found in Jharia & Bokaro in bihar state in raniganj in west bengal. Lignite coals are found in neyveli in tamilnadu.

Next to russia, india has the largest supply of manganese. The manganese mining areas are Madhya-pradesh, Maharastra & bihar-Orissa. Chromite deposits are found in bihar, cuttack in orissa, Krishna district in andhra & mysore & hassan in Karnataka. Bauxite deposits are found in western bihar, southwest Kashmir, central tamilnadu & parts

of Kerala, U.P., maharashtra & Karnataka.

India produces third quantity mica among the world. Gypsum reserves in tamilnadu & rajasthan. Nickel ore is found in cuttack and mayurbhanj in orissa. Gold mines are found in kamagiri field in andhra, kolar & hutti in karnataka. The panna diamond field at located in the district of panna, chhatarpur & madhya pradesh. petroleum deposits are found in Assam & Gujarat.

FOOD RESOURCES

World food problem

Before 21st century, it seemed that for food production is not sufficient for the present population. Food production is less or less because people were using old techniques & seeds etc. whe the population starts increasing, fertilizers, pesticide insecticides are discovered to increase the production. In 1999, International food policy research institute (IFPRI)

reported the increase in world food production by 2020. In that report the consider six emerging issues:- nutrition, grain prices, WTO (world trade organisation), agroecological approaches to small scale farming, biotechnology, information technology & precision farming. In world food submit in 1996 in ~~farm~~ rome the following points were discussed:-

(i) Reduce world hunger
(ii) Agricultural supply & demand
(iii) population growth

Different scenarios have been exmined to explore a number of issues such as the expansion of irrigated agriculture the increase in food production in rainfed areas, and the public acceptance of genetically modified crops.

Severe droughts & sharply rising food prices noticed to national government & international agencies to address the food crisis of the 1960s & 1970s. The 'green revolution'

consisting of crops variety improvements, increased use of fertilizers & expansion of irrigation, and averted the projected shortages in food production.

Changes caused by Agriculture

Agriculture in US & India was food raising activities, and over half of the current crops comes from plants such as corn, cotton, potatoes, tobacco etc. Fields were dug by oxen pulling wooden plows, seeds were broadcast by lands & grains were spread through the land. In the year 1800 their were a great change that the cultivation method, improvement of crop varities & use of fertilizers which brought in advance & crop rotation is to maintain soil productivity. By 1860 seven factories had been established in US to manufacture mixed chemical fertilizers. Farm labour requirements reduces with the introduction of mechanised

Invention of machine for tilling, planting, reaping & threshing increased farm efficiency vastly.

Use of fertilizers and pesticides including DDT increased by 50% in between 1940-1944. But in india the productivity was not so, because england ruled india till 1947. The production was not sufficient. Some time we import the food grains & other food materials. After the independance we progressed by giving the facilities to farmers. Farmers didn't have high quality mechanical power, seeds, fertilizers, pesticides etc. For all people were depent on Govt.

Overgrazing

Grazing management is the foundation of grass land based live-stock productions since it affects both animal & plant health & productivity. Overgrazing can occure under continuous or rotational grazing.

It can be caused by having too many animals on the farm or by not properly controlling their grazing activity. Overgrazing reduces plant leaf areas which reduces interception of sunlight and plant growth. plants weakened and have reduce root length and pasture sod weakens. The reduced root length makes the plants more susceptible to death during dry weather.

Overgrazing can increase soil-erosion, reduced soil depth, soil organic metal & soil fertility hurt ~~because~~ the land's future productivity because under continuous grazing overgrazed pastures are predominated by short grass spices such as blue grass & will be less than two to three inches tall in the grazed areas.

Effects of Modern Agriculture

In between 1950 to 1975 the agricultural productivity increased rapidly. The farm output increased more than half due to technological innovations, development of hybrid

strains & other genetic improvements and a bourbold increase in the use of pesticides & fertilizers. Not only in america, all over world productivity and means of farming were changed. Thus the agriculture has become more intensive producing higher yields per acre. It also has become more expensive, relying on purchase of machinary & chemicals to replace heavy labour requirements of the past.

Fertilizers

Nutrients are lost from agricultural fields through runoff, drainage. The amounts of lost depend on the soil type and organic matter content, the climate, slope of the land, depth to groundwater & types of fertilizer & irrigation are used.

The three major nutrients in fertilizers are nitrogen, phosphorus, and potassium. Out of this nutrients nitrogen has increased its lost in the nitrate form. When nitrate form will leach on the agricultural field, it can elevate the concentration of

underlying groundwater to the drinking water quality.

Phosphorus does not leach as like as nitrogen because it is more tightly bound to soil particles also it carried eroded soils into the surface water bodies which causes excessive growth of aquatic plants. If this process conti continuous then lakes and reservoirs become choked with algae, which have offensive odour and oxygen kill fish due to lack of oxygen.

Potassium is the third major nutrient which has on water quality problem it is not hazardous in drinking water and it is not a limiting nutrient for growth of aquatic plants. It is tightly held by soil particles and it can be removed from the fields by erosion.

Pesticides

The intensive crop production in modern farming has led to increased potential for damage by pests & diseases. The pesticides are the mixed biological community are not supported

by large fields of a single crop.

The demerit of pesticides kill not only the pest of the concern, but also wide range of other organism including beneficial insects and other pest predators.

After the second world war, DDT (Dichloro Diphenyl Trichloroethane) and chlorinated hydrocarbons were introduce as new pesticides and were used through out the world for protection of agricultural crops as well as mosquitoes, lice.

Waterlogging

The excessive irrigation on poorly demand soil is known as water logging. waterlogging causes waste of water which can't penetrate deeply in a poorly drained soil. In poorly drained soil, the clay layer is impermiable due to which the irrigated water raises the water table in the ground.

The raised water table causes the soil to be waterlogged. When the soils are waterlogged, air spaces are

filled with water & plant roots are become suffocate that is lack of oxygen. Waterlogging also damages the soil structure.

All about 10% of land suffers from waterlogging by which 20% of crop production has fallen. (2)

Salinity

The concentration of dissolved salt in a given volume of water is called salinity. It is expressed in gram of salt per kilogram of water.

Ex :- There is 1 gram of salt & 1000 gram of water then the salinity is 1g/1kg or ppt.

The crop production in india is limited due to salinity or alkalinity or both. There are 3 classes of saline or alkaline soils are :-

(1) **Saline soils** :- The soil containing toxic concentrations of soluble salts in the root zone are called saline soils. Electrical conductivity in the saturation extract of such soils taken as measure of salts is greater than 4.0 mmhos/cm.

Exchangeable sodium percentage is less than 15 & the pH is less than 8.5. The soluble salts mainly consist of chlorides and sulphates of sodium, calcium & magnesium.

② Non-saline Alkali or sodic soils

These soils do not contain any large amount of neutral salts & as such, the electrical conductivity is less than 4 mmhos/cm. The detrimental effect of alkali soil on plants is largely due to toxicity of a high amount of exchangeble sodium & the pH. Alkali soils have an exchangeble sodium percentage of more than 15 & a pH greater than 8.5. Because of high alkalinity resulting from sodium carbonate, the surface soil is discoloured & black & hence the term is black alkali which is frequently used to designate the non-saline alkali soil.

③ Saline-Alkali soils

This group of soils is both saline and alkali. They have appreciable

amounts of soluble salts, are indicated by the electrical conductivity values of more than 4 mmhos/cm. The percentage of the exchangeble sodium is greater than 15. However, the pH is likely to be less than 8.5.

The soil salinity or alkalinity or both have many adverse effects, which are summarized below;-

(i) causing low yields of crops or crop failure in extreme cases.

(ii) The limiting of the choise of crops, because of some crops are sensitive to salinity or alkalinity or to both.

(iii) Rendering the equality of fodder is poor, at times, the fodder grown on alkali soils may contain a high amount of molybdenum & a low amount of zinc, causing nutritional imbalance and diseases among live-stock.

(iv) Creating difficulties in the construction of buildings and roads and their maintenance.

(v) Causing excessive run-off & floods owing to low infiltration, resulting in damage to crops in the adjoining areas.

ENERGY RESOURCES

Energy is needed by all living organisms and vegetations for biochemical reactions of their cells. It is the power which is needed in one form or other for work done. Before many years power is available to human society was limited to solar energy trapped by green plants which produced organic matter. Biological oxidation of the organic matter provided fuel to muscle power. The fire was the first form of energy used for cooking, heating purposes. The formation of fossil fuels (coal, oil & natural gas) is also due to photosynthesis carried on by plants which occured millions of years ago.

Growing Energy Needs

Energy is the prime input of the country. It converted into heat & electricity. For every activity energy

is required in the form of heat, light electricity and also food for our body.

As the economy grows, energy intensity rises as energy consumption increases. But at the certain level of per capita income energy intensity begins to decline. These linkages between energy & economic factors, manifested in energy elasticity & energy intensity, which are broadly related to –

(i) Demographic changes, including a relatively faster growth in urban areas higher capita GDP (Gross Domestic Product) & per capita gross saving.

(ii) Efficient end-use devices.

(iii) Technological improvements in conversion equipments.

(iv) Inter fuel substitution with more efficient alternatives.

Renewable or non-conventional or inexhaustible energy sources

These sources continuously induced by natural processes. For

example, solar energy, wind energy, bio energy, hydro power etc. These energy systems convert such energy into a form which we can use. Renewable energy sources are essentially flows of energy. At present total potential of 126000 MW assessed by different non-conventional energy sources.

At present, most important non-conventional energy source is wind energy, for which a capacity of 1800 MW has been set up in the country. There is also a large potential for tapping of ocean energy, geo thermal energy & tidal power, but the techno-economic viability for power generation from these sources has still to be established.

Non-renewable or conventional or exhaustible energy sources

Some examples of this are coal, petroleum, natural gas & nuclear power. These are traditional sources available to us. All these

Sources are limited & takes millions of years for formation. As a result of unlimited use, they will exhaust one day. Therefore we should conserve these for longer period.

In addition to commercial fuels like coal, oil, natural gas and power. India consumes large quantities of traditional fuels. Firewood, dung cake & agricultural wastes constitute the primary source of energy for cooking in over 90 percent of rural households. These fuels are also used for water heating. Traditional fuels are often classified as non-commercial sources because they are mostly collected from the neighbourhood.

Various forms of renewable energy sources

(1) Solar energy:- Solar energy is the free source of energy which is available continuously. Solar energy is equivalent to over 15000 times of world's annual

Flowsheet
(sources of energy)

commercial energy consumption reaches the earth every year. It is non polluting which helps in less in green house effect. Solar energy can be utilised through two different routes, as solar thermal routes and solar electric route. Solar thermal energy is used for cooking, heating, drying, timber seasoning distillation, electricity generation, cooling, refrigeration, cold storage etc. Solar photovoltaic uses sun's heat to produce electricity for lighting home & building running motors, pumps, electric appliances, lighting streets, village electrification powering of remote telecommunication and railway signals etc. Solar cells convert solar energy into DC electricity but in solar thermal route, solar energy can be converted into thermal energy with the help of solar collectors and receivers known as solar thermal devices. These devices are used in solar water heaters, air heaters, solar cookers & solar dryers for domestic and industrial applications.

Solar cooker is a device which uses solar energy for cooking saving

fuel to a large extent. It can only supplement the cooking fuel & not replace it totally. In solar water pumping system, the pump is driven by motor run by solar electricity instead of conventional electricity.

Different types of solar cookers are:

(i) Box type solar cookers
(ii) parabolic concentrating solar cooker
(iii) positioning of solar panels or collectors.

Solar Electric Generation

Solar photovoltaic (PV):- photovoltaic is the technical term of solar electric. Photo means "light" & voltaic means "electric". PV cells are usually made of silica, an element that naturally releases electrons when exposed to light. Amount of electrons released from silicon cells depend upon intensity of light incident on it. The silicon cell is covered with a grid of metal that directs the electrons to flow in a path to create an electric current. This current is guided into a wire that is connected to a battery or DC appliance.

Typically, one cell produces about 1.5 watts of power. Indivisual cells are connected together to form a solar panel or module, capable of producing 3 to 110 watts power. panels can be connected together in series & parallel to make a solar array. which an produce any amount of wattage as space will allow. Modules are usually designed to supply electricity at 12 volts. PV modules are rated by their peak watt output at solar noon on a clear day.

Some applications for pv systems are lighting for commercial buildings, outdoor lighting, rural & village lighting etc.

(2) Wind Energy

Wind energy is basically harnessing of wind power to produce electricity. The kinetic energy of the wind is converted to electrical energy. Since air blow from warmer to cooler regions, this causes winds & it is this airflows that are hardness in wind mills and wind turbines to produce power. Wind power is not a new

developement as this power in the form of traditional windmills for grinding corn, pumping water, sailing ships have been used for centuries. The basic wind energy conversion device is the wind turbine. These turbines are generally of two types - vertical axis wind turbines and horizontal axis turbines depending upon the rotation of axis.

Wind electric generators (WEG) convert kinetic energy available in wind to electrical energy by using rotor, gear box and generator. These are from 225 KW to 1000 KW are being installed in our country. In order for a wind energy system to be feasible, there must be an adequate wind supply. It requires an average annual wind speed of at least 75 KM/h. Obstructions such as trees or hills can interfere with the wind supply to the rotors.

(3) Hydro Energy

potential energy of falling water, captured and converted to mechanical energy by water-wheels, powered the start of the industrial

revolution. wherever sufficient head or change in elevation could be found, rivers and streams were dammed & mills were built. Water under pressure flows through a turbine causing it to spin. The turbine is connected to a generator, which produces electricity.

In india the potential of small hydropower is estimated out 10,000 MW small hydropower is a reliable, mature and proven technology. It is non-polluting and does not involve setting up of large dams or problems of deforestation, submergence and rehabilitation. Hilly regions of india particularly the Himalayan belt are endowed with rich hydel resources with tremendous potential. Micro (upto 100 KW) mini hydro (101 - 1000 KW) schemes can provide power for farms, hotels, schools and rural communities.

(4) Bio Energy

Biomass is a renewable energy source which is divided from the carbonaceous waste of various human and natural activities. It is derived

from numerous sources that is the by-products from the wood industry, agricultural crops, raw materials from the forest, household waste.

Biomass does not add carbon-dioxide to the atmosphere as it absorbs the same amount of carbon in growing as it release when consumed as a fuel. Its advantage is that it can be used to generate electricity with the same equipment which is used for burning fossil fuels. Biomass is the important energy source as like as coal, oil, natural gas.

Application :- Bio energy is used for cooking mechanical applications, pumping power generation.

(5) Hydrogen Energy

It is a clean fuel and energy storage medium for various application. It can be produced by biological conversions of various organic effluent like distillary, starch.

Hydrogen contained in metal hydrides which can be used in vehicles.

(6) Tidal and Ocean Energy

Tidal Energy:- Tidal electricity generation involves the construction of a barrage across an stopable to block the incoming and outgoing tide. The head of the water is then used to drive turbines to generate electricity from the elevated water in the basin as in hydro-electric dam. A tidal range of at least 7m is required for economical operation.

Ocean Energy:- Ocean covers more than 70% of earth surface causing them world's largest solar collector. Ocean energy draws on the energy of ocean waves tides or on the thermal energy stored in the ocean. The ocean contains two types of energy that is thermal energy from the sun's heat and mechanical energy from waves & tides.

(7) Geothermal Energy

The earth's population lives between two great energy sources that is hot rocks under the surface of earth & the sun in the sky.

Geothermal energy is based on the core of the earth which is very hot. In greek language, Geothermal means heat from the earth. The areas containing heat are volcanoes, hot springs, geysers and methane.

Geothermal energy derived from high temperature geothermal fluids, which can be utilized for power generation. Thermal applications like greenhouse cultivation, space heating and cooking.

(8) Chemical sources of Energy

Fuel cells electrochemically produce direct current (DC) electricity through a reaction between hydrogen and oxygen. The fuel cells are also known as electrochemical devices. The chemical energy of a fuel directly and very efficiently into electricity and heat by the combustion process.

The most suitable fuel for such cells is hydrogen or a mixture of compounds containing hydrogen. A fuel cell consists of an electrolyte

Sandwiched between two electrodes. Oxygen passes over one electrode and hydrogen over the other and they react electrochemically to generate electricity, water and heat. Fuel cell technologies which are being commercialized including phosphoric acid, polymer electrolyte membrane fuel cells, solid oxide and molten carbonate fuel cells.

Though fuel cell have been used in space flights and combined supplies of heat and power, electric vehicles powered by this energy are considered the most promising option available to dramatically reduce urban air pollution. Compared to vehicles powered by the internal combustion engine, fuel-cell powered vehicles are very high energy near-zero pollution. Fuel-cell-powered EVs (electric vehicles) score over battery operated EVs in terms of increased efficiency and easier and faster refuelling.

Fuel cells can also supply a combination of heat and power to commercial buildings, hospitals, airports and military installations at remote locations. Fuel cells have efficiency levels up to 55 percent as compared to 35 percent of conventional power plants. The emissions are very low as compared to conventional options.

LAND RESOURCES

In india, land is generally called as "MOTHER LAND". It is because of our life depend on a for food, fibre, fuel and other basic amenities. Therefore, it is the valuable gift of nature to human beings. Top layer of the land is called soil, which is renewable resources and essential for survival of life. Though it is life support system, but it is over used which causes environmental problems. The existing land use pattern in different regions in india has been involved as the result of the action and interaction of the various factors that is physical characteristics of land, the institutional

frame work, the structure of other resources available and the location of the region on relation to other aspects of the economic development for example those relating to transport as well as to industry and trade.

Out of the total geographical area of 328 million hectares, the area of land for roughly of 306 million hectares constituting 93% of land area available for cultivation which is 14 million hectares. But the area of land is reducing day by day which is due to mismanagement. The earth is made up three principal layers that is core, mantle and crust. The inner most third layer is core, middle layer is mantle and the upper layer is crust.

In India, the land area was classified into five categories:-

(i) Forests
(ii) The area which is not available for cultivation
(iii) The uncultivated land
(iv) Follow land
(v) Net area.

But after few years the land area is classified again into 9 categories:-

(i) Forests
(ii) Non-agricultural land
(iii) Barren land
(iv) Permanent pastures and other grazing land
(v) Tree crops
(vi) Cultivable waste
(vii) Fallow
(viii) Current Fallow
(ix) Net area.

Land Suitable For Cultivation and Other uses

There are four class of land which are suitable for cultivation & other purpose. Their details and limitations are as

CLASS I (Green colour): Soils in class I have very few or no limitations that restrict their use. This type of land is nearly level and the erosion hazard is low. The soils are deep, well-drained easily worked, hold water well and are either fairly well supplied with plant nutrients or are highly responsive to

the application of fertilizers. The soils are not subject to damage because of overflow. The local climate must be favourable for growing many of the common field crops. In irrigated areas, the soils may be placed in Class I, if the limitation of the arid climate has been removed by relative permanent irrigation works.

These soils need ordinary management practices to maintain productivity. Such practices may include the use of one or more of the following: Fertilizers, lime, cover and green-manure crops, pastures, forests and wild life, food and cover.

CLASS II (Yellow colour) :- Soils in class II have some limitations which reduce the choice of plants or require simple conversion practices.

The limitations of soils in class II may result from the effects of one or more of the following factors (i) a gentle slope, (ii) a slight susceptibility to erosion (iii) less than ideal soil depth, (iv) occasional damaging

overflow, (v) wetness which can be corrected by drainage, but existing permanently as a moderate limitation, (vi) slight to moderate salinity or sodium, easily corrected but likely to re-occur, and (vii) a slight climatic limitation on soil use and management.

They needy terracing, strip-cropping, contour cultivation, water-disposal area, covered with vegetation crop rotation, cover and green-manure crops, stubble mulching, the use of fertilizers, manure and lime. These soils may be used for growing cultivated crops, raising pastures, forests and for wild-life food & cover.

CLASS III (Red colour):- Soils in class III have moderate limitations which reduce the choice of plants and require special conservation practices.

Limitations of soils in class III may result from the effects of one or more of the following factors :- (i) moderately sloping land, (ii) moderately susceptible to water or wind erosion.

(iii) Frequent overflow accompanied with some crop damage, (iv) very slow permeability of the sub-soil, (v) wetness or continuing water-logging after drainage, (vi) shallow soil depth up to the bed-rock, hard-pan or clay-pan which limits the rooting-zone and the water storage, (vii) low moisture-holding capacity, (viii) moderate salinity or sodium, and (ix) moderate climatic limitation.

The soils can be used for raising cultivated crops, pastures, forests and wild-life food and cover.

CLASS IV (Blue colour):- Soils in class IV have severe limitations that restrict the choice of plants and require careful management.

The restrictions in the use of these soils are greater than those in class III and the choice of plants is more limited. When these soils are cultivated, very careful management required and the conservation practices & more difficult to apply and maintain.

The use of these soils for cultivated crops is limited as a result of the effect

of one or more permanent features, such as (i) steep slopes, (ii) severe susceptibility to water and wind erosion, (iii) severe effect of past erosion, (iv) frequent over-blow accompanied with severe crop damage, (vii) excessive wetness with a continuing hazard of water-logging after drainage, (viii) severe salinity or sodium, and (ix) moderately adverse climate.

These soils can be used for crops, pastures forests and wild life food and cover.

SOIL:-

The word "SOIL" is derived from the latin word "SOLUM" it means ground. by the scientific sense. Merely the soil is not product of simple rock it is the result of both chemical decomposition and mechanical disintegration of rocks.

Soil is defined as a thin layer of earth's crust which serves as a natural medium for the growth of plants. Soil is formed by weathering process of parental material rocks. Soil differ from parental material in the physical

chemical and biological properties. In other word it is mixture of mineral constituents and of organic matter, which later consists more or less of the decomposed residues of plant material and to a lesser extent of animals.

There are various types of soil like red, black, yellow - alluvial etc. Depth of soil is variable and it differ in texture like coarse, fine, soils serve as reservoirs of nutrients and soil's flora. The most characteristic constituents of soil are the colloidal organic matter and colloidal clay. soil organic even mechanical anchorage and favour abl tilth. The components of the soil are mineral material organic material, water and air the proportion of which vary.

The main interest of soils is for growing his crops. It is necessary to human being to learn about the physical and chemical properties of a soil. The physical properties of soils are :- (i) specific gravity, (ii) pore space, (iii) plasticity, (iv) cohesion, (v) colour, (vi) texture (vii) soil temperature, (viii) permeability.

Soil types and soil Groups

Depending upon weather a particular soil had originated from the direct decomposition of the crystalline rocks.

The soil group of the worlds are:

① **Soils of the podsolic group:-** These are found in cold regions to temperate under humid condition. The pod sols are completely leached soil in which calcium carbonate and calcium sulphate are present only very subordinate amounts.

② **Tschernosems and their related groups:-** A soil common in cooler temperate semiarid climates. Thus leaching is rather incomplete and generally there is always the development of horizone of carbonate deposition. The tschernosems are also known as Black Earth's.

③ **Groundwater soils including peat:-** Such soils are found through out the middle, northern and western parts of Europe and their greatest development is the groundwater table is either at or

near to the surface.

(4) Brown and grey soils of the semi-desert: As one moves from regions covered with chestnut soils, into more arid areas, brown and grey semi-desert soils are noticed. The latter have a lower organic matter content and calcareous and gypseous salts occur in such soils within a few inches of the surface.

(5) Saline, Alkaline and Solonth soils:- Such soils are form on areas of inland drainage without and outlet to the sea such as the inland seas or salt lakes, there is always characteristic of mainly the sodium salts with some amount of potassium salts. Alkaline soils are characterised by the presence of the carbonate of sodium.

(6) Soils of the Humid Tropics and the Sub Tropics:- The tropical soils are made up almost entirely of the product of chemical weathering, together with a greater or less admixture of un-weathering minerals such as quartz, magnetic, etc. It is red in colour but

modified by organic matter content.

(7) Soil associated with calcareous parent rocks :- Two types of this soils are -

(a) Soils of a brownish or brownish grey colour

(b) Soils predominantly red or reddish brown in colour.

Classification of soils in India

The properties and characteristics of soils are vary in every region. By the properties of the soil it is the best management requirement of its efficient and productive use. Their are different types of soil which are classified from time to time.

(i) Alluvial soils :- Such soils contains deltaic alluvium calcareous alluvial soils, coastal alluvium and coastal sands. This soil is derived from the deposition laid by numerous tributaries of the Indus, Ganges and Brahmaputra systems. These streams draining the Himalayas. Geologically, alluvium is divided into khadar which is light coloured sandy and Bhanger which

is dark and full of "kankar".

(ii) Black soil :- Black soils are very in depth from shallow to deep. This soil is derived from deccan trap or regur which is also known as black cotton soils. These soil is common in maharastra western part of madhya pradesh, Andhrapradesh, gujerat, Tamilnadu. (1)

(iii) Red soil :- The crystalline metamorphic rocks which is diffuse due to weathering is given rise to red soil diffusion. This colour is due to wide of iron with high proportion. These soils have poor in nytrogen, lime, phosphorous, potash, ironoxide. This soils are present in tamilnadu, Goa, Karnataka, Daman Dice, madhyapradesh, odisha, bihar, westbengal, uttar pradesh, etc. (2)

SOIL EROSION

The removal of material from the surface of the soil due to running of water, wind or by gravity is known as soil erosion. Since the superficial layers of the soil are richest in plant food so the feeding

ground of plant roots, the process of soil erosion involves a definite loss of valuable plant nutrients which will lead the complete destruction of the soil. The following types of soil erosion are :-

① Normal or geologic erosion :- Such erosion takes place due to the landscape. It takes place slowly for which so many ages are required of the earth surface.

② Accelerated soil Erosion :- The removal of surface soil from the areas which is covered by the protective layer. As a result of human and animal whose interference takes place at a faster rate than that the soil-forming processes. By the nature, it requires average of about thousand years to build up 2.5 cm of top soil, but wrong farming methods may take place only a few year to destroy from the lands.

③ Wind Erosion :- Wind erosion takes place in arid and semi-arid areas where wind velocity is high and vegetation process can not occure. The soil particle on the land surface are lifted and

blown off as dust-storms.

(4) Water Erosion:- The soil which is erosion by water is known as water erosion. It is classified as 3 types:- (i) sheet Erosion
(ii) Rill Erosion
(iii) gully Erosion

(i) Sheet Erosion:- sheet erosion removes a thin covering of soil from large areas by the more or less uniformly during every rain.

(ii) Rill Erosion:- When sheet erosion is allowed to uncheeked, a finger-shape grooves over the entire field is well defined run-off such types of thin channelling is known as rill erosion

(iii) Gully Erosion:- When rill erosion is neglected, a tiny grooves develop into wider & deeper channels. This is called gully erosion. Gullies are the most spectacular evidence of destruction of soil. The gullies tend to deepen & widen with every year rainfall which cut of large field into small fragment and very little duration & such type of field unfit for cultivation.

Land-slides or slip erosion :- A land slide is defined as, it is an outward and downward movement of the slope-forming material which is composed of natural rocks, soil. The land slides are caused by topography of the region & geological structure, the kinds of rocks. The sudden cause of slide may be can earthquake or a heavy rainfall.

Land Degradation :- The total land under agricultural use is around 58.4% that is grossed cropped area is 167.41 million hectares. The land which is not fit for cultivation is around 9.9% & the area under forest is 21.6%. As like water land resources are the precious resources food security depend upon conservation & proper utilization of all resources. Due to use & over explotation land resources are degraded due to increasing population.

Land degradation gives the alarm to protect the soil as the soil formation is a very slow process. A layer of crust fertile soil needs millions of years. The formation of 1.0 (m) soil

crust from its parental material takes 300-400 years. Each gram of fertile soil have 50 billion micro-organisms. 1.9 billion hectares of agricultural land have been degraded out of 8 million hectares are converted to non agricultural land like home, highway, shopping centres, factories, reservoir. In india 175 million hectares land effected by degradation problem.

Man Induces Land slides

Man can also cause slides by mining the earth, underground excavation, pumping & draining of ground water level. Man induced landslides for the development purpose like industrial, forming of roads, agricultural use, homes, for which the use heavy explosives.

DESERTIFICATION

Desertification is a process by which productive potential of arid or semiarid land falls. The decrease in productivity is varies from 10%-50%. Thus desertification leads to the conversion of irrigated crop land to desert.

Water have a binding capacity also it provides vegetal cover. Draught has accelerated wind erosion & desertification in three consecutive year in central india. Climate change activities are also responsible for desertification.

During last so many years the large agricultural land area are destroyed by sahara desert. Deforestation is also one of the most cause of desertification. Because forests grasslands are used by human beings, so human beings are also responsible for desertification. The increasing cattle population heavily graze to grasslands which cause barren the land & which is not suitable for seed germinations. The dry barren land becomes loose & more proper to soil erosion. Thus overgrazing is also cause for desertification.

Mining & quarrying activities are also responsible for conversion of productive land into desertification In last 50 years about 900 million hectare of land have undergone desertification over the world.

Salinization is also one of the causes for the conversion of agricultural land to desert.

Role of an individual in conservation of Natural resources

Planning of a suitable strategy for the conservation of the natural resources & most judicious execution of planned strategies is called as conservation management. Environmental planning, evaluation, monitoring, impact assessment are the methods of conservation management.

There are some roles of individual in place, harmony & equity in nature, as

1) people should at once stop the over utilization of natural resources instead they must be properly used.

2) Instead of deforestation, representation should keep in mind. We should take help from the Govt. for plantation programmes.

3) We should protect wildlife. Though hunting is not allowed even then the

persons are doing so. For this educated young should teach the lesson of wild life act.

4) Mixed croping, crop rotation & proper use of fertilizer insecticide, pesticides should be taught to farmers.

5) We should make habit for waste disposal, compose & to restore biodiversity.

6) Try to educate local people for the protection & judicious use of natural resources.

7) We should use light, fans & other domestic appliances when it is needed.

8) Maintain a balance between resources & human needs.

9) Maintain the essential ecological process-es & the life support systems.

10) Install rain water harvesting system in houses, colonies.

11) We should recycle the waste & waste water for agriculture purposes.

12) The fossil fuel should be used only when no other alternative source is available.

13) We must develop energy saving methods

to avoid wastage of energy.

14) prevent soil erosion.

15) use drip irrigation & sprinkling irrigation to improve irrigation efficiency and reduce evaporation.

16) Utilize renewable energy sources as much as possible. Encourage use of solar cooker, pump, etc.

17) Discourage the frequent use of car, bike, encourage the walk & bicycle.

We know "collecting drop-drop-drop form a ocean". so if each of us will aware about the judicious use of natural resources, all of us will conserve the nature.

Equitable use of resources for sustainable life style

The equal distribution of natural resources should be for all irrespective of rich or poor. There must be balance between the need & consumption for drinking water, food, fuel, etc. The imbalance of the resources is the responsible rich becomes richer poor becomes poorer due to sharp

increase in population in developing countries.

Developed countries like, USA, canada, japan, Australia have 22% of world's population utilising 86% of natural resources. so it is needed to divert the resources to poor countries. To achieve sustainable life style, there should be equal distribution of global resources & income to meet everyone's need.

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Spatio
29/9/19

ECOSYSTEMS

INTRODUCTION :-

Every living organism is surrounded by materials & forces which constitute its environment. For the survival, a plant, an animal or a microbe can not live completely without skin or shell. so it requires from its environment a supply of energy, a supply of materials & removal of waste products. For these basic requirements each living organism has to depend & also to interact with different non-living or abiotic & living or biotic components of the environment. The scientific study of the interactions of organism with their physical environment & with each other said "ECOLOGY". The word ecology concerns with direct influence of abiotic & biotic environmental factors which overs the growth, distribution, behaviour & survival of organisms.

The word ecology comes from two greek words "Oikos" means "house hold" or "home" or "place to live or

habitation" & "logos" means "Discourse" or "study". Thus ecology deals with the organism & its place to live.

Concept of Ecosystem

Ecosystem is defined as a community of organism interacting with one another and with environment in which they live. For example :- A home can be a drop of water for an amoeba but a home for a lion may be many miles of landover which it searches for its food, a forest, a lake, a river, an ocean, a dam, garden, aquarium and fields are the examples of ecosystem. Ecosystem may be natural or artificial like an aquarium.

There are two types of ecosystem that is :- (i) open & (ii) cybernetic.

The ecosystem is an opensystem for its receives energy from an outsides sources that is sun. which fixes, utilized & dissipates heat whose space. Ecosystem also an abstraction and it has no particular size.

Definition of Ecosystem

An ecosystem concept is that the living organisms of a community not only interact among themselves but also have functional relationship with their non-living environment. This structural or functional system of communities and their environment is called an ecosystem.

Functioning & types of Ecosystem

Functioning of ecosystem is self-regulating & self-sustaining. It depends upon flow of energy, cycling of materials. The control of ecosystem concerns by nutrients flux and the condition of the physical environment is called bottom-up-control but function with tropic interaction is called top-down control.

Depending upon the species, diversity & the manner in which they are organised ecosystems are of following types:-

(1) **Permanent & Natural Ecosystem**:- such type of system operates under natural

condition without any interference. Such type of system can be further classified in to 2 types :- (i) Terrestrial ecosystem
(ii) Aquatic Ecosystem

Terrestrial ecosystems operate on land so, forest, desert, grassland are included in this type. But aquatic ecosystem operates in water. It can be divided into 2 types :-

(i) Fresh water ecosystem
(ii) Marine ecosystem

Freshwater ecosystems are usually named after the size & the nature of the fresh water body. Example :- pond, lakes and river.

Marine ecosystems is largest ecosystem on earth, which consists of several sub-divisions each division having its physico-chemical & biological characteristics.

(2) Temporary & Natural Ecosystem :- These system are short lived but operate under natural conditions.

(3) Artificial Ecosystem :- These system are man-made like fishery tanks dams,

croplands. Fish aquarium is also the another example of artificial ecosystem

Structure of An Ecosystem

These species of organisms which are present like information on their life histories, populations & distribution in space is known as structure of an ecosystem. The structure of ecosystem provides information about the range of climatic conditions that prevail in area, composition & organization of biological communities & abiotic compounds constitute the structure of an ecosystem. According to the trophic (food) point of view, an ecosystem has the following components:-

(1) **Biotic Structure:-** producers, consumers and decomposers are the components of abiotic ecosystem. Living things are made of Control & other chemicals with a lot of water added. Living things exple assemble, disassembles, organise & manipulate the constitute of earth, air & water. Biotic structure includes plants, animals & micro

organisms present in an ecosystem. producers, consumers, decomposers are the components of biotic ecosystem. These can be distringuished on the bases of their sources of energy and material.

(i) Autotrophic Components :- The mean of autotrophic is self nourishing. In which the fixation of light, use of simple inorganic substances and manufacture of complex material predominates. These are also called as producers.

(ii) Heterotrophic Components :- It means other nourishing. These utilizes, rearranges & decomposes the complex materials which as synthesized by the autotrophs. The heterotrophic activity takes place where the organic matter accumulates in the soils. These are called as consumers.

Producers

All green plants are producers. They are also called as "converters" or "transformers". They are living members of the ecosystem that utilize sunlight as their energy source & sing inorganic materials from soil, air & water to transform them by photosynthesis into more complex energy rich chemicals as their own food. producers are largely photosynthetic plants & their kind varies with the kind

of ecosystem. In dense forest the trees are the most important producer. In lakes & ponds, the producers are rooted of large floating & microscopic plants known as algae. They are also known as "photo-autotrophs" (photo = light, auto = self, troph = food). In Ocean depth, the ecosystem is based on chemical energy, which have no light the producer in this systems are bacteria that are able to gain energy from the oxidation of its which produces from volcanic effect in the ocean, As these organisms get their energy from chemical reaction rather than sunlight, they are called as "chemotrophs".

Consumers

Consumers are heterotrophs that is the living organism which ingest other organism. They derive their food directly or indirectly from the producers. The food is then digested that is broken down to simple substances which are totaly mix in the consumers body & released the waste product to the environment. Consumers are of following types:-

(i) primary consumers :- These are also called as "HERBIVORES" which feed directly on the producer. They vary with the kind of ecosystem. Ex :- a deer & giraffe is a primary consumer in the forest ecosystem, while cow or a goat is in a grassland or crop ecosystem.

(ii) Secondary consumers :- They are also called as "CARNIVORES" (Meat eaters). Example fish in a pond eats insects.

(iii) Tertiary consumers :- In most of ecosystem some organism that eat other carnivores is known as tertiary consumers.

(iv) Omnivore :- A person or animal eating plants & animals is called as omnivores.

(v) Top carnivores :- Some ecosystem have animals like lion & vulture which are not killed or rarely killed & eaten by other animals are called top carnivores.

(vi) Detritivores :- These are bottom living which subsist on the rain of organic detritus from autotrophic layer. Examples beetles, termites, ants, etc.

Decomposers

These are also living organism, mainly bacteria & fungi which break-down complex compounds of dead proto-plasm of producers & consumers to simple organic compounds. In all eco-system, this biotic structure prevails. The de-composers are responsible for the completion of ecosystem mineral cycles. So they are also called as microconsumers or saprobes or saprophytes or saprotrophs. Examples :- Bacteria and Fungi.

(2) ABIOTIC STRUCTURE

The physical & chemical components of an ecosystem constitute its abiotic structure. Its constitute of 2 things :-

(i) Materials or chemical Factors :- The materials are like water, mineral, atmospheric gases & other inorganic salts. They also include some organic matter such as amino acids, decay products, carbohydrates, proteins, etc. The quantity of abiotic materials like the minerals present at any given tim

in an ecosystem is termed as the "standing state" or "standing crop".

(ii) Energy or physical Factor :- This is in the form of light, heat & stored energy in chemical bonds. Annual rainfall, wind latitude & altitude etc are some physical factors, which have a strong influence on ecosystem there must be a continuous "flow of energy" & 'cycling of minerals' among the organisms of the ecosystem.

Energy Flow in the Ecosystem

Energy is needed for every biological activity. solar energy is transformed into chemical energy by the process of photosynthesis. Energy is stored in the plant tissue and then transformed into mechanical and heat form during metabolic activities. In the biological world the energy flows from sun to plants and then to all heterotrophic organisms like nitro-organisms, animals and man that is from producers to consumers. 1% of total sunlight is utilized for photosynthesis. This is sufficient to maintain

all life on earth. There is no 100% flow of energy can not be recycle in an ecosystem that is it can only flow one way. so it is lost to the environment.

The flow of energy follows the two laws of thermodynamics:-

1st law of Thermodynamics

The law states the energy Created be nor be destroyed but can be transformed from one to another form. Solar energy utilized by green plant in photosynthesis process, which is converted into biochemical energy of plant and later into that of consumers.

2nd Law of Thermodynamics

The law states that energy transformation involves degradation or dissipation of energy from a concentrated to a dispersed form. The dissipation of energy occurs at a every trophic level. There is loss 90% of energy, only 10% of energy is transferred to the trophic level to other.

SUN AS THE SOURCE OF ENERGY

Sun is the source of energy which extends radiations from high frequency to low frequency. Approximately 99% of total energy is in the region between UV and IR. The visible spectrum spreads over 0.38 μ to 0.77 μ. involving 50% solar radiations. Some autotrophs however utilize energy released from oxidation processes for the synthesis of organic food.

Sun as the source of Energy

ENERGY FLOW MODELS

There is unidirectional from Sun to the producers and then various types of consumers. so the behaviour of energy of ecosystem is known as energy flow about 34% of the sun-light reaches the atmosphere. which is reflected back in to its atmosphere. 10% is held by ozone layer, water vapours and atmospheric gases and rest 56% reaches earth surface out of this 1-5% is used by green plant for photosynthesis.

$$6CO_2 + 6H_2O \xrightarrow[\text{chlorophyll}]{\text{sunlight}} C_6H_{12}O_6 + 6O_2$$

The rest of energy is absorbed as heat by ground vegetation and water. The flow of energy in an ecosystem can be explained with the help of various energy.

(1) ODUM'S ENERGY FLOW MODEL

E.P. Odum in year 1963 explain the flow of energy involving three trophic levels with the help of his

universal energy flow model. From the figure as the flow of energy takes place. There is a gradual loss of energy at every level which results and the less energy available at next trophic level.

Out of total 3000 KCal of light Kcal on producers level only 50% that is 1500 Kcal is absorbed by the autotrophs with an efficiency of energy capture by the 21% of this energy is absorbed in metabolic reactions of autotrophs for their growth, development, maintenance, reproduction. Thus gradual decline in energy and second trophic level that is herbivores and then at third trophic level that is carnivores in grazing

food chain is observed.

(2) LINDEMAN'S ENERGY FLOW MODEL

Lindeman in the year 1942 gave the unidirectional energy flow model of fresh water ecosystem. These model shows that out of total 118,872 g.cal/cm²/year incident solar radiations producers can utilize only 1% (111.0 g.cal/cm²/year) in their photosynthesis.

About 21% of this gross production is utilized in metabolic functions of producers, 3% is utilized in decomposition and remains are utilized. Thus only 13-14% that is 15 g.cal/cm²/year of gross production is available to herbivores. At this level about 30% it utilized in metabolic functions that is respiration, growth and reproduction but the autotrophs consumed more than herbivores that is 21%. Again 3% is utilized and remains as un-utilized. Thus only 20% of energy that is (3 g.cal/cm²/year) of the autotrophs is available to carnivorous. Carnivores utilized 60% of energy at this level in metabolic activities

and rest remains un-utilized.

Energy flow Diagram

From the both odum and Lindemar energy clear

(1) There is unidirectional flow of energy that is the system would collapse if the primary source, the sun were cut off.

(2) progressive decrease in energy at each trophic level.

(3) There is also corresponding decrease in biomass. But there is no correlation between biomass and energy. This relationship may differ according to the situations.

ECOLOGICAL SUCCESSION

Biotic communities are not static, they change with time. Changes takes place continuously in the community structure, organization and physiognomy which is associated with animals and environment of a place in the period of time. These phenomenon is known as ecological succession. The rate of successional changes in rapid initially and gradually slows down until a point of dynamic equilibrium is reached and the community is more or less stable. A complete succession is called SERE. (A series of ecological communities formed in ecological succession). A Sere is made up of a number of seral stages (It is an intermediate stage found in ecological succession in an ecosystem advancing towards its climax community).

Seral communities are large in number depending on minor differences in edaphic, topographic or other local conditions. These communities are

large scale invasion for other species. Seral communities are short lived & quick in development but climax communities are in few numbers & similar in identical climax conditions. Climax communities attain a dynamic equilibrium with their environment. They can not change their environment to an extent. Climax communities are formed after a long period of time and once formed they maintain the structure and composition. which is the final or last seral stage.

Succession is the birth of an ecosystem and subsequent aging process of its abiotic and biotic features.

There 3 following parameters of ecological succession:-

(i) It is an orderly process of community development that involves changes in species structure and community process with time.

(ii) It results from modification of the physical environment by the community

that is succession is commerity controlled even through the physical environment determines the pattern, the rate of change and often sets limits as to how for development.

(iii) It culminates in a stabilized ecosystem in which maximum biomass & symbiotic function between organisms are maintained per unit of available energy flow.

On the basis of terrestrial, fresh water or marine water, the succession is 2 types :- (i) primary and (ii) Secondary

(i) PRIMARY SUCCESSION :- It is the process of species colonization and replacement in which the environment is initially virtually free of life, that is the process starts with base rock or sand dune or river delta or glacial debris and it ends when climax is reached. The sere involved in primary succession is called PRESERE. primary succession occurs when a community begins to develop on a site previously

unoccupied by living organisms.

(ii) SECONDARY SUCCESSION :- The term secondary succession refers to community development on locations or sites previously occupied by well developed communities. It occures where a commcenity has been disrupted and the surface is completely or largely devoid of vegetation. It may be due to earthquake, fire or even clearing of forests by man. In each case organis modify the environment in a way that allow one species to replace another. The sere involved in secondary succession is called SUBSERE.

Depending on the moisture content, the primary and secondary succession may be of the following types:-

(a) HYDRACH OR HYDROSERE :- These succession when starts in the aquatic environment like ponds, lake, streams, etc.

(b) MESARCH OR MESOSERE :- It is an intermediate type with adequate moisture. The succession when begin in such an area is called

mesarch.

(c) XERACH OR XEROSERE :- The succession when starts in xeric or dry habitate containing minimum amount of moisture such as rocks, dry deserts is called xerach.
A temporary community in an ecological succession on dry habitate is called xerosere. It may be 3 types :-

(i) LITHOSERE :- succession initiating on rocks.
(ii) PSAMMOSERE :- succession initiating on sand
(iii) HALOSERE :- succession initiating on saline water or soil.

Succession is also classified into two types on the basis of community metabolism :-

(a) HETEROTROPHIC SUCCESSION :- It is characterised by early dominance of heterotrops such as bacteria, fungi and animals.

(b) AUTOTROPHIC SUCCESSION :- It is characterised by early & continued dominance of autotrophic organisms like green plants.

The replacement of one type community by another is due to modification of the environment by communities themselves. Such process is called as Autogenic Succession. But it replacement is largely due to forces other than effects of communities on the environment is called Allogenic succession.

GENERAL PROCESS OF SUCCESSION

The complete process of primary autotrophic ecological succession involves these steps which follows one another:-

1) NUDATION:- The process of succession begins with the formation of a base area or nudation by several reasons such as volcanic eruption, flood, landslide, fire, disease it also some base areas which are created by human being such as walls, burning, digging etc.

2) INVASION:- The invasion is the arrival of the reproductive bodies of various organisms and their settlement in the new or base area. plants are the first

invaders in any area because the animals depend on them for food. It includes 3 steps :-

(i) Dispersal or Migration :- It is the process in which the reproductive bodies leaves the parent plant and arrives the bare area through the agency of air, water or animals.

(ii) ECESIS :- This is the successful establishment of migrated plant species in to new area. It includes germination of seeds, growth of seedlings and starting of reproduction.

(iii) AGGREGATION :- This is the final stage of invasion where immigrant species increase the number by reproduction and aggregate in a large population in the area.

3) COMPETITION :- As the number of individuals grows, there is the competition between different species that is both inter-specific and within same species that is intra specific for space, water &

nutrition. They influence each other in a number of ways known as COATION.

4) REACTION :- When living organism grows using water and nutrients from the soil by which they have a strong influence on the environment which is modified to a large extent. This extent is known as reaction.

5) STABILIZATION OR CLIMAX :- When a final terminal community becomes more or less stabilized for a longer period of time and it can maintain itself in the equilibrium and steady state with climate of that area. This is the last seral stage which mature, self maintaning, self reproducing through development stages which is relatively permanent. This final stable community of the different stages is known as CLIMAX COMMUNITY and the vegetation which supports is known as CLIMAX VEGETATION.

FOOD CHAINS

A food chain is a linear network of links in a food web starting from producer organism that is grass or

trees which use radiation from the sun to make their food and ending at predator species like grizzly bears or killer whales, detritivores like earthworms or woodlice or decomposer species like fungi or bacteria. Thus in food chain organisms of an ecosystem are linked together. Each step is known trophic level and study of energy flow through these steps is known as trophic ecology. Food chains are not isolated from each other.

Plants form link between biotic & abiotic components of the ecosystem. They receives water and minerals from the soil with the combination of sun light and carbon dioxide from the air to make carbohydrates, fats, proteins, vitamins and usable minerals through photosynthesis.

Ex:- A sheep may eat some grass which in term in may be eaten by a person. They algae of a lake will be eaten by many zooplanton and they are eaten by small fish and it term they are eaten by bars and this bars may be caught by a bar.

primary producers receive energy from sun and transfer that to chemical or potential energy of organic compound such as carbohydrates, proteins and fats. When herbivore eats a plant & these compounds are oxidised. The energy liberated is just equal to the amount of energy used in synthesizing the substances. When this animal is eaten by another one, along with transfer of energy from a herbivore to carnivore a further decrease in energy occurs as a the carnivore oxidise the organic substances of the first herbivore to liberate energy to synthesize its own cellular constituents.

Thus energy flows from primary producer to primary consumers, from primary consumers to secondary consumers, and from secondary consumers to tertiary consumers. A food chain in grass land ecosystem starts with grass and forbs and goes through grasshoppers, the frogs, the snake, the hawk.

A generalized Food chain of the ecosystem

Ex:-

① Grass → Rabbit → Fox → Wolf → Lion
(Grassland ecosystem)

② phytoplanktons → Waterfleas → small fish → Tuna (pond ecosystem)

③ Lichens → reindeer → Man
(Arctic Tundra)

According to the nature food chain is two types :- ① Grazing Food chain
② Detrities Food chain

① Grazing Food chain :- This type of food chain starts from green plants and ends to carnivores by passing through herbivores. The primary carnivores or secondary consumers eat herbivores or primary consumers of the ecosystem. The total energy by the primary carnivores and its deposition in to respiration, decay and further consumption by other carnivores is the entirely linked with that of herbivores.

Autotrophs primary producers → Herbivore primary consumer → primary carnivore secondary consumer →

Secondary carnivore / Tertiary consumer → so on

② Detrities Food chain :- The term detrities is given to organic wastes and dead matter derived from grazing food chain. The energy contained in this detrities is not loss to the ecosystem and also

its serves as a source of energy for a group of organisms, they differ from grazing food chain called the detritus food chain. These food chains are less depent on solar energy.

But in some ecosystems, more energy flows through the detritus food chains from the grazing food chains. The organisms of the detritus food chains are algae, bacteria, fungi, insects, worms, etc.

FOOD WEBS

A network of food chain where different types of organisms are connected at different trophic level, so that their are a number of options of eating and being eaten at each trophic level.

The organisms, thus are operating in simple food chain may operate in the ecosystem at more than one trophic level that is it may derive its food more than source. Individual food chain interconnected to form a network with several linkages is known as food web.

There are following 5 types of food chains are interconnected to form food web.

① Grass → Grasshoper → predatory bird (hawk)

② Grass → Grasshoper → Lizzard → hawk

③ Grass → Rabbit → hawk (or vulture or man)

④ Grass → Mouse → hawk

⑤ Grass → Mouse → snake → hawk

ECOLOGICAL PYRAMIDS

In year 1927, charles Elton found that the animals at the base of the food chain are relatively more while at the end are relatively few

in number their is progressively decrease between the two extremes. Also their is some sort of relationship between the numbers, biomass and energy content of the primary producers, consumers of the first and second orders and carnivores in the ecosystem. These relationship is represented in diagrammatic or graphic which is also known as ecological pyramid or Eltonian pyramids.

Ecological pyramids are generaly 3 types :-

① pyramid of number - (based on number of organism at each level)

② pyramid of biomass - (based on biomass of organisms)

③ pyramid of energy - (rate of energy flow and productivity at successive trophic level)

1) Pyramid of numbers :- Gives with relationship between number of producers, herbivores and carnivores at each successive trophic level. At the base of such pyramid the primary producer

is many in number but at the top the consumer level relatively low or decreases.

In grassland ecosystem, the producers which are mainly grasses are always many in numbers. This number is then decrease towards up level. Ex:- the primary consumer or herbivores like rabbit are less in number than the grasses. The secondary consumer are lesser than to primary consumer and finally the top consumers like hawks are least in numbers. Thus the pyramid becomes upright. In a pond ecosystem, the pyramid is also upright. In this system the producers which are mainly the phytoplanktons as algae or bacteria etc which are maximum in number while the herbivores which are smaller fish are lesses in number. The secondary and top consumers are least in number respectively.

In a forest ecosystem, the pyramid is inverted, where the number of primary producer is less

than that of herbivore birds feeding upon the tree fruits. The number of parasites like bugs, lice living and feeding upon the birds body is still higher. Thus depending upon the size and biomass the pyramid of numbers is not always pyramidal, it may be completely inverted in shape.

2) Pyramid of Biomass :- The pyramid of biomass is upright because it is inverted nature because weight of the primary producers forms the base. The biomass of one tree is very high as the biomass of a number of birds feeding upon a tree is far less than that of tree. similarly, the biomass of even a very large number of parasites in and on the body of the birds is far less.

3) Pyramid of Energy :- The energy pyramid gives the best picture of overall nature of the ecosystem. The shape of the pyramid is always upright among the biomass pyramid

or pyramid number. The pyramid of energy represent the total quantity of energy utilized by the different trophic level organisms of an ecosystem per unit area over a set period of time. The base upon which pyramid of energy is constructed is the quantity of organisms produced per unit time. Energy pyramids are always upright because the less energy is transferred from each level. The quantity of energy produced by the green plants in an area over a period is more than that of organism of other trophic level so the base of pyramid is large. The population of photoplanktons in aquatic ecosystem complete their life cycle and sets of new generation in every few hours or a days. The energy content of these generation of phyto-planktons produced in a year is much more that of herbivore fishes. The energy content of top carnivore is the least, so the pyramid of energy is upright.

The ratio of the amount of energy absorbed and the amount of energy which would be retained in biomass is known as ecological efficiency.

Major Ecosystem

According to the nature there are three types of ecosystem:-

1. Terrestrial ecosystem
2. Freshwater ecosystem
3. Marine ecosystem

A large geographical area with its specific and complex flora & associated fauna is known as biome. The physical factors like, nature of soil, rainfall, temperature, light, etc.

Terrestrial ecosystems

The terrestrial ecosystem are following 3 types:-

(i) Forest ecosystem
(ii) Grassland ecosystem
(iii) Desert ecosystem

(i) **Forest Ecosystem**:- Around 40% of the land is occupied by forest. But in india it is one-tenth. In india, tropical rain forests are found in western Ghats,

Andamans and north-east Himalayas. So these have maximum bio-diversity. The different components of a forest ecosystems are :-

(a) Abiotic Component :- These are the organic and inorganic substances present in the soil and atmosphere.

(b) Biotic Component :- The living organisms present in the food chain which are in the following order ① producers ② consumers ③ Decomposers.

AQUATIC ECOSYSTEM

More than 70% of the land is covered by the water so the aquatic ecosystems are :-

Pond Ecosystems :- ponds are small bodies of water in which the littoral zone is relatively large and limnetic regions are small. ponds may be found in most regions of adequate rainfall. They are continually forming as a stream shift position.

Temporary ponds are dry for

part of the year. ponds created by damming of stream or basin by man or by animals.

ponds play an important role in the villages where most of the activities like washing, clothes, bathing, swimming, cattle bathing etc are centre around ponds. pond ecosystem is divided into basic components are :-

(i) Abiotic component :- Other than heat, light the basic inorganic and organic compounds, elements are water, CO_2, oxygen, calcium, nitrogen, phosphorus, amino acids, etc.

Light intensity and turbidity index of water at different depths can be measured by Lux-photometer. pH of water and Mud is determined by Electrical pH meter. carbohydrates, proteins are estimated for biomass determination.

(ii) Biotic components :- The biotic components in pond ecosystem are :-

(A) producers :- These are acetotrophic, green plants and bacteria. They fix radiant

energy and with the help of minerals from water and mud form complex organic substances like proteins, carbohydrates. producer are of the following types :-

(a) Macrophytes :- These are rooted types larger plants which include partly or completely submerged floating and emergent hydrophytes. The common species of plants are trapa, typha, sagittaria, nymphaea, chara, hydrilla, utricularia, marsilea, azolla, sylvinia, spirodella, lemna etc.

(b) phytoplankton :- These are minute, floating or lower plants like ulothrix, spirogyra, cladophora, oedogonium, cosmarium, Eudorina pandorina, volvox, chlamydomonas etc. Biomass is estimated as weight of standing crop per unit area or volume. Energy content is generally expressed in terms of cal/gm dry wt.

(B) Consumer

Most of the consumers are herbivores except insects and some large fish. In ponds consumers are distinguished as.

(a) Primary consumers :- These are herbivores, also known as "primary macro consumers", which are feeding directly on living plants. They may be large or small in size. They are further classified as:-

(i) Benthos :- These are the associated with living plants. Benthic population include fish, mites, insect larvae, molluscs, etc. Besides there some animals like cows, buffaloes and birds also visit the pond.

(ii) Zooplanktons :- Such consumers feed on phytoplanktons. Eg:- Rotifers, protozoans and Crustaceans.

(b) Secondary consumers :- These are carnivores like insects and fish which feed on primary consumers like Zooplanktons.

(c) Tertiary consumers :- These are some large fish feed on smaller fish.

(C) Decomposers :-

These are microconsumers, which absorb only a fraction of the decomposed matter. They decompose organic matter of both producers as well as micro-consumer. Thus they play an important

role in return of mineral elements again to the pond. The bacteria, fungi, actinomycetes are the most common decomposers in water and mud of the pond.

MARINE (OCEAN) ECOSYSTEM

The marine environment of seas and ocean is large occupying 70% of the earths surface. The volume of the surface area of marine environment is lighted by sun is small in comparison to the total volume of water involved. All the seas are interconnected by currents, dominated by waves, influenced by tides and characterised by saline water. Each ocean represents a very large and stable ecosystem. Oceans play an important role in regulating many bio-geochemical and hydrological cycles and also regulates the earths climate. The biotic component of the oceans are :-

1) PRODUCERS

These are autotrophs, which are mainly phytoplanktons. They receive the radient energy from sun through their pigments. (Brown and red algae) are in this category.

2) CONSUMERS

These are heterotrophic macro-consumers, which are depend upon the primary producers for their nutrition. These are :-

(i) The herbivores like crustacions, molluscs, fishes etc. which feed directly on producers are called primary consumers.

(ii) The carnivores fishes like shad, herring etc. feeding on herbivores are called secondary consumers.

(iii) The top carnivores fishes like cod, haddock, halibut etc. that feed on secondary consumers are called tertiary consumers.

3) DECOMPOSERS

The microbes active in the decay of dead organic matter which are bacterias and some fungi.

LAKE ECOSYSTEM

Lakes are inland depressions containing standing water. They vary in size and depth (Few feet to 5000 feet). Some lakes have outlet streams. In lake there are three to five well recognized horizontal zone :-

(i) Littoral zone :- Shallow water near the shore forms this zone. It contains upper warm and oxygen rich circulating water layer, which is called epilimnion. It include rooted vegetation.

Different zone of a deep freshwater lake

(ii) Sublittoral zone :- It extends from rooted vegetation to the non circulating cold water with poor oxygen zone, known as hypolimnion.

(iii) Limnetic zone :- It is the open water zone away from the shore. It is up to the depth of effective light penetration where rate of photosynthesis is equal to the rate of respiration.

(iv) Profundal zone :- It is the deep water area beneath limnetic zone and beyond the depth of effective light penetration.

(v) Abyssal zone :- It is found only in deep lakes since it begins at about 2000 meter from

the surface.

Based on humic acid contents, the lakes are classified in to clear water lakes and Brown water lakes.

Biotic communities of lakes

Organisms depends upon substratum are called as pedonic forms and that are free from it called limnetic forms. The lakes have several type of organisms.

(i) Neuston :- These including floating plants such as duckweeds and many type of animals are called epineuston, while others including insects called hyponeuston.

(ii) Plankton :- These are small plants and animals whose powers of self locomotion is limited. Generally zooplanktons are very active are known as nektoplanktons.

(iii) Nekton :- These animals are swimmers.

(iv) Bethos :- These includes the organisms living at the bottom of the water mass. These living above the sediment water interface are termed benthic epifauna and those living in sediments itself are termed as infauna.

Stratification in lakes

During the summer the top water become warmer than the bottom waters, as a result only the warm top layer circulates and it does not mix with the more cold water, is known as thermocline. The upper water layer is epilimnion. Non-circulating water is hypolimnion. Subtropical lakes having surface temperatures that never fall below 4°c.

Categories

(a) Dimictic :- (mictic = Mixed) Two sessional periods of free circulation.

(b) Cold monomictic :- Water never above 4°c (polar regions), seasonal overturn in summer.

(c) Warm monomictic :- Water never below 4°c. One period of circulation in winter.

(d) polymictic :- More or less continuously circulating with only short, if any, stagnation period.

(e) Oligomictic :- Rarely mixed

(f) Micromictic :- permanently stratified.

STREAMS

Biotic community in streams is quite different from that of ponds. Most streams of urban areas are polluted. Streams are fresh water aquatic systems where water current is a measure controlling factor, oxygen and nutrients are in water.

(i) **Current:-** It is a major controlling and limiting factor in streams. Velocity of the current varies greatly in different parts of the same stream and from one time to another. In large streams, the current may be so reduced that virtually standing water conditions result the reduction of current. The velocity of the current is determined by steepness of the surface gradient, the roughness of depth and width of the stream bed.

(ii) **Land-Water Interchange:-** The land-water surface junction is relatively great in proportion to the size of the stream habitat that is the streams are more closely associated with the surrounding land. Most streams depend on land areas and on connected ponds, lakes for a large portion of their basic energy supply.

(iii) Oxygen :- Stream organisms face more extreme conditions in regard to the current and temperature. Because of small depth large surface exposed to the air and constant motion streams generally contain and continuous supply of the oxygen even there is no green plants by which stream animals have a narrow tolerance and less reduction of oxygen.

ZONATION IN STREAMS

In streams, zonation is longitudinal changes are more induced in the upper part because of gradient volumes flow and chemical composition increases.

STREAM COMMUNITIES :-

Streams are generally exhibit two major habitats that is rapid & pools. within these categories the type of the bottom whether sand, pebbels, clay, bedrock is very important in determining the nature of the community and population density.

ESTUARIES (ESTUARINE ECOLOGY)

Estuarine is derived from the word

aestus means tide. Estuarine is defined as a semi-enclosed coastal body of water, which has a free connection with the open sea. It is strongly affected by tidal action and within it sea water is mixed with fresh water from land drainage. River mouths, coastal bays are the example of estuaries.

Estuaries differ in size, shape and volume of water flow, all influenced of the region in which they occur. When silt and mud accumulations becomes high which is exposed at low tide, then tidal flats are developed.

There are different classifications which are based upon:-

(i) Geomorphology
(ii) water circulation and stratification
(iii) Systems energetics.

There are four sub divisions of estuaries of Geomorphological:-

(i) Drowned river valleys
(ii) Fjord type estuaries
(iii) Bar - built estuaries
(iv) Estuaries formed by tectonic processes.

River-delta estuaries found at the mouths of large rivers such as Mississippi or the Nile. It is different from formers. On hydrographic basis estuaries can be placed in three broad categories.

(a) Highly stratified or salt wedge estuary.
(b) The partially mixed or moderately stratified estuary.
(c) The completely mixed or vertically homogeneous estuary.

Physico Chemical Aspects of Estuaries

Current and salinity both are important. Estuarine current induced from the interaction of one direction stream flow which varies with the session and rainfall with oscillation ocean tide and with wind. The salinity varies vertically and horizontally and fluctuates between 0.5 to 0.35%. The water level in the estuary fluctuate regularly unlike that of river.

The sessional and tidal cycles cause changes in nutrient concentration in the estuary, all estuaries have high productivity. The concentration of nutrients

and fix carbon is very high level of production.

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UNIT: ENVIRONMENTAL POLLUTION

Air pollution

Air pollution is defined as the presence in the outdoor atmosphere of one or more combination in such quantities and such duration as may be or may tend to be injurious to human, plant or animal life or property etc.

The atmosphere is dynamic system, which absorbs various pollutants from natural as well as artificial sources. Gases such as CO, CO_2, H_2S, SO_2 and NO_x with particular matter like sand, dust and also natural activities like forest fires, volcanic irruptions, decay of vegetation, winds and sand of dust storms. The magnitude of the problems of air pollution has increased continuously due to population explosion, industrialization, urbanizations, automobiles etc.

Classification of Air pollutants

The air pollutants may be classified in different ways:-

(a) According to the origin

(i) primary pollutants which are directly emitted into the atmosphere. Eg:- CO, NO_2, SO_2 and hydrocarbons.

(ii) Secondary pollutant which are derived from the primary pollutants due to chemical or photochemical reaction into the atmosphere. Eg:- Ozone, peroxy-acy: nitrate (PAN), photo-chemical smog, etc.

(b) According to the chemical composition

(i) Organic pollutants Eg:- Hydrocarbons, aldehydes, ketones, amines and alcohols.

(ii) Inorganic pollutants :- Carbon compounds (CO and carbonates), nitrogen compounds (NO_x and NH_3), sulphur compounds (H_2S, SO_2, SO_3, H_2SO_4), Halogen compounds (HF, HFC and metalic Fluorides). Inorganic particles like fly-ash, silica, asbestos and dust from transport, mining and other industrial activities.

(c) According to the state of Matter:-

(i) Gaseous pollutants which get mixed with the air and do not get settle out normally Eg:- CO, NO_x and SO_2.

(ii) The particulate pollutants which is divided in solids or liquids an exist and often exist in colloidal state Eg:- (smoke, fumes, dust, fog and (sprays.

Biochemical Effects of some important air pollutants:-

Pollutant	Major Sources	Typical Effects
Carbon monoxide (CO)	Incomplete combustion of fuels, automobile exhausts, jet engine emissions, blast furnaces, mines and tobacco smoking.	Toxicity, blood poisoning, increased proneness to accidents, CNS impairment, CO combines with haemoglobin, forming carboxy haemoglobin, which is useless for respiratory purposes and hence leads to death.
Sulphur dioxide (SO_2)	Combustion of coal, combustion of petroleum products, burning of refuse, petroleum industry, oil refining, power house, sulphuric acid plants, metallurgical operations and from domestic burning of fuels.	Increased breathing rate and feeling of air-starvation, suffocation, aggravation of asthma and chronic bronchitis, impairment of pulmonary functions, respiratory irritation, sensory irritation, irritation throat and eyes.

Oxides of Nitrogen (NO)	Automobile exhausts, coal-fired and gas-fired furnaces boilers, power stations, explosives industry, fertilizer industry, manufacture of HNO_3, combustion of wood & refuse.	Respiratory irritation, headache, bronchitis, pulmonary emphysema, impairment of lung defences, edema of lungs, lachrymatory effect, loss of appetite, corrosion of teeth.
Hydrogen sulphide (H_2S)	coke ovens, kraft paper mills, petroleum industry, oil refining, viscose rayon manufacturing plants, manufacture of dyes, tanning industry and sewage treatment plants.	Irritation of eyes, nose and throat, toxicity, respiratory irritation, lachrymatory effects. In large doses it may cause edema, pneumonitis, emphysema and bronchitis.
Chlorine (Cl_2)	Accidental breakage of chlorine cylinders, electrolysis of brine, bleaching of cotton pulp and other process industries using chlorine.	Headaches, conjunctivitis sleeplessness, pain in the eyes irritation of respiratory tract, respiratory paralysis, asphyxiation malodorous. In high concentrations, it may lead to blockages of

		oxygen transfer, poisoning cell enzymes and damaging nerve tissues.
Hydrogen Fluoride (HF)	Glass fibre manufacture, chemical industry, fertilizer industry, aluminium industry, ceramic industry, phosphate rock processing.	Irritation, respiratory diseases, fluorosis of bones, mottling of teeth.
Carbon dioxide (CO_2)	Combustion of fuels, automobile exhausts, jet engine emissions.	Toxic in large quantities, Hypoxia.
Hydrocarbons	Organic chemical industries, petroleum refineries, automobile exhausts, rubber manufacture.	Some hydrocarbons have carcinogenic effects, lachrymatory effect.
Oxidants (e.g. O_3)	Photochemical reaction in atmosphere involving organic materials and NO_2 etc.	Irritation of lungs, eyes and respiratory tract. Accumulation of fluids in lungs and demage to lung capillaries

	Reactions induced by silent electrical discharge and intense U.V. radiations in the atmosphere.	These biochemical effects of O_3 mostly arise from generation of free radicals which attack the SH groups present in the enzymes.
Dusts	Asbestos factories, mining activities, power stations, metallurgical industries, ceramic industry, factory stacks, glass industry, cement industry, boundaries	Respiratory diseases, torrently from metallic dusts, silicosis and asbestosis from the specific dusts. Asbestos dust cause pulmonary fibrosis, pleural calcification and lung cancer.
Ammonia (NH_3)	chemical industries, coke oven refineries, stocks yards, fuel incineration.	Damage to respiratory tracts and eyes, corrosive to mucous membranes. Irritation to eyes, skin and respiratory tract.
Formaldehyde (HCHO)	Waste incineration, automobile exhausts, combustion of fuels, photochemical reactions.	Irritation to eyes, skin and respiratory tract.

Hydrochloric acid (HCl)	By-product from chlorination of organic compounds, combustion of gasoline in which ethylene dichloride is present, burning of coal, paper and chlorinated plastics.	Inflammation and ulceration of upper respiratory tract, clouding of cornea, coughing and choking while inhalation.
Radioactive gases & dusts	Radioactive gases and suspended dusts from natural and artificial radioisotope sources.	Somatic effects such as leukaemia and other types of cancer, cataracts and reduction in life expectancy. Genetic effects such as mutations in human gametes.
Arsenic (As)	Arsenic containing fungicides, pesticides and herbicides, metal smelters, by-product of mining activities, chemical wastes.	Inhalation, ingestion or absorption through skin can cause mild bronchitis, nasal irritation or dermatitis. Carcinogenic activity also is suspected. Attack -SH groups of enzymes, coagulate proteins.

Beryllicum (Be)	Coal, nuclear power & space industries, production of fluorescent lamps, motor fuels and other industrial use.	Damage to skin and mucous membrane, pulmonary damage, perhaps carcinogenic.
Boron (B)	Boron producing units, production and use of petroleum fuel and additives, burning coal and industrial wastes, detergent formulations.	Ingestion or inhalation as dust causes irritation and inflammation. Boron hydrides can damage CNS and may result in death.
Cadmium (Cd)	Cadmium producing industries, electroplating, welding, By-product from refining of Pb, Zn and Cu, fertilizer industry, pesticide manufacture, cadmium nickel batteries, nuclear fission plants, production of TEL used as additive in petrol.	Inhalation of fumes and vapours causes kidney damage, bronchitis, gastric and intestinal disorders, cancer, disorder of heart, liver and brain. Chronic and acute poisoning may result. Renal dysfunction, anaemia, hypertension, bone-marrow disorder and cancer.

	ries, nuclear fission plants, production of TEL used as additive in petrol.	hypertension, bone-marrow disorder and cancer.
Chromium (Cr)	Metallurgical & chemical industries processes using chromate compounds, cement and asbestos units.	Toxic to body tissues, can cause irritation, dermatitis, ulceration of skin, perforation of nasal septum. Carcinogenic action suspected.
Lead (Pb)	Automobile emissions, lead smelters, burning of coal or oil, lead arsenate pesticides, smoking mining and plumbing.	Absorption through gastrointestinal and respiratory tract and deposition at mucous membranes, cause liver & kidney damage, gastro-intestinal damage, mental retardation in children, abnormalities in fertility and pregnancy.
Manganese (Mn)	Ferromanganese production, organomanganese fuel additives, welding rods, incineration of manganese	poisoning of CNS, absorption, ingestion, inhalation, or skin contact may cause manganic pneumonia.

	containing substances.	
Nickel (Ni)	Metallurgical industries using nickel, combustion of fuels containing nickel additives, burning of coal and oil, electroplating units using nickel salts, incineration of nickel containing substances vanaspati manufacture.	Respiratory disorders, dermatitis, cancer of lungs and sinus.
Mercury (Hg)	Mining and refining of mercury, organic mercurials used in pesticides, laboratories using mercury.	Inhalation of mercury vapours may cause toxic effects and protoplasmic poisoning. Organo-mercurials are highly toxic and may cause irreversible damage to nervous system and brain.

Effects of Air pollutants on man & his Environment

① **Damage to Materials:-** The materials that may be affected by air pollutants include metals, building materials, rubbers, paper, textiles, leather dyes, glass, enamels and surface coating. The intensity of damage depends upon factors such as moisture, temperature, sunlight etc.

② **Damage to Vegetation:-** Air pollutants like sulphur dioxide (SO_2), Hydrofluoric acid (HF), smog, Ethylene, NO_x, chlorine effects on vegetation. The extent of damage to a plant depends upon the nature and concentration of the pollutant, time of the exposure, soil and plant condition, stage of growth, humidity and extent of sunlight.

③ **Damage to farm animals:-** Arsenic, lead and fluorides are the main pollutants which cause damage to livestock. Due to poison which is contaminated with the vegetation.

Arsenic occurs as an impurity in coal and many ores. It is also used

in insecticides. Livestock near smelting and industrial operation suffer arsenic poisoning with symptoms like salivation, thirst, liver necrosis, inflammation of depression of central nervous system.

Lead is emmited from metallurgical smelters coke-ovens and coal combustion operations. Lead poisoning occurs in the horses with the symptoms such as depression, lethargy, gastritis, paralysis and breathing troubles.

(4) Darkening of sky and reduction in visibility :- Sky darkening may be caused by heavy smoke and fog or by dust storms. The reduction in the visibility in the size range of 0.4 to 0.9 μm which scatter light. The intensity of these effects depends upon the particle size, angle of the sun, thickness of the affected air mass and meteorological factors such as wind speed and humidity.

(5) Effect of human health and human activities :- The effects of air pollution on humans, animals and vegetation causes harmful. Air pollution effects the health of workers within the

industrial premises, causes sickness and drop in production. Epidemiological and toxicological studies indicate a link between air pollution and respiratory conditions like chronic bronchitis and bronchial asthma, lung cancer. Irritation of nose, eyes, throat and bad odour due to air pollutants causes allergy and health hazards.

Controlling Measures of Air-pollution

It is not easy to control air pollution at resonable cost, because it is not so simple. But we can check it or prevent by careful planning for industries better design, operation of equipments. The following general methods of air pollution control are:-

(i) Controlling the air pollution at source
(ii) Site selection
(iii) Controlling air pollution by devices or equipments or process modification.
(iv) Air pollution control by growing vegetation.
(v) Air pollution control by fuel selection and utilization.

(iv) It should not contain toxic dissolved impurities, such as heavy metals, pesticides, etc.

(v) It should have a pH in the range 7-8.5.

(vi) It should be moderately soft, having hardness preferably in the range 50-100 ppm. Its hardness should not be above 150 ppm.

(vii) It should not be corrosive to the pipelines.

(viii) It should not stain clothes.

Water pollutants and their sources

The various types of water pollutants are:-

(i) oxygen-demanding wastes
(ii) Disease-causing wastes
(iii) synthetic organic compounds
(iv) sewage and agricultural run-off
(v) oil
(vi) Inorganic pollutants
(vii) suspended solids and sediments
(viii) Radioactive materials
(ix) Heat

Effects

Some important effects of various types of water pollutants are as:-

Water pollution

Water is essential for the survival of any form of life. On an average, a human being consumes about 2 litres of water everyday. Water accounts for about 70% of the weight of a human body. About 80% of the earth's surface (that is 80% of the total 50,000 million hectares in area). Out of 1,011 million km^3 of the total water present on earth, only 33,400 m^3 of water is available for drinking, agriculture, domestic and industrial consumption. The rest of the water is locked up in oceans as salt water, polar ice-caps and glaciers and under-ground. The water that is fit for drinking purposes is called potable water.

Characteristics of potable Water

(i) It should be colourless, odourless and tasteless.

(ii) It should be free from turbidity and other suspended impurities.

(iii) It should be free from germs, bacteria and other pathogenic organisms.

(i) Tannery effluents contain several constituents which are deleterious, irrespective of the fact that where they are discharged viz., into river, stream, sewer, land or sea.

(ii) It imparts persistent dull brown colour to the receiving water causing aesthetic and other problems described earlier.

(iii) Highly repulsive odour is imparted to the receiving water. The dissolved constituents like proteins are putrifiable

(iv) The acidic or alkaline effluents are corrosive to concrete and metal pipes.

(v) Excess NaCl in the effluent is also corrosive and renders the receiving water unsuitable for irrigation.

(vi) The effluents may contain pathogenic bacteria.

(vii) The dissolved chromium present is toxic to fish and aquatic life and thus affects the natural self-purification property of the stream.

(viii) The suspended solids such as hair, fish, $CaCO_3$, etc. interfere with aeration

and photosynthetic activities of the aquatic flora.

(ix) If the wastewater is discharged into sewer, the suspended impurities such as $CaCO_3$, hairs etc. may choke the sewerage pipes. The sulphides present in the wastewater cause "crown corrosion" to the concrete structures, etc.

(x) The chromicum and sulfides present in the waste water being toxic to microorganisms disrupt the biological treatment operation such as trickling filtration. The suspended lime etc. also interfere with the biological activities in the sewage treatment plants.

(xi) The presence of excessive salt & Cr in the wastewaters may deteriorate the quality of the ground water in the affected areas.

(xii) High amounts of fluoride (over 1000 mg/1) present in phosphatic fertilizer effluent enrich the fluoride content of the receiving waters causing dental and skeletal fluorosis to humans, abnormal calcification of bones in animals and adverse effects

on plants. presence of Cr, cyanide, ammonia are harmful to aquatic life.

(xiii) volatile substances such as alcohols, aldehydes, ethers and gasoline may cause explosion in sewers.

(xiv) suspended solids such as silt and coal may injure the gills of the fish and cause asphyxiation.

(xv) suspended solids may also cause bad odour and tastes and also may promote conditions favourable for growth of pathogenic bacteria.

(xvi) Radioactive isotopes are toxic to living forms. For instance, Sr^{90}, which emanates from testing of nuclear weapons, accumulates in bones and teeth and causes serious disorders in human beings. The maximum permissible level of Sr^{90} in water is 10 pico curies per liter (1 pico curie = 10^{12} curie).

Control of Water pollution

The control of water pollution is difficult, but we may try for its prevention and minimisations. Industrial

used and developing countries spend a handsome amount of their GNP (Gross National product) on pollution control measures, but the problem is going to be worsening day by day.

The respective safety measures to achive for water quality at the least cost are :-

(i) scientific techniques are necessary to be adopted for the environmental control of catchment areas of rivers, lakes, ponds or streams.

(ii) Industrial plants should be based on recycling operations.

(iii) The possible reuse or recycle of treated sewage effluents and industrial wastes should be emphasized and encouraged.

(iv) Instead of throwing wastes in to water, the rycycling should be done for better use. Gobar gas plant, composting, manufacture of hardboard, paper etc. such examples where respective waste can be used.

(v) Minimum, appropriate quantity and concentration of fertilizers, pesticide and insecticides should be used, because excess

will cause pollution.

(vi) There should be propoganda for water pollution control, on radio, TV, newspapers etc. because public awareness is a must.

(vii) Treatment plants should be constructed and Govt should also help by funding for domestic, sewage and industrial effluents.

(viii) Local authorities, industrialists, Govt officials, with public participation should co-ordinate to finds ways to control water pollution.

(ix) water resources should be used in the best possible economic way.

(x) To conduct seminars and training courses for helping those, who are directly or indirectly engaged in water management and water pollution control.

(xi) Govt. should encourage people to participate in research programmes like disposal of sewage and industrial effluents.

(xii) Destruction of forest should be discouraged our goal should be "conservation of forests" and "plant more tree".

(xiii) Techniques like adsorption, electro dialysis, iron exchange and reverse osmosis etc can be used for removal of water pollutants.

(xiv) plants should be developed to recover metal from metal bearing waste water.

Soil pollution -

(Soil is a very important constituents of the lithosphere. The word "soil" is derived from a latin word "solum" which means earthy material in which growth of plants take place.) "Soil" may be broadly defined as the weathered layer of the earth's crust with living organisms and their products of decay. It is a complex physio-biological system containing water, mineral, salts, nutrients and dissolved oxygen. It provides anchorage to plants. The study of soil science is called pedology or edaphology.