UNIT 2:

Natural Resources

1. INTRODUCTION

The natural resources include, air, water, soil, minerals, along with the climate and solar energy, which form the non-living or 'abiotic' part of nature. Thus, forests, grasslands, deserts, mountains, rivers, lakes and the marine environment all form habitats for specialized communities of plants and animals to live in. Many of these living organisms are used as our food resources. Others are linked to our food less directly, such as pollinators and dispersers of plants, soil animals like worms, which recycle nutrients for plant growth, and fungi and termites that break up dead plant material so that micro-organisms can act on the detritus to reform soil nutrients.

History of our global environment: About ten thousand years ago, when mankind changed from a hunter-gatherer, living in wilderness areas such as forests and grasslands, into an agriculturalist and pastoralist, we began to change the environment to suit our own requirements. As our ability to grow food and use domestic animals grew, these 'natural' ecosystems were developed into agricultural land. Most traditional agriculturists depended extensively on rain, streams and rivers for water.

Changes in land and resource use: During the last 100 years, a better health care delivery system and an improved nutritional status has led to rapid population growth, especially in the developing countries. This phenomenal rise in human numbers has, in the recent past, placed great demands on the earth's natural resources. Large stretches of land such as forests, grasslands and wetlands have been converted into intensive agriculture.

Industrial development is aimed at meeting growing demands for all consumer items. However, these consumer goods also generate waste in ever larger quantities. The growth of industrial complexes has led to a shift of people from their traditional, sustainable, rural way of life to urban centers that developed around industry.

Earth's Resources and Man: The resources on which mankind is dependent are provided by various sources or 'spheres'.

1) Atmosphere

• Oxygen for human respiration.

• Oxygen for wild fauna in natural ecosystems and domestic animals used by man as food.

• Oxygen as a part of carbon dioxide, used for the growth of plants.

2) Hydrosphere

• Clean water for drinking.

• Water for washing and cooking.

• Water used in agriculture and industry.

• Food resources from the sea, including fish, crustacea, seaweed, etc.

3) Lithosphere

• Soil, the basis for agriculture to provide us with food.

• Stone, sand and gravel, used for construction.

• Micronutrients in soil, essential for plant growth.

4) Biosphere

• Food, from crops and domestic animals, providing human metabolic requirements.

• Food, for all forms of life which live as interdependent species in a community and form food chains in nature on which man is dependent.

• Energy needs: Biomass fuel wood collected from forests and plantations, along with other forms of organic matter, used as a source of energy.

Natural cycles between the spheres: All four spheres are closely inter-linked systems and are dependent on the integrity of each other. Disturbing one of these spheres in our environment affects all the others.

The linkages between them are mainly in the form of cycles. For instance, the atmosphere, hydrosphere and lithosphere are all connected through the **hydrological cycle.** Water evaporated from the hydrosphere, forms clouds in the atmosphere. This becomes rain, which provides moisture for the lithosphere, on which life depends. The rain also acts on rocks as an agent of erosion and over millions of years has created soil, on which plant life grows.

2. RENEWABLE AND NON-RENEWABLE RESOURCES

Ecosystems act as resource producers and processors. Solar energy is the main driving force of ecological systems, providing energy for the growth of plants in forests, grasslands and aquatic ecosystems. A forest recycles its plant material slowly by continuously returning its dead material, leaves, branches, etc. to the soil. Grasslands recycle material much faster than forests as the grass dries up after the rains are over every year.

2.1 Natural resources and associated problems

The unequal consumption of natural resources: A major part of natural resources are today consumed in the technologically advanced or 'developed' world, usually termed 'the North'. The 'developing nations' of 'the South', including India and China, also over use many resources because of their greater human population. However, the consumption of resources per capita (per individual) of the developed countries is up to 50 times greater than in most developing countries. Advanced countries produce over 75% of global industrial waste and greenhouse gases.

2.2 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.

2.3 Renewable resources

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

a) Forest Functions

Watershed protection:

• Reduce the rate of surface run-off of water.

• Prevent flash floods and soil erosion.

Atmospheric regulation:

• Absorption of solar heat during evapo-transpiration.

• Maintaining carbon dioxide levels for plant growth.

Erosion control:

• Holding soil (by preventing rain from directly washing soil away).

Land bank:

• Maintenance of soil nutrients and structure.

Local use - Consumption of forest produce by local people who collect it for subsistence – (Consumptive use)

• Food - gathering plants, fishing, hunting from the forest.

• Apiculture - bees for honey, forest bees also pollinate crops.

Market use - (Productive use)

• Most of the above products used for consumptive purposes are also sold as a source of income for supporting the livelihoods of forest dwelling people.

• Minor forest produce - (non-wood products): Fuelwood, fruit, gum, fiber, etc. which are collected and sold in local markets as a source of income for forest dwellers.

• Major timber extraction - construction, industrial uses, paper pulp, etc. Timber extraction is done in India by the Forest Department, but illegal logging continues in many of the forests of India and the world.

Deforestation:

Where civilizations have looked after forests by using forest resources cautiously, they have prospered, where forests were destroyed, the people were gradually impoverished.

Based on these experiences, new JFM guidelines were issued in 2000. This stipulates that at least 25 per cent of the income from the area must go to the community. From the initiation of the program, until 2002, there were 63,618 JFM Committees managing over 140,953 sq. km of forest under JFM in 27 States in India.

The States have tried a variety of approaches to JFM. The share for village forest committees ranges from 25 per cent in Kerala to 100 percent in Andhra Pradesh, 50 per cent in Gujarat, Maharashtra, Orissa and Tripura. In many States 25 per cent of the revenue is used for village development. In many States non-timber forest products (NTFPs) are available for people free of cost.

Timber extraction, mining and dams are in variably parts of the needs of a developing country. If timber is overharvested the ecological functions of the forest are lost. Unfortunately forests are located in areas where there are rich mineral resources. Forests also cover the steep embankments of river valleys, which are ideally suited to develop hydel and irrigation projects. Thus there is a constant conflict of interests between the conservation interests of environmental scientists and the Mining and Irrigation Departments. This leads to high levels of suffering for which there is rarely a satisfactory answer.

b) Water resources

The water cycle, through evaporation and pre cipitation, maintains hydrological systems which form rivers and lakes and support in a variety of aquatic ecosystems. Wetlands are intermediate forms between terrestrial and aquatic ecosys tems and contain species of plants and animals that are highly moisture dependent. All aquatic ecosystems are used by a large number of people for their daily needs such as drinking water, washing, cooking, watering animals, and irri gating fields. The world depends on a limited quantity of fresh water. Water covers 70% of the earth’s surface but only 3% of this is fresh water.

Overutilization and pollution of surface and groundwater:

With the growth of human population there is an increasing need for larger amounts of water to fulfill a variety of basic needs. Today in many areas this requirement cannot be met. Overutilization of water occurs at various levels. Most people use more water than they really need. Most of us waste water during a bath by using a shower or during washing of clothes. Many agriculturists use more water than necessary to grow crops. There are many ways in which farmers can use less water without reducing yields such as the use of drip irrigation systems.

Global climate change: 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.

Floods: Floods have been a serious environmen tal hazard for centuries. However, the havoc raised by rivers overflowing their banks has be come progressively more damaging, as people have deforested catchments and intensified use of river flood plains that once acted as safety valves. Wetlands in flood plains are nature's flood control systems into which overfilled riv ers could spill and act like a temporary sponge holding the water, and preventing fast flowing water from damaging surrounding land.

Drought: In most arid regions of the world the rains are unpredictable. This leads to periods when there is a serious scarcity of water to drink, use in farms, or provide for urban and industrial use.

Water for Agriculture and Power Genera tion: 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.

Sustainable water management: 'Save water' campaigns are essential to make people everywhere aware of the dangers of water scar city. A number of measures need to be taken for the better management of the world's water resources.

Dams: Today there are more than 45,000 large dams around the world, which play an important role in communities and economies that harness these water resources for their economic development. Current estimates suggest some 30-40% of irrigated land worldwide relies on dams. Hydropower, another contender for the use of stored water, currently supplies 19% of the world's total electric power supply and is used in over 150 countries. The world's two most populous countries – China and India – have built around 57% of the world's large dams.

Dams problems

• Fragmentation and physical transformation of rivers.

• Serious impacts on riverine ecosystems.

• Social consequences of large dams due to displacement of people.

• Water logging and salinisation of surrounding lands.

c) Mineral Resources

A mineral is a naturally occurring substance of definite chemical composition and identifiable physical properties. An ore is a mineral or combination of minerals from which a useful sub stance, such as a metal, can be extracted and used to manufacture a useful product.

Mine safety: Mining is a hazardous occupation, and the safety of mine workers is an important environmental consideration of the industry. Surface mining is less hazardous than underground mining. Metal mining is less hazardous than coal mining. In all underground mines, rock and roof falls, flooding, and inadequate ventilation are the greatest hazards. Large explosions have occured in coal mines, killing many miners. More miners have suffered from disasters due to the use of explosives in metal mines.

Environmental problems: 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 environ mental side effects of the use of these non-renewable resources.

d) Food resources

Today our food comes almost entirely from agriculture, animal husbandry and fishing. Al though India is self-sufficient in food production, it is only because of modern patterns of agriculture that are unsustainable and which pollute our environment with excessive use of fertilizers and pesticides.

World food problems: In many developing countries where populations are expanding rap idly, the production of food is unable to keep pace with the growing demand. Food production in 64 of the 105 developing countries is lagging behind their population growth levels.

Food Security: It is estimated that 18 million people worldwide, most of whom are children, die each year due to starvation or malnutrition, and many others suffer a variety of dietary deficiencies.

Fisheries: Fish is an important protein food in many parts of the world. This includes marine and fresh water fish. While the supply of food from fisheries increased phenomenally between 1950 and 1990, in several parts of the world fish catch has since dropped due to overfishing. In 1995 FAO reported that 44% of the world's fisheries are fully or heavily exploited, 16% are already overexploited, 6% are depleted, and only 3% are gradually recovering. Canada had to virtually close down cod fishing in the 1990s due to depletion of fish reserves.

Loss of Genetic diversity: There are 50,000 known edible plants documented worldwide. Of these only 15 varieties produce 90% of the world's food. Modern agricultural practices have resulted in a serious loss of genetic variability of crops. India's distinctive traditional varieties of rice alone are said to have

numbered between 30 and 50 thousand. Most of these have been lost to the farmer during the last few decades as multinational seed companies push a few commercial types.

Alternate food sources: Food can be innovatively produced if we break out of the current agricultural patterns. This includes working on new avenues to produce food, such as using forests for their multiple non-wood forest products, which can be used for food if harvested sustainably. This includes fruit, mush rooms, sap, gum, etc. This takes time, as people must develop a taste for these new foods.

e) Energy resources

Energy is defined by physicists as the capacity to do work. Energy is found on our planet in a variety of forms, some of which are immediately useful to do work, while others require a process of transformation.

Growing energy needs: Energy has always been closely linked to man's economic growth and development. Present strategies for development that have focused on rapid economic growth have used energy utilization as an index of economic development. This index however, does not take into account the long-term ill effects on society of excessive energy utilisation.

Types of energy: There are three main types of energy; those classified as **non-renewable;** those that are said to be **renewable;** and **nuclear energy,** which uses such small quantities of raw material (uranium) that supplies are to all effect, limitless.

Nonrenewable energy

To produce electricity from non-renewable resources the material must be ignited. The fuel is placed in a well contained area and set on fire. The heat generated turns water to steam, which moves through pipes, to turn the blades of a turbine. This converts magnetism into electric ity, which we use in various appliances.

Oil and its environmental impacts: India's oil reserves which are being used at present lie off the coast of Mumbai and in Assam. Most of our natural gas is linked to oil and, because there is no distribution system, it is just burnt off. This wastes nearly 40% of available gas.

Coal and its environmental impacts: Coal is the world's single largest contributor of greenhouse gases and is one of the most important causes of global warming.

Renewable energy

Renewable energy systems use resources that are constantly replaced and are usually less polluting. Examples include hydropower, solar, wind, and geothermal. We also get renewable energy from burning trees and even garbage as fuel and processing other plants into biofuels.

Hydroelectric Power

This uses water flowing down a natural gradient to turn turbines to generate electricity known as 'hydroelectric power' by constructing dams across rivers. Between 1950 and 1970, Hydropower generation worldwide increased plateau, the water is tunneled through the crest of the Ghats to drop several hundred meters to the coastal belt. Large turbines in the power plants generate electricity for Mumbai and its giant industrial belt.

Drawbacks: Although hydroelectric power has led to economic progress around the world, it has created serious ecological problems.

Solar energy: In one hour, the sun pours as much energy onto the earth as we use in a whole year. If it were possible to harness this colossal quantum of energy, humanity would need no other source of energy. Today we have developed several methods of collecting this energy for heating water and generating electricity.

Photovoltaic energy: The solar technology which has the greatest potential for use throughout the world is that of solar photo voltaic cells which directly produce electricity from sunlight using photovoltaic (PV) (also called solar) cells.

Solar thermal electric power: Solar radiation can produce high temperatures, which can generate electricity. Areas with low cloud levels of cover with little scattered radiation as in the desert are considered most suitable sites. According to a UNDP assessment, STE is about 20 years behind the wind energy market exploitation, but is expected to grow rapidly in the near future.

Biomass energy: When a log is burned we are using biomass energy. Because plants and trees depend on sunlight to grow, biomass energy is a form of stored solar energy. Although wood is the largest source of biomass energy, we also use agricultural waste, sugarcane wastes, and other farm byproducts to make energy.

Biogas: Biogas is produced from plant material and animal waste, garbage, waste from households and some types of industrial wastes, such as fish processing, dairies, and sewage treatment plants. It is a mixture of gases which includes methane, carbon dioxide, hydrogen sulphide and water vapour. In this mixture, methane burns easily. With a ton of food waste, one can produce 85 Cu. M of biogas. Once used, the residue is used as an agricultural fertilizer.

Wind Power: Wind was the earliest energy source used for transportation by sailing ships. Some 2000 years ago, windmills were developed in China, Afghanistan and Persia to draw water for irrigation and grinding grain. Most of the early work on generating electricity from wind was carried out in Denmark, at the end of the last century. Today, Denmark and California have large wind turbine of electricity.

Tidal and Wave Power: The earth's surface is 70% water. By warming the water, the sun, creates ocean currents and wind that produces waves. It is estimated that the solar energy absorbed by the tropical oceans in a week could equal the entire oil reserves of the world – 1 trillion barrels of oil. The energy of waves in the sea that crash on the land of all the continents is estimated at 2 to 3 million megawatts of energy. From the 1970s several countries have been experimenting with technology to harness the kinetic energy of the ocean to generate electricity.

Geothermal energy: is the energy stored within the earth ("geo" for earth and "thermal" for heat). Geothermal energy starts with hot, molten rock (called magma) deep inside the earth which surfaces at some parts of the earth's crust. The heat rising from the magma warms underground pools of water known as geothermal reservoirs. If there is an opening, hot underground water comes to the surface and forms hot springs, or it may boil to form geysers.

Nuclear Power

In 1938 two German scientists Otto Hahn and Fritz Strassman demonstrated nuclear fission. They found they could split the nucleus of a uranium atom by bombarding it with neutrons. As the nucleus split, some mass was converted to energy. The nuclear power industry however was born in the late 1950s. The first large-scale nuclear power plant in the world became operational in 1957 in Pennsylvania, US.

Energy Conservation: Conventional energy sources have a variety of impacts on nature and human society. India needs to rapidly move into a policy to re duce energy needs and use cleaner energy production technologies. A shift to alternate energy use and renewable energy sources that are used judiciously and equitably would bring about environmentally friendly and sustainable lifestyles. India must reduce its dependency on imported oil. At present we are under-utilizing our natural gas resources. We could develop thousands of mini dams to generate electricity. India wastes great amounts of electricity during transmission. Fuel wood plantations need to be enhanced and management through Joint Forestry Management (JFM) has a great promise for the future.

f) Land resources:

Land as a resource: Landforms such as hills, valleys, plains, river basins and wetlands include different resource generating areas that the people living in them depend on. Many traditional farming societies had ways of preserving areas from which they used resources. Eg. In the 'sacred groves' of the Western Ghats, re quests to the spirit of the Grove for permission to cut a tree, or extract a resource, were ac companied by simple rituals.

Land Degradation: Farmland is under threat due to more and more intense utilisation. Every year, between 5 to 7 million hectares of land worldwide is added to the existing degraded farmland. When soil is used more intensively by farming, it is eroded more rapidly by wind and rain. Over irrigating farmland leads to salinisation, as evaporation of water brings the salts to the surface of the soil on which crops cannot grow. Over irrigation also creates water logging of the topsoil so that crop roots are affected and the crop deteriorates.

Soil erosion: The characteristics of natural eco systems 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.

3. ROLE OF AN INDIVIDUAL IN CONSERVA TION OF NATURAL RESOURCES

Until fairly recently mankind acted as if he could go on forever exploiting the ecosystems and natural resources such as soil, water, forests and grasslands on the Earth's surface and extracting minerals and fossil fuels from underground. But, in the last few decades, it has become increasingly evident that the global ecosystem has the capacity to sustain only a limited level of utilization. Biological systems cannot go on replenishing resources if they are overused or misused. At a critical point, increasing pressure de stabilizes their natural balance. Even biological resources traditionally classified as 'renewable' - such as those from our oceans, forests, grass lands and wetlands, are being degraded by over use and may be permanently destroyed. And no natural resource is limitless. 'Non-renewable' resources will be rapidly exhausted if we continue to use them as intensively as at present.

The two most damaging factors leading to the current rapid depletion of all forms of natural resources are increasing ‘consumerism’ on the part of the affluent sections of society, and rapid population growth. Both factors are the results of choices we make as individuals. As individuals we need to decide;

• What will we leave to our children?

• Is my material gain someone else’s loss?

Greed for material goods has become a way of life for a majority of people in the developed world. Population growth and the resulting shortage of resources most severely affects people in the developing countries. In nations such as ours, which are both developing rap idly, and suffering from a population explosion, both factors are responsible for environmental degradation. We must ask ourselves if we have perhaps reached a critical flash point, at which economic ‘development’ affects the lives of people more adversely than the benefits it pro vides.

4. EQUITABLE USE OF RESOURCES FOR SUSTAINABLE LIFESTYLES

Reduction of the unsustainable and unequal use of resources, and control of our population growth are essential for the survival of our nation and indeed of human kind everywhere. Our environment provides us with a variety of goods and services necessary for our day-to-day lives, but the soil, water, climate and solar energy which form the ‘abiotic’ support that we derive from nature, are in themselves not distributed evenly throughout the world or within countries. A new economic order at the global and at national levels must be based on the ability to dis tribute benefits of natural resources by sharing them more equally among the countries as well as among communities within countries such as our own. It is at the local level where people subsist by the sale of locally collected resources, that the disparity is greatest. ‘Development’ has not reached them and they are often unjustly accused of ‘exploiting’ natural resources. They must be adequately compensated for the removal of the sources to distant regions and thus develop a greater stake in protecting natural resources.