**UNIT I**  **ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY**

**(Definition, scope and importance of Risk and hazards; Chemical hazards, Physical hazards, Biological hazards in the environment)**

**Environmental science** is the **science** of the interactions between the physical, chemical, and biological components of the **environment. Environmental science** is more often refers to human impact on the **environment**.

Environment is not a single subject. It is an integration of several subjects that include both Science and Social Studies. To understand all the different aspects of our environment we need to understand biology, chemistry, physics, geography, resource management, economics and population issues. Thus the scope of environmental studies is extremely wide and covers some aspects of nearly every major discipline.

We live in a world in which natural resources are limited. Water, air, soil, minerals, oil, the products we get from forests, grasslands, oceans and from agriculture and livestock, are all a part of our life support systems. Without them, life itself would be impossible. As we keep increasing in numbers and the quantity of resources each of us uses also increases, the earth’s resource base must inevitably shrink. The earth cannot be expected to sustain this expanding level of utilization of resources. Added to this is misuse of resources. We waste or pollute large amounts of nature’s clean water; we create more and more material like plastic that we discard after a single use; and we waste colossal amounts of food, which is discarded as garbage.

Manufacturing processes create solid waste byproducts that are discarded, as well as chemicals that flow out as liquid waste and pollute water, and gases that pollute the air. Increasing amounts of waste cannot be managed by natural processes. These accumulate in our environment, leading to a variety of diseases and other adverse environmental impacts now seriously affecting all our lives. Air pollution leads to respiratory diseases, water pollution to gastro-intestinal diseases, and many pollutants are known to cause cancer.

Improving this situation will only happen if each of us begins to take actions in our daily lives that will help preserve our environmental resources. We cannot expect Governments alone to manage the safeguarding of the environment, nor can we expect other people to prevent environmental damage. We need to do it ourselves. It is a responsibility that each of us must take on as ones own.

India is rich in biodiversity which provides various resources for people. It is also the basis for biotechnological development. Only about 1.8 million living organisms have been described and named globally. Still many more remain to be identified and described. Attempts are made to conserve them in ex-situ and in-situ situation. Intellectual Property Rights (IPRs) have become important in a biodiversity rich country like India to protect microbes, plants and animals that have useful genetic properties. Destruction of habitats, over use of energy resources and environmental pollution have been found to be responsible for the loss of a large number of life forms. It is feared that a large proportion of life on earth may get wiped out in the near future.

Emperor Ashoka’s edict proclaimed that all forms of life are important for our well being in Fourth Century BC. Our dependence on nature is so great that we cannot continue to live without protecting the earth’s environmental resources. Thus most traditions refer to our environment as ‘Mother Nature’ and most traditional societies have learned that respecting nature is vital for their livelihoods.

Over the past 200 years however due to the industrial development and intensive agriculture that provides the goods for our increasingly consumer oriented society uses up large amounts of **natural resources** such as water, minerals, petroleum products, wood, etc. **Nonrenewable resources,** such as minerals and oil are those which will be exhausted in the future if we continue to extract these without a thought for subsequent generations. **Renewable resources,** such as timber and water, are those which can be used but can be regenerated by natural processes such as re-growth or rainfall.

But these too will be depleted if we continue to use them faster than nature can replace them. For example, if the removal of timber and firewood from a forest is faster than the re-growth and regeneration of trees, it cannot replenish the supply. Loss of forest cover not only depletes the forest of its resources, such as timber and other non-wood products, but affects our water resources because an intact natural forest acts like a sponge which holds water and releases it slowly. Deforestation leads to floods in the monsoon and dry rivers once the rains are over.

Such multiple effects on the environment resulting from routine human activities must be appreciated by each one of us, if it is to provide us with the resources we need in the long-term. Our natural resources can be compared with money in a bank. If we use it rapidly, the capital will be reduced to zero. On the other hand, if we use only the interest, it can sustain us over the longer term. This is called **sustainable utilisation or development**.

**Non-renewable resources:**

These are minerals that have been formed in the lithosphere over millions of years and constitute a closed system. These non-renewable resources, once used, remain on earth in a different form and, unless recycled, become waste material. Non-renewable resources include fossil fuels such as oil and coal, which if extracted at the present rate, will soon be totally used up. The end products of fossil fuels are in the form of heat and mechanical energy and chemical compounds, which cannot be reconstituted as a resource.

**Renewable resources:**

Though water and biological living resources are considered renewable, they are in fact renewable only within certain limits. They are linked to natural cycles such as the water cycle.

• Fresh water (even after being used) is evaporated by the sun’s energy, forms water vapor and is reformed in clouds and falls to earth as rain. However, water sources can be overused or wasted to such an extent that they locally run dry. Water sources can be so heavily polluted by sewage and toxic substances that it becomes impossible to use the water.

• Forest, once destroyed takes thousands of years to re-grow into fully developed natural ecosystems with their full complement of species. Forests thus can be said to behave like non-renewable resources if overused.

• Fish are today being over-harvested until the catch has become a fraction of the original resource and the fish are incapable of breeding successfully to replenish the population.

• The output of agricultural land if mismanaged drops drastically.

• When the population of a species of plant or animal is reduced by human activities, until it cannot reproduce fast enough to maintain a viable number, the species becomes extinct.

• Many species are probably becoming extinct without us even knowing, and other linked species are affected by their loss. The Dodo of Madagascar and the Cheetah in India are well known examples of extinct species.

One of India’s serious environmental problems is forest degradation due to timber extraction and our dependence on fuel wood. A large number of poor rural people are still highly dependent on wood to cook their meals and heat their homes. We have not been able to plant enough trees to support the need for timber and fuel wood.

Water covers 70% of the earth’s surface but only 3% of this is fresh water. Of this, 2% is in polar ice caps and only 1% is usable water in rivers, lakes and subsoil aquifers. Only a fraction of this can be actually used. At a global level 70% of water is used for agriculture about 25% for industry and only 5% for domestic use. However this varies in different countries and industrialized countries use a greater percentage for industry. India uses 90% for agriculture, 7% for industry and 3% for domestic use.

India is expected to face critical levels of water stress by 2025. At the global level 31 countries are already short of water and by 2025 there will be 48 countries facing serious water shortages. The UN has estimated that by the year 2050, 4 billion people will be seriously affected by water shortages. This will lead to multiple conflicts between countries over the sharing of water.

Indian population on today is about 127 crores and the world population is increasing at the rate of 1.6% per year. India becomes the most populous country by 2050.

India and Bangladesh already have a negotiated agreement on the water use of the Ganges. The upstream countries could starve the downstream nation’s leading to political unstable areas across the world. Examples are Ethiopia, which is upstream on the Nile and Egypt, which is downstream and highly dependent on the Nile.

Agriculture also pollutes surface water and underground water stores by the excessive use of chemical fertilizers and pesticides. Methods such as the use of biomass as fertilizer and non toxic pesticides such as neem products and using integrated pest management systems reduces the agricultural pollution of surface and ground water.

Industry tends to maximise short-term economic gains by not bothering about its liquid waste and releasing it into streams, rivers and the sea. In the longer term, as people become more conscious of using ‘green products’ made by eco-sensitive industries, the polluter’s products may not be used.

Changes in climate at a global level caused by increasing air pollution have now begun to affect our climate. In some regions global warming and the El Nino winds have created unprecedented storms. In other areas, they lead to long droughts. Everywhere the ‘greenhouse effect’ due to atmospheric pollution is leading to increasingly erratic and unpredictable climatic effects. This has seriously affected regional hydrological conditions.

Deforestation in the Himalayas causes floods that year after year kill people, damage crops and destroy homes in the Ganges and its tributaries and the Brahmaputra. Rivers change their course during floods and tons of valuable soil is lost to the sea.

Drought has been a major problem in our country especially in arid regions. It is an unpredictable climatic condition and occurs due to the failure of one or more monsoons. It varies in frequency in different parts of our country. One of the factors that worsens the effect of drought is deforestation. Forest cover permits water to be held in the area permitting it to seep into the ground. This charges the underground stores of water in natural aquifers. This can be used in drought years if the stores have been filled during a good monsoon. If water from the underground stores is overused, the water table drops and vegetation suffers. This soil and water management and afforestation are long-term measures that reduce the impact of droughts.

India’s increasing demand for water for intensive irrigated agriculture, for generating electricity, and for consumption in urban and industrial centers, has been met by creating large dams. Irrigated areas increased from 40 million ha. in 1900 to 100 million ha. in 1950 and to 271 million ha. by 1998. Dams support 30 to 40% of this area. Although dams ensure a year round supply of water for domestic use, provide extra water for agriculture, industry, hydropower generation, they have several serious environmental problems.

They alter river flows, change nature’s flood control mechanisms such as wetlands and flood plains, and destroy the lives of local people and the habitats of wild plant and animal species. Irrigation to support cash crops like sugarcane produces an unequal distribution of water. Large landholders on the canals get the lion’s share of water, while poor, small farmers get less and are seriously affected.

**Sustainable water management:** ‘Save water’ campaigns are essential to make people everywhere aware of the dangers of water scarcity. A number of measures need to be taken for the better management of the world’s water resources. These include measures such as:

• Building several small reservoirs instead of few mega projects.

• Develop small catchment dams and protect Wetlands Effective rain water harvesting in urban environments.

• Water conservation measures in agriculture such as using drip irrigation.

In deforested areas where land has been degraded, soil management by bunding along the hill slopes and making ‘nala’ plugs, can help retain moisture and make it possible to re-vegetate degraded areas.

**Sardar Sarovar Project** The World Bank’s withdrawal from the Sardar Sarovar Project in India in 1993 was a result of the demands of local people threatened with the loss of their livelihoods and homes in the submergence area. This dam in Gujarat on the Narmada has displaced thousands of tribal folk, whose lives and livelihoods were linked to the river, the forests and their agricultural lands. While they and the fishermen at the estuary, have lost their homeland, rich farmers downstream will get water for agriculture.

Mining is a hazardous occupation, and the safety of mine workers is an important environmental consideration of the industry. Mining operations are considered one of the main sources of environmental degradation. The extraction of all these products from the lithosphere has a variety of side effects. Depletion of available land due to mining, waste from industries, conversion of land to industry and pollution of land, water and air by industrial wastes, are environmental side effects of the use of these non-renewable resources.

Sustainable agriculture as that which conserves land, water and plant and animal genetic resources, does not degrade the environment and is economically viable and socially acceptable. Most of our large farms grow single crops (monoculture). If this crop is hit by a pest, the entire crop can be devastated, leaving the farmer with no income during the year. On the other hand, if the farmer uses traditional varieties and grows several different crops, the chance of complete failure is lowered considerably. Many studies have shown that one can use alternatives to inorganic fertilizers and pesticides. This is known as **Integrated Crop Management**.

Loss of genetic diversity in crop plants is another issue that is leading to a fall in agricultural produce. Rice, wheat and corn are the staple foods of two thirds of the world’s people. As wild relatives of crop plants in the world’s grasslands, wetlands and other natural habitats are being lost, the ability to enhance traits that are resistant to diseases, salinity, etc. is lost. Genetic engineering is an untried and risky alternative to traditional cross breeding.

The earth can only supply a limited amount of food. If the world’s carrying capacity to produce food cannot meet the needs of a growing population, anarchy and conflict will follow. Thus food security is closely linked with population control through the family welfare program. It is also linked to the availability of water for farming. Food security is only possible if food is equitably distributed to all. Many of us waste a large amount of food carelessly. This eventually places great stress on our environmental resources.

Israel began using drip irrigation systems as it is short of water. With this technique, farmers have been able to improve the efficiency of irrigation by 95%. Over a 20-year period, Israel’s food production doubled without an increase in the use of water for agriculture. Integrated Pest Management includes preserving pest predators, using pest resistant seed varieties and reducing the use of chemical fertilizers.

**Soil erosion:** The characteristics of natural ecosystems such as forests and grasslands depend on the type of soil. Soils of various types support a wide variety of crops. The misuse of an ecosystem leads to loss of valuable soil through erosion by the monsoon rains and, to a smaller extent, by wind. The roots of the trees in the forest hold the soil. Deforestation thus leads to soil erosion.