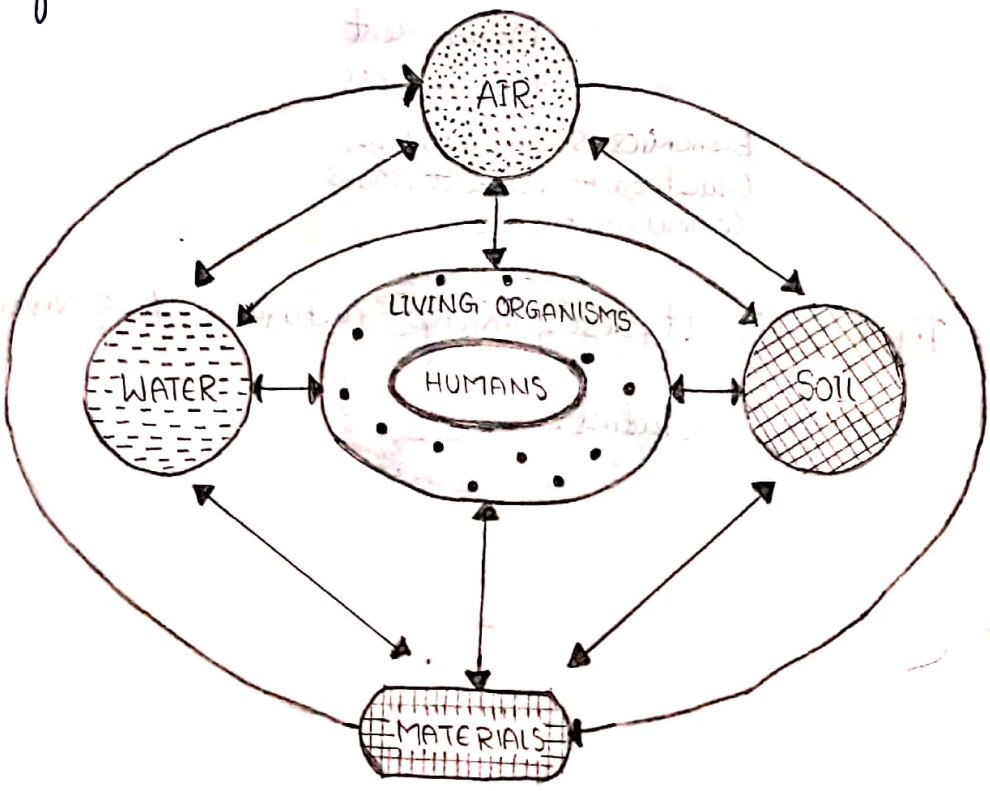
ENVIRONMENTAL STUDIES.

1. 1. ENVIRONMENT

"Environment" is derived from the French word Environner, which means to encircle OR Surround. All the biological and non-biological entities Surrounding us are included in environment. As per Environment (Protection) Act, 1986, environment includes all the physical and biological surroundings of an organism along with their interactions.

Environment is thus defined as "the Sum total of water, air and Land and the inter-relationships that exist among them and with the human beings, other living Organisms and Materials." The Concept of environment can be clearly understood



1.2. MULTIDISCIPLINARY NATURE OF ENVIRONMENTAL STUDIES.

Keeping in view the complex nature of environment, knowledge inputs from various disciplines of Science, Social Science, Law and engineering are included in Environmental Studies. [Fig. 1.2.]

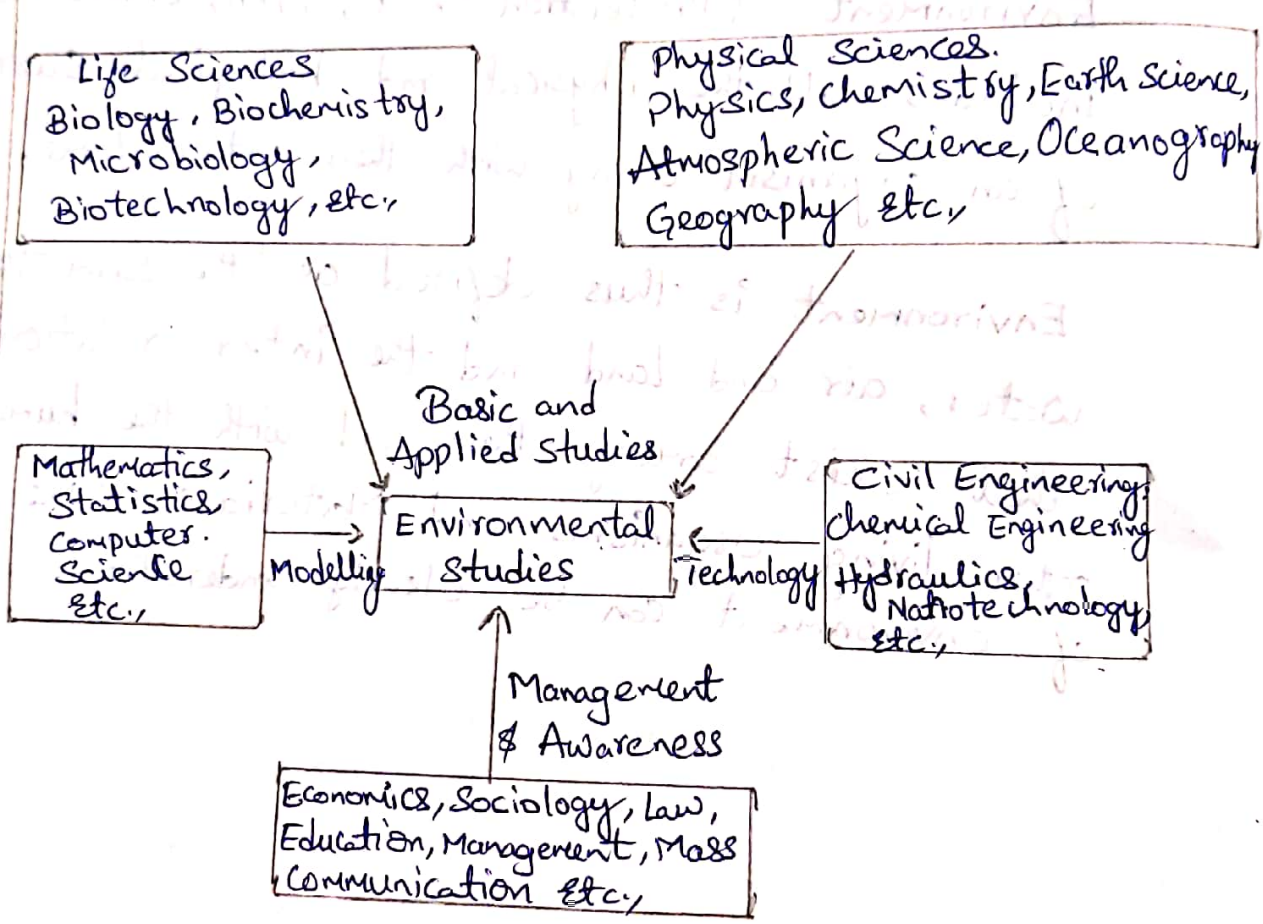


Fig 1.2. Multidisciplinary nature of environmental Studies.

1.3. SCOPE.

Environmental studies as a subject has a wide scope. It encompasses a large number of areas and aspects, which may be summarized as follows:

- → Natural Resources – their Conservation and Management.
- → Ecology and biodiversity.
- → Environmental pollution and Control.
- → Social issues in relation to development and environment.
- → Human population and environment.

These are the basic aspects of environmental studies, which have a direct relevance to every section of the Society. Environmental studies can also be highly Specialized Concentrating on more technical aspects. like enviromental Science, environmental engineering or environmental Management.

4. IMPORTANCE OF ENVIRONMENT

Environment belongs to all and is important to all. whatever be the occupation or age of a person, he will be affected by environment and also he will affect the environment by his deeds. That is why we find an internationally observed environment Calender to Mark Some important aspect OR issue of environment.

Environmental Calender.

World Wetland Day	February 2.
World Forest Day	March 21.
World Day for water.	March 22.
World Meteorological Day.	March 23.
Earth Day.	April 22.
International Biodiversity Day	May 22.
Anti-tobacco Day	May 31.
World Environment Day	June 5.
World Ocean Day	June 8.
World Population Day	July 11.
Ozone week	Sep. 16-23.
World Car-free Day	Sep 22.
Green Consumer Day	Sep 28.
World Farm Animal's Day	oct. 2.
World Habitat Day	oct 3.

World Animal welfare Day	Oct 4.
Wildlife Week	Oct. 1-7.
World Conservation Day	Oct 24.
International Day for Natural Disaster Reduction	Oct 13.
International Day for Biological Diversity	Dec 29.

Global Vs. Local Nature of Environment.

Environment is one subject that is actually global as well as local in nature.

Issues like global warming, depletion of ozone layer, dwindling forests and energy resources, Loss of global biodiversity etc., which are going to affect the mankind as a whole are global in nature and for that we have to think and plan globally.

However, there are some environment problems which are of localized importance. For dealing with local environmental issues, eg., impact of mining OR hydro-electric project in an area, problems of disposal and management of solid waste, river OR lake pollution, soil erosion,

water logging and Salinization of soil, fluorosis problem in local population, arsenic pollution of ground water etc., we have to think and act locally.

In order to make people aware about those aspects of environment with which they are so intimately associated, it is very important to make every one environmentally educated.

Individualistic Nature of Environment.

Environmental studies is very important since it deals with the most mundane problems of life where each individual matters, like dealing with safe and clean drinking water, hygienic living conditions, clean and fresh air, fertile land, healthy food and sustainable development. If we want to live in a clean, healthy, aesthetically beautiful, safe and secure environment for a long time and wish to have hand over a clean and safe earth to our children, grand children and great grand children, it is most essential to understand the basics of environment.

5. NEED FOR PUBLIC AWARENESS.

International Efforts for Environment.

Environmental issues received international attention about 35 years back in Stockholm Conference, held on 5th June, 1972, Since then we celebrate "World Environment Day on 5th June". At the United Nations Conference on "Environment and Development" held at Rio de Janeiro, in 1992, known popularly as Earth Summit, and ten years later, the World Summit on Sustainable Development, held at Johannesberg in 2002, key issues of global environmental concern were highlighted. Attention of general public was drawn towards the deteriorating environmental conditions all over the world.

Award of the Nobel Peace Prize (2004) to an environmentalist, for the first time, came as a landmark decision, showing increasing global concern towards environmental issues and recognition to efforts being made for environmental conservation and protection.

Public Awareness for Environment:

The goals of Sustainable development cannot be achieved by any government at its own level until the public has a participatory role in it, Public Participation is possible only when the public is aware about the ecological and environmental issues.

There is a Chinese proverb "If you plan for one year, plant rice, if you plan for 10 years, plant trees and if you plan for 100 years, educate People."

If we want to protect and manage our planet earth on Sustainable basis, we have no other option but to make all persons environmentally educated.

NATURAL RESOURCES.

Life on this planet earth depends upon a variety of goods and services provided by the nature, which are known as Natural resources. Thus water, air, soil, minerals, coal, forests, crops and wildlife are all examples of natural resources. Any stock or reserve that can be drawn from nature is a natural resource.

The natural resources are of two kinds:

→ Renewable resources which are inexhaustive and can be regenerated within a given span of time eg., forests, wildlife, wind energy, biomass energy, tidal energy, hydro power etc, Solar energy is also a renewable form of energy as it is an inexhaustible source of energy.

⇒ Non-renewable resources. which cannot be regenerated eg., Fossil fuels like coal, petroleum, minerals etc., Once we exhaust these reserves, the same cannot be replenished.

WATER RESOURCES:

Water is an indispensable natural resource on this earth on which all life depends. About 97% of the earth's surface is covered by water and most of the animals and plants have 60-65% water in their body.

Water - a Unique Resource:

Water is characterized by certain unique features which make it a Marvellous resource:

(i) It exists as a liquid over a wide range of temperature i.e. from 0° to 100°C.

(ii) It has the highest specific heat, due to which it warms up and cools down very slowly without causing shocks of temperature jerks to the aquatic life.

(iii) It has a high latent heat of vaporization. Hence, it takes a huge amount of energy for getting vaporized, That's why it produces a cooling effect as it evaporates.

(iv) It is an excellent solvent for several nutrients. Thus, it can serve as a very good carrier of nutrients,

including oxygen, which are essential for life. But, it can also easily dissolve various pollutants and become a carrier of pathogenic microorganisms.

(v) Due to high surface tension and cohesion it can easily rise through great heights through the trunk even in the tallest of the trees like sequoia.

(vi) It has an anamolous expansion behaviour i.e., as it freezes, it expands instead of contracting and thus becomes lighter. It is because of this property that even in extreme cold, the lakes freeze only on the surface. Being lighter the ice keeps floating, where as the bottom waters remain at a higher temperature and therefore, can sustain aquatic organisms even in extreme cold.

Hydrological Cycle:

The water we use keeps on cycling endlessly through the environment, which we call as Hydrological cycle.

The water from various moist surfaces evaporates and falls again on the earth in the form of rain or snow and passes through living organisms and ultimately returns to the oceans.

Plants too play a very important role by absorbing the ground water from the soil and releasing it into the atmosphere by the process of transpiration.

WATER USE AND OVER-EXPLOITATION.

Due to its unique properties water is of multiple uses for all living organisms. Water is absolutely essential for life. Most of the life processes take place in water contained in the body. Uptake of nutrients, their distribution in the body, regulation of temperature and removal of wastes are all mediated through water.

Human beings depend on water for almost every developmental activity. Water is used for drinking, irrigation, transportation, washing and waste disposal for industries and used as a coolant for thermal power plants. water shapes the earth's surface and regulates our climate.

Consumption:

The water which is taken up but not returned for reuse. Globally, only about 60 percent of the water withdrawn is consumed due to loss through evaporation.

Groundwater:

About 9.86% of the total fresh water resources is in the form of groundwater and it is about 35-50 times that of surface water supplies. Till some time back groundwater was considered to be very pure. However, of late, even groundwater aquifers have been found to be contaminated by leachates from sanitary landfills etc.,

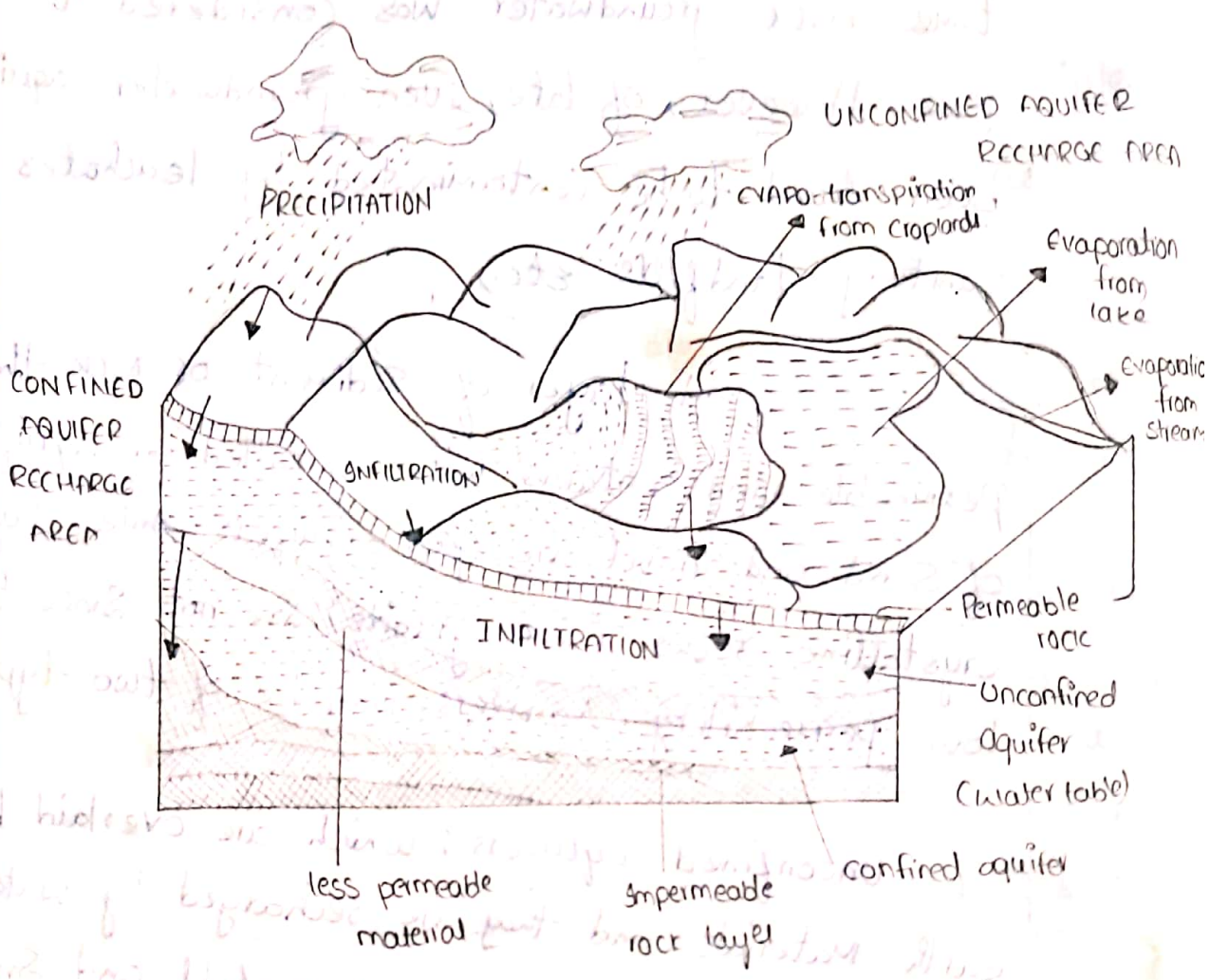
A layer of sediment or rock that is highly permeable and contains water is called an aquifer. Layers of sand and gravel are good aquifers while clay and crystalline rocks (like granite) are not since they have low permeability. Aquifers may be of two types:

Unconfined aquifers: which are overlaid by permeable earth materials and they are recharged by water seeping down from above in the form of rainfall and snow melt.

Confined aquifers: which are sandwiched between two impermeable layers of rock or sediments and are recharged only in those areas where the aquifer intersects the land surface. Sometimes the recharged area is hundreds of kilometers away from the location of the well,

Fig 2.2.1 shows the groundwater System.

Groundwater is not static, it moves, though at a very slow rate of about a meter or so in a year.



Effects of Ground water Usage:

(i) Subsidence:

When ground water withdrawal is more than its recharge rate, the sediments in the aquifer get compacted, a phenomenon known as ground subsidence. Huge economic losses may occur due to

this phenomenon because it results in the sinking of overlying land surface. The common problems associated with it include structural damage in buildings fracture in pipes, reversing the flow of sewers and canals and tidal flooding.

(ii) Lowering of water table: Mining of groundwater is done extensively in arid and semi-arid regions for irrigating crop fields. However, it is not advisable to do excessive mining as it would cause a sharp decline in future agricultural production, due to lowering of water table.

(iii) Water logging: When excessive irrigations is done with brackish water it raises the water table gradually leading to water-logging and salinity problems.

Surface water:

The water coming through precipitation (rainfall, snow) when does not percolate down into the ground or does not return to the atmosphere as evaporation or transpiration loss, assumes the form of streams, lakes, ponds, wetlands or artifical reservoirs known as surface water.

The surface water is largely used for irrigation, industrial use, public water supply, navigation etc, A country's economy is largely dependent upon its rivers.

FLOODS:

In some countries like India and Bangladesh rainfall does not occur throughout the year, rather, 90% of it is concentrated into a few months (Jun-Sep) Heavy rainfall often causes floods in the low-lying coastal areas. Prolonged downpour can also cause the over-flowing of lakes and rivers resulting into floods.

Deforestation, overgrazing, mining, rapid industrialization, global warming etc., have also contributed largely to a sharp rise in the incidence of floods, which otherwise is a natural disaster.

DROUGHTS:

There are about 80 countries in the world, lying in the arid and Semiarid regions that experience frequent spells of droughts, very often, extending up to year long duration. When annual rainfall is

below normal and less than evaporation, drought conditions are created. Ironically, these drought-hit areas are often having a high population growth which leads to poor land use and makes the situation worse.

Anthropogenic Causes: Drought is a meteorological phenomenon, but due to several anthropogenic causes like over grazing, deforestation, mining etc., there is spreading of the deserts tending to convert more areas to drought affected areas. In the last twenty years, India has experienced more and more desertification, there by increasing the vulnerability of larger parts of the country to droughts.

Remedial Measures:

Indigenous knowledge in control of drought and desertification can be very useful for dealing with the problem. Carefully selected mixed cropping help optimize production and minimize the risks of crops failures. Social forestry and wasteland development can prove quite effectives. Social forestry and Wasteland development can prove quite effective to fight the

problem, but it should be based on proper understanding of ecological requirements and natural process.

CONFLICTS OVER WATER:

Indispensability of water and its unequal distribution in different regions has often led to inter-state or international disputes. Issues related to sharing of river water have been largely affecting our farmers and also shaking our governments. Some major water conflicts are discussed here.

Water conflict in the Middle East:

Three river basins, namely the Jordan, the Tigris-Euphrates and the Nile are the shared water resources for Middle East Countries Ethiopia controls the head waters of 80% of Nile's flow and plans to increase it. Sudan too is trying to divert more water. This would badly affect Egypt, which is a desert, except for a thin strip of irrigated cropland along the river Nile and its delta.

The Indus Water Treaty:

The Indus, one of the mightiest rivers is dying a slow death due to dams and barrage that have been built higher up on the river. The Sukkur barrage (1932), Ghulam Mohammad Barrage at Kotri (1958) and Tarbela and Chasma Dams on Jhelum, a tributary of Indus have resulted in severe shinking of the Indus delta.

The Cauvery water dispute:

Out of Indian's 18 major rivers, 17 are shared between different states. In all these cases, there are intense conflicts over these resources which hardly seem to resolve. The Cauvery river water is a bone of contention between Tamil Nadu and Karnataka and the problem is almost hundred years old. Tamil Nadu, occupying the downstream region of the river wants water-use regulated in the upstream.

BIG DAMS - BENEFITS AND PROBLEMS.

Big dams are often regarded as a symbol of national development. However, there are several other issues and problems related to these.
Fig. 2.2.2. depicts various aspects associated with big dams.

Benefits:

River valley projects with big dams have usually been considered to play a key role in the development process due to their multiple uses. India has the distinction of having the largest number of river-valley projects. The tribals living in the area pin big hopes on these projects as they aim at providing employment and raising the standard and quality of life. The dams have tremendous potential for economic upliftment and growth. They can help in checking floods and famines, generate electricity and reduce water and power shortage, provide irrigation water to lower areas, provide drinking water in remote areas and promote navigation, fishery etc.)

Environmental Problems:

The environmental impacts of big-dams become a subject of controversy. The impacts can be at the upstream as well as downstream levels.

(A) The upstream problems include the following:

(i) Displacement of tribal people.
(ii) Loss of forests, flora and fauna.
(iii) Changes in fisheries and the spawning grounds.
(iv) Siltation and sedimentation of reservoirs.
(v) Loss of non-forest land.
(vi) Stagnation and waterlogging near reservoir.
(vii) Breeding of vectors and spread of vector-borne diseases.
(viii) Reservoir induced seismicity (RIS) causing earthquakes.
(ix) Growth of aquatic weeds.
(x) Microclimatic changes.

(B) The downstream impacts include the following:

(i) Water logging and salinity due to over irrigation.
(ii) Micro-climatic changes.
(iii) Reduced water flow and silt deposition in river

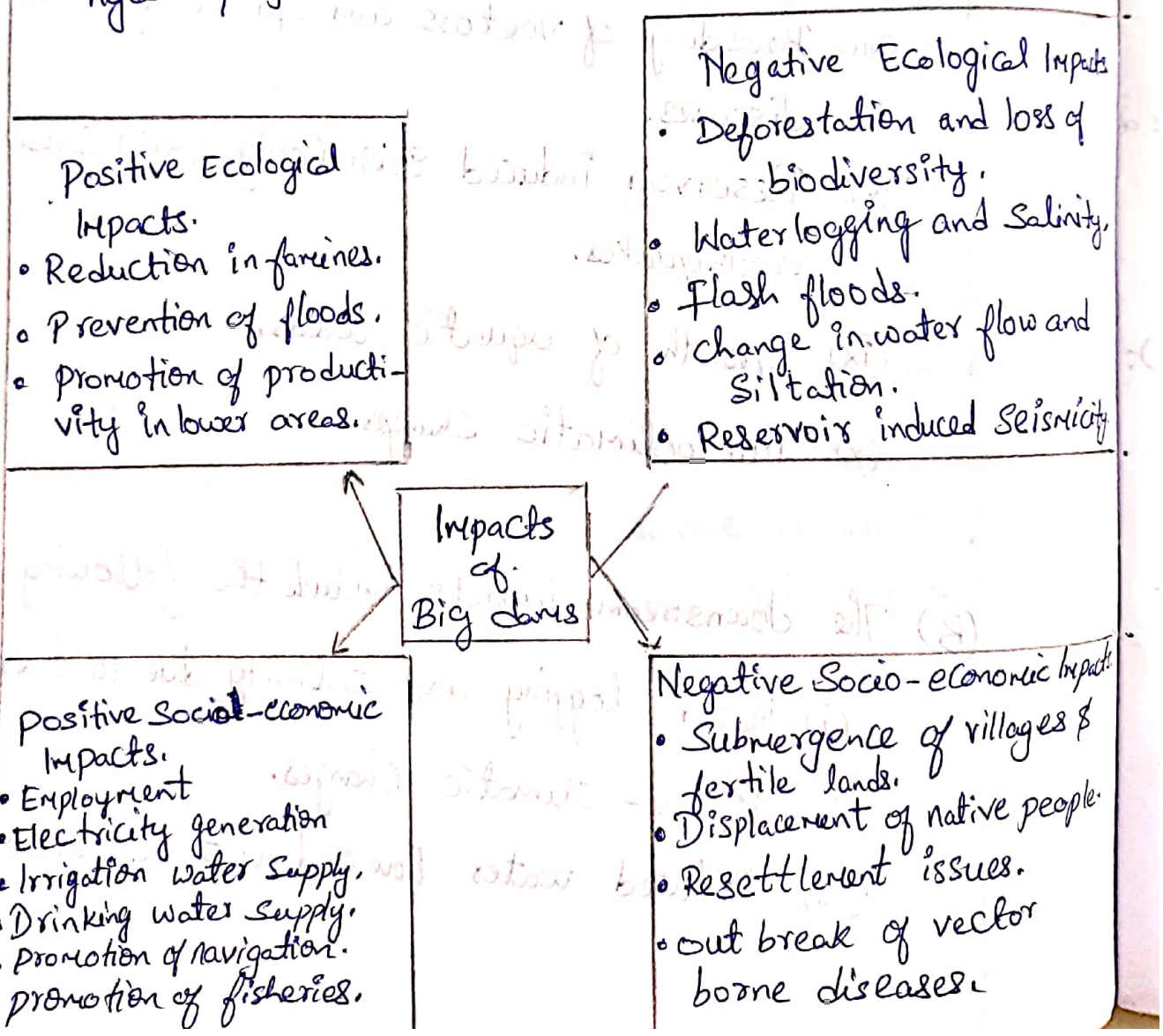
(iv) Flash floods.

(v) Salt water intrusion at river mouth.

(vi) Loss of land fertility along the river since the sediments carrying nutrients get deposited in the reservoir.

(vii) Outbreak of vector-borne diseases like Malaria.

Thus, although dams are built to serve the society with multiple uses, but it is has several serious side-effects. That is why now there is a shift towards construction of small dams OR Mini-hydel projects.



Effects of Modern Agriculture:

In the early years of human existence on this earth, Man was just a hunter gatherer and was quite like other animal species. Some 10,000 to 12,000 years ago he took to agriculture by cultivating plants of his own choice. He used the practice of slash and burn cultivation or shifting cultivation, which is still prevalent in many tribal areas, as in the North East Hills of India. The type of agriculture practiced these days is very different from the traditional ones and their outputs in terms of yield as well as their impacts on the environment show lots of differences.

(1) Traditional Agriculture and its Impacts:

It usually involves a small plot, simple tools, naturally available water, organic fertilizer and a mix of crops. It is more near to natural conditions and usually it results in low production. It is still practiced by about half the global population.

The main impacts of this type of agriculture are as follows:

(i) Deforestation: The slash and burn of trees in forests to clear the land for cultivation and frequent shifting result in loss of forest cover.

(ii) Soil erosion: Cleaning of forest cover exposes the soil to wind, rain and storms, thereby resulting in loss of top fertile layers of soil.

(iii) Depletion of nutrients: During slash and burn the organic matter in the soil gets destroyed and most of the nutrients are taken up by the crops within a short period, thus making the soil nutrient poor which makes the cultivators shift to another area.

(2.) Modern Agriculture and its Impacts:

It makes use of hybrid seeds of selected and single crop variety, high-tech equipments and lots of energy subsidies in the form of fertilizers, pesticides and irrigation water. The food production has increased tremendously, evidenced by "green revolution". However, it also gave rise to several problematic off-shoots as discussed.

(i) Impacts related to high yielding varieties (HYV):

The uses of HYVs encourage monoculture i.e. the same genotype is grown over vast areas. In case of an attack by some pathogen, there is total devastation of the crop by the disease due to exactly uniform conditions, which help in rapid spread of the disease.

(ii) Fertilizer related problems:

(a) Micronutrient imbalance: Most of the chemical fertilizers used in modern agriculture have nitrogen, phosphorus and potassium (N, P, K) which are essential Macronutrients. Farmers usually use these fertilizers indiscriminately to boost up crop growth. Excessive use of fertilizers cause micronutrient imbalance. for example, excessive fertilizer use in punjab and Haryana has caused deficiency of the micronutrient zinc in the soils, which is affecting productivity of the soil.

(b) Nitrate pollution: Nitrogenous fertilizers applied in the fields often leach deep into the soil and ultimately contaminate the ground water. The nitrates get concentrated in the water and when their concentration exceeds 25 mg/L, they become the cause of a serious health hazard called "Blue Baby Syndrome", OR methaemoglobinemia.

(C) Eutrophication: Excessive use of N and P fertilizers in the agricultural fields leads to another problem, which is not related to the soil, but relates to water bodies like lakes. A large proportion of nitrogen and phosphorus used in cropfields is washed off and along with runoff water reach the water bodies causing over nourishment of the lakes, a process known as Eutrophication.

Pesticide related problems: Thousands of types of pesticides are used in agriculture. The first generation pesticides include chemicals like Sulphur, arsenic, lead OR Mercury to kill the pests. DDT [Dichlorodiphenyl trichloroethane] whose insecticidal properties were discovered by Paul Mueller in 1939 belongs to the second generation pesticides. After 1940, a large number of synthetic pesticides came into use. Although these pesticides have gone a long way in protecting our crops from huge losses occurring due to pests yet they have a number of side-effects, as discussed below:

(a) Creating resistance in pests and producing new pests: Some individuals of the pest species usually survive even after pesticide spray. The survivors give rise to highly resistant generations. About 20 species of pests are now known which have become immune to all types of pesticides and are known as "Super pests".

(b) Death of non-target organisms: Many insecticides are broad spectrum poisons which not only kill the target species but also several non-target species that are useful to us.

(c) Biological magnification: Many of the pesticides are non-~~biodegradable~~ biodegradable and keep on accumulating

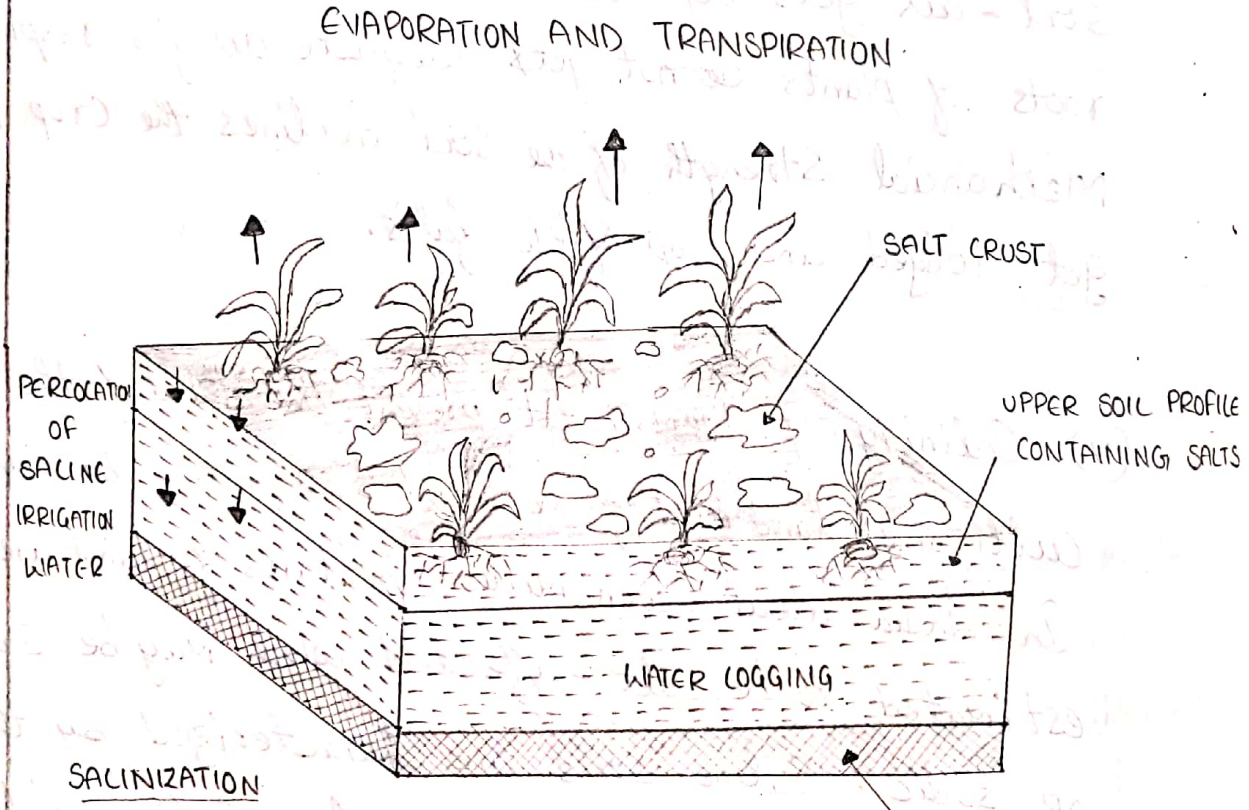
in the food chain, a process called biological magnification. Since human beings occupy a high trophic level in the food chain, they get the pesticides in a bio-magnified form which is very harmful.

(iv) Water logging: Over irrigation of Croplands by farmers for good growth of their crop usually leads to water-logging. Inadequate drainage causes excess water to accumulate underground and gradually forms a continuous column with the water table. Under water-logged conditions, pore-spaces in the soil get fully drenched with water and the soil-air gets depleted. The water table rises while the roots of plants do not gets adequate air for respiration. Mechanical Strength of the soil declines the crop plants get lodged and crop yield falls.

(v) Salinity problems: At present one third of the total cultivable land area of the world is affected by salts. In India about seven million hectares of land are estimated to be salt-affected which may be saline OR sodic. Saline Soils are characterized by the accumulation of soluble salts like Sodium chloride, Sodium Sulphate, Calcium Chloride, Magnesium Chloride etc.,

in the soil profile. Their electrical conductivity is more than 4 ds/m. Sodic soils have carbonates and bicarbonates of sodium, the pH usually exceeds 8.0 and the exchangeable sodium percentage (ESP) is more than 15%.

Causes: A major cause of salinization of soil is exessive irrigation. About 20% of the world's croplands receive irrigation with canal water OR ground water which unlike rainwater often contains dissolved salts. Under dry climates, the water evaporates leaving behind salts in the upper soil profile



SALINIZATION

- Addition of salts with saline irrigation water
- Evapo-transpiration leaves behind salts
- Salt build up occurs in upper soil profile

WATER LOGGING

- Rain water and irrigation water percolates down
- Water table raises

Thousands of hectares of land area in Haryana and Punj... are affected by soil salinity and alkalinity. Salinity causes stunted plant growth and lowers crop yield. Most of the crops can not tolerate high salinity.

Remedy: The most common method for getting rid of salts is to flush them out by applying more good quality water to such soils. Another method is laying underground network of perforated drainage pipes for flushing out the salts slowly. This Sub-Surface drainage system has been tried in the experimental station of CSSRI at Sampla, Haryana. The Central soil Salinity Research Institute (CSSRI) located in Karnal, Haryana has to its achievement the success story of converting zarifa Viran... Village to zarifa Abad i.e., "from the barren, land to productive land" through its research applications.

ENERGY RESOURCES

Energy Consumption of a nation is usually considered as an index of its development. This is because almost all the developmental activities are directly or indirectly dependent upon energy. We find wide disparities in per capita energy use between the developed and the developing nations.

The first form of energy technology probably was the fire, which produced heat and the early man used it for cooking and heating purposes. Wind and hydropower have also been in use for the last 10,000 years. The invention of steam engines replaced the burning of wood by Coal and Coal was later replaced to a great extent by Oil.

GROWING ENERGY NEEDS.

Development in different sectors relies largely upon energy. Agriculture, industry, Minning, transportation, lighting, cooling and heating in buildings all need energy, with the demands of growing population the world is facing further energy deficit. The fossil fuels

like Coal, Oil and natural gas which at present are supplying 95% of the commercial energy of the world resources and are not going to last for many more years. Our life style is changing very fast and from a simple way of life we are shifting to a luxurious life style.

RENEWABLE AND NON-RENEWABLE ENERGY SOURCES.

A source of energy is one that can provide adequate amount of energy in a usable form over a long period of time. These sources can be of two types.

(1) Renewable resources which can be generated continuously in nature and are inexhaustible e.g., Wood, Solar energy, wind energy, tidal energy, hydropower, biomass energy, bio-fuels, geo-thermal energy and hydrogen. They are also known as non-conventional sources of energy and they can be used again and again in an endless manner.

(2) Non-renewable resources which have accumulated in nature over a long span of time and cannot be quickly replenished when exhausted E.g., Coal, petroleum, natural gas and nuclear fuels like uranium and thorium.

Wood is a renewable resource as we can get new wood by growing a sapling into a tree within 15-20 years but it has taken millions of years for the formation of coal from trees and cannot be regenerated in our life time, hence coal is not renewable. We will now discuss various forms of renewable and non-renewable energy resource.

LAND RESOURCES.

LAND AS A RESOURCE:

Land is a finite and valuable resource upon which we depend for our food, fibre and fuel wood, the basic amenities of life. Soil, especially the top soil, is classified as a renewable resource because it is continuously regenerated by natural process though at a very slow rate. About 200 - 1000 years are needed for the formation of one inch OR 2.5 cm soil, depending upon the climate and the soil type. But, when rate of erosion is faster than rate of renewal, then the soil becomes a non-renewable resource.

LAND DEGRADATION

Soil degradation is a real cause of alarm because soil formation is an extremely slow process as discussed above and the average annual erosion rate is 20-100 times more than the renewal rate.

Soil erosion, water-logging, salinization and contamination of the soil with industrial wastes like

fly-ash, press-mud or heavy metals all cause degradation of land.

SOIL EROSION:

The literal meaning of 'soil erosion" is wearing away of soil. Soil erosion is defined as the movement of soil components, especially surface-litter and top soil from one place to another. Soil erosion results in the loss of fertility because it is the top soil layer which is fertile.

Soil erosion is basically of two types based upon the cause of erosion:

(i) Normal erosion or geologic erosion: Caused by the gradual removal of top soil by natural processes which bring an equilibrium between physical, biological and hydrological activities and maintain a natural balance between erosion and renewal.

(ii) Accelerated erosion: This is mainly caused by anthropogenic (man-made) activities and the rate of erosion is much faster than the rate of formation of soil. Overgrazing, deforestation and mining are some important activities causing accelerated erosion.

DESERTIFICATION:

Desertification is a process where by the productive potential of arid OR semi-arid lands falls by ten percent OR more. Moderate desertification is 10-25% drop in productivity, severe desertification causes 25-50% drop while very severe desertification results in more than 50% drop in productivity and usually creates huge gullies and sand dunes.

Causes of Desertification: Formation of deserts may take place due to natural phenomena like climate change OR may be due to abusive use of land. Even the climate change is linked in many ways to human

activities. The Major anthropogenic activities responsible for desertification are as follows:

(a) Deforestation.
(b) Overgrazing.
(c) Mining and quarrying.