**Nalanda Open University**

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**E-CONTENT 10**

for

Part-I Examination, 2020

**SHORT DESCRIPTION OF THE SUGGESTED TOPICS**

**THEORY PAPER**

**PAPER – V**

**(NATURAL RESOURCE & THEIR CONSERVATION)**

**THEORY PAPER**

**PAPER – V**

**(NATURAL RESOURCES AND THEIR CONSERVATION)**

**(Second installment)**

1. **Meaning of biotic resource. Importance of livestock resource of India.**

**Biotic Resources: An Introduction**

Based on their living and non-living character, natural resources have been put under two categories:

Biotic Resources and Abiotic Resources

All living resources derived from the biosphere fall under this category. Plants and Animals – Forests, Fisheries, wildlife including Man, Birds, Marine Life form, domesticated animals and micro-organisms are the examples of biotic natural resources. Biotic resources also include materials derived from them. Thus mineral fuels like Petroleum, Coal gas, Natural gas etc. are regarded as biotic resources since they are derived from or are products formed from decayed organic matter.

Livestock Resources of India: **Description and their importance**

**Note:** For detailed description of Livestock Resources of India, it is suggested to consult Study Learning Material (S.L.M), Part – I, Paper – V, Chapter – 4 provided by Nalanda Open University, Patna. Other resource materials may also be consulted, if felt so.

1. **Reserves, distribution, production and related problems of fisheries in India.**

**Note:** Examinees are advised to consult Study Learning Material (S.L.M), Part – I, Paper – V, Chapter – 4 provided by Nalanda Open University, Patna. Other resource materials may also be taken help of if so needed.

1. **Importance of soil, brief description of problems of soil and measures of its conservation.**

**Importance of Soil:**

Soil is an essential natural resource. Life on earth is directly dependent upon soil because without it there would be no vegetation and no food for animals and human beings. Common importance of soil are as described below:

1. Soil is a medium for growth of plants. Soil provides nutrients, minerals and water to plants, trees and grassland. It provides anchorage and support to plants and trees. Moreover, soil plays a vital role in providing oxygen (air) to the roots of plants for their growth and for seed germination through the process known as aeration. Crops and plants in turn, provide us with food, fiber, fuel, building materials, medicines and several other useful things of our use.
2. Soil is the home for enormous number for organisms – both micro fauna as well as macro fauna. Organisms that live in soil perform numerous functions that make them a vital part of the ecosystem and of agriculture.

**Soil organisms are involved in:**

1. Breaking down (i.e. decomposition) of organic matter – dead and decayed plants and animals – and produce nutrients and humus which make the soil fertile.
2. Improving and maintaining soil texture.
3. Controlling pathogens
4. Fixing of atmospheric nitrogen etc.
5. Soil acts as a medium for percolation, purification and retention of water. Immediately after rain or irrigation, water percolates through the porous soil and continues to move in the soil mass to deeper layers because of the gravitational force. Thus, the soil facilitates percolation of rainwater to the underground aquifer for our use as groundwater. The water which is retained by the soil is called Soil Water or Soil Moisture, which is required by plants for their growth.
6. Soil is used in huge quantity in brick kilns for manufacture of bricks used in construction of buildings, dams, roads, bridges etc.

**Note:** For brief **description of problems of soil and measures for its conservation** it is suggested to consult description of Topic No. – 7, Paper – III (Environmental Chemistry) already uploaded on the Nalanda Open University website in e-content – 6.

1. **Classification of Energy Sources. Importance of energy sources in economic progress of a nation.**

**Energy - An Introduction:**

Energy is defined as the capacity of man, machine or animals to do work. Energy is an essential need for existence of all life forms on the earth. All natural processes, be the water cycle, flowing of rivers and blowing of air, growth and decay of plants, cyclones and floods, formation of mountains and countless other phenomenon occurring far and near are all driven by energy. We experience energy in different forms – Thermal Energy, Mechanical Energy, Solar Energy, Chemical Energy, Nuclear Energy and the like. Energy gets converted through nature or is converted by human efforts from one form of energy to another. For example, absorption of solar energy by the seas and oceans converts water into water vapour to become the part of water cycle. We burn wood and coal to produce heat energy that cooks meals and drive automobiles.

**Importance of energy sources in economic progress of a Nation**

**Energy consumption has become synonymous with socio – economic development of a Nation.**

Today, most items of our use are produced on a large scale in factories which are machine driven. From industrial and agricultural activities to transportation and communication, recreational activities to games and sports, health care facilities to educational activities including operation of home appliances such as heaters and coolers, air conditioners and refrigerators, washing machines, television, radio, computers, electric stoves and music systems huge quantity of energy is required. Good quality of education, better health facilities, availability of facilities for recreation and for games and sports, efficient transport, communication and information system, adequate household/workplace facilities, ensured comforts and enhanced work efficiency are the essential ingredients of a good quality of life. Since all these activities and facilities require energy input quantum of energy consumption has become synonymous with socio-economic development of a nation. A nation which generates and consumes more energy is considered more developed and its people have a better quality of life than the one which generates and consumes less energy. Per capita consumption of energy has become one of the important indices of economic development of a country. To cite an example, the United States of America, with only about 4.6% share of the world population consumes nearly 25% of the total world energy consumption and has a better quality of life than India, which with over 16%share of the world’s population consumes only about 3% of the total energy consumption of the world.

**Classification of Energy Sources:**

Energy sources can broadly be put under two categories based on whether they are renewable or non-renewable.

**Energy Sources**

Conventional Sources Non-Conventional Sources

or or

Non-Renewable Sources Renewable Sources

**Conventional Energy Sources:**

Other than muscle power of humans and animals, fire woods has been the main sources of energy during most part of man’s history. Later, coal was discovered as a huge and conventional source of thermal energy. The recognition of huge coal reserves as a source of energy was the driving force behind the Industrial revolution of the Seventeenth and eighteenth centuries. In subsequent years petroleum and natural gas were explored as other potent sources of energy. In the years after industrial revolution wood, coal, petroleum oil and natural gas have dominated the global fuel energy market. They are still major sources of energy all over the world. In 2016, 80% of the world’s primary energy came from coal, petroleum and natural gas. Therefore, fire wood, coal, petroleum oil and natural gas have been called Conventional Energy Sources. Coal, Petroleum and Natural gas are collectively called Fossil fuels. They are given this name because they were formed beneath the earth’s crust by fossilization (i.e. decaying) of the burned plants and animals in millions of years of time. Fossil fuels are also called Non Renewable Energy Sources as they have been formed in nature over millions of years and once exhausted, they cannot reappear in nature for the next thousands and thousands of years to come.

Let us describe briefly the conventional sources of energy individually.

**Fire wood (Fuel Wood):**

As mentioned earlier, firewood or fuel wood has been the main source of energy during most part of man’s history. It has been used mainly for cooking and heating. Even today 70% of the families in the developing world are forced to rely on wood as their sole source of fuel. On a global scale nearly 50% of the world’s population depends on fuel wood as a source of energy.

**Coal:**

Coal is a black rock like material which is obtained from deep mines. It is used as fuel for both domestic and industrial purposes. It is used on a large scale to generate electricity in thermal power plants. It can be changed into better industrial fuels such as coke, coal gas, water gas and producer gas. It is also used to prepare synthetic petrol and synthetic natural gas. It has other uses too, as in iron and steel plants and in the manufacture of various items.

Coal accounts for 39 percent of the world’s commercial energy requirements and 67 percent of India’s energy requirements. Thus coal may be regarded as the backbone of our economy.

It is a fact that globally there are vast reserves of coal. But the demand for coal has gradually increased. If coal, being a non-renewable energy source, is consumed at the present rate, cannot last for more than 200 years.

**Petroleum:**

Huge quantities of organic materials, mainly hydrocarbons occur naturally as oil deposits beneath the earth’s crust called as crude Oil or Petroleum. It is a thick, dark coloured and highly inflammable liquid.

Crude oil is pumped out from beneath the earth’s crust by drilling holes, called Oil Wells. It is refined to obtain useful components such as petrol, diesel, kerosene, lubricants and paraffin wax. Petroleum is the major source of fuel and is also used to produce petrochemicals which have innumerable uses. Petroleum has been given the name “liquid gold” because modern civilization has found it so valuable.

**Natural gas:**

In many part of the world large quantities of hydrocarbon gases flow to the surface of the earth through the natural outlets from gas deposits. This mixture of hydrocarbons consisting mainly of methane (about 95 percent by volume) and small quantities of ethane and propane is called Natural Gas. It is also found dissolved in petroleum and is released when the oil is extracted. Some oil wells produce nothing but natural gas.

Natural Gas is a good domestic and industrial fuel for several reasons – its calorific value is high, its combustion in automobiles and in industries produces little pollution, its transportation through a network of underground pipelines is convenient and cost effective, can be used as a source of hydrogen which is needed in the fertilizer industry, used to produce carbon black which is used for making tyres etc.

**Environmental Consequences:**

Burning of fossil fuels causes Pollution. Most air pollutants are produced by the burning of fossil fuels in transportation and industry. When fossil fuels burn they produce gaseous pollutants, like oxide of Sulphur and Nitrogen in addition to huge amounts of suspended particulate matter (SPM). Coal is the world’s single largest contributor of the green-house gas, carbon dioxide. Fly ash is another potent pollutant produced on burning coal.

Vehicular exhausts released as a result of burning of petrol and diesel in internal combustion engine of vehicles is the single largest source of carbon monoxide, contributing to about 50% of its total emission in the atmosphere.

The increasing proportion of carbon dioxide and other greenhouse gases released in the atmosphere due to burning of fossils fuels has led to global warming which may cause great harm to plant and animal life on the earth. Many petrochemicals produced from petroleum are hazardous to health and deplete the protective ozone layer.

**Non-Conventional Energy Sources:**

In modern times the demand for energy for the industrial sector, transport sector, agriculture sector and domestic sector has increased manifold. At present our main source of energy is fossil fuels as over 80% of the world’s energy demand is met by burning these fuels. We know that fossil fuels are non-renewable. At the present rate of consumption the fossil fuel reserves are not going to last long. This situation gets further complicated by the fact that large-scale use of fossil fuels is stressing our environment by way of pouring in huge quantity of pollutants in air, water and soil. These facts have made the world community think seriously in terms of an efficient and sustainable energy source, which has to be environmentally benign. A viable solution to the ever-deepening energy crisis is to work for and find non-conventional sources of energy such as solar energy, hydel energy, nuclear energy, biomass energy, wind energy, ocean energy and geothermal energy.

It is fortunate that scientists the world over have been able to achieve some amount of success in harnessing these non-conventional (alternate) energy sources. Non-conventional energy sources are mostly renewable in nature and hence are called as “Renewable Energy Sources”. Moreover, technology based on these energy sources is largely pollution free. For these reasons non-conventional energy sources are poised to transform various aspects of our life in the years to come.

Let us now describe briefly these energy sources individually.

**Solar Energy:**

The sun is the ultimate source of all forms of energy on the earth. On fossilization, energy reserves of plants are changed into coal and petroleum. Sunlight causes evaporation from rivers, seas and oceans. The water vapour condenses into rainwater in a natural (hydrological) cycle. Hydel energy, biomass energy and energy from the oceans also have their origin in solar energy. Since time immorial, humans have been using solar energy directly too, for examples, for drying of food grains, firewood, fishes and fruits and preparing salt from sea water.

The sun is an inexhaustible source of energy. But the difficulty in using solar energy directly is that it comes to us in highly scattered form and most of it is radiated back into space. However, even the meager portion that is retained in the earth’s atmosphere is staggeringly high, being approximately 750 million kilowatt hours per year.

Scientists all over the world are working on methods to collect sunlight and convert it to energy we can use. Some amount of success has been achieved, but we have yet to master techniques that can allow this inexhaustible energy source to become a real substitute for fossil fuels.

Some devices and techniques which are based on harnessing of solar energy are as given below:

* Solar photovoltaic cell
* Solar collector and solar heater
* Solar power tower and solar furnace.

India receives abundant sunshine for about 250 to 300 days in a year. India is one among few countries which have developed and adopted techniques for maximum use of solar energy through various artificial devices.

**Hydel Energy:**

Hydel energy or Hydroelectricity refers to electric power generation by falling water.

**Harnessing of Hydel Energy:**

Rain or river water is stored at a height in large reservoirs commonly called dams. A dam is a barrier made up of concrete to check the flow of water. It is provided with iron gates to regulate the flow of water. The stored water in a dam has tremendous potential energy. When this water is made to fall on a turbine, the turbine rotates and drives attached generators that produce electricity.

It is a clean energy source and does not generate waste or heat. It is a renewable energy source, replenished by the hydrological cycle.

Hydroelectricity accounts for about 6 percent of the world’s energy production. In our country hydroelectricity is the second largest source of energy, after thermal energy.

**Wind Energy:**

Fast blowing air is called wind. Wind possesses enormous kinetic energy. Wind energy has been in direct use sailing boats and ships since ancient times. In recent times techniques have been developed to harness wind power and convert it into mechanical and electrical energy on a commercial scale.

In coastal areas and on hills where wind velocity is very high wind mills are installed to harness wind energy. A wind mill is a device that converts wind energy into mechanical energy. Wind mills are used to grind grains and to pump water for irrigation and drinking. Another important application of wind energy is in electricity generation. The mechanical energy of the wind is used to move wind turbines that generate electricity. A large number of windmills installed in a given area constitute a wind energy farm. Together they can generate electricity on a commercial scale.

Wind power is a key renewable source of energy which is pollution free and cost effective.

India has made significant progress in the use of wind power especially in coastal areas. In wind energy production India occupies the fifth position after Germany, America, Denmark and Spain.

**Biomass Energy:**

Biomass is waste material from plants and animals. It includes crops and plants, agricultural wastes, animal wastes such as animal dung, urine, waste foods and vegetables. Biomass is the product of photosynthesis by plants. Nearly 75% of the biomass consists of carbohydrate and the rest is lignin. These two main components of biomass are organic, being compounds of carbon. They can be used to produce thermal energy, either by burning directly or after conversion to more useful forms.

Biomass can be converted into energy in the following ways:

* By controlled burning of fuel wood and agricultural left overs to obtain heat energy for kitchen and industrial use.
* By converting biomass into alcohol by fermentation process. The alcohol can be used as fuel in automobiles.
* By converting biomass into bio-oil
* By converting biomass into Biogas.

**Biogas Generation**

Biogas is produced when micro-organisms decompose biomass in the presence of water but in the absence of air, in a digester chamber called a Biogas plant. The plant and animal materials gradually decompose to produce biogas which is a mixture of about 55 percent methane, 40 percent carbon dioxide and small amounts of other gases. Biogas is a good fuel for cooking. It can also be used for lighting homes and streets. The solid residue from the digester is an excellent bio-manure.

A huge quantity of plant and animal waste is produced in the rural areas of India. If used properly, this waste can solve the energy problem of rural areas. India has launched biogas programme on a massive scale. The Department of Non-Conventional Energy Sources launched a National Biogas Development Programme as long back as during 1981-82. Other forms of Non-Conventional Energy sources are as described below in brief.

**Tidal Energy**

In oceans, the gravitational pull by the Sun and the Moon causes tides, in which the sea level rises and falls down in 24 hours. Technology has been developed to utilize the energy associated with huge oceanic water moving up and down during tides for power generation. Exploitation of the tidal power for power generation is possible along the coasts where there is sufficient (above 6 metre) vertical difference between high and low tides. At present, tidal power plants are in operation in Russia, France and a few more countries.

**Oceanic Wave Energy**

High energy waves are produced in the oceans where air currents rub against the surface of oceans. These waves reach the seashore with enormous speed and their kinetic energy gets dissipated. Techniques have been developed to use this energy to drive turbo generators and produce electricity. Our Country’s first power plant that makes use of oceanic wave energy is located near Thiruvananthapuram, Kerala.

**Ocean Thermal Energy**

In oceans there exists a temperature difference between the upper and lower layers of sea water. In tropical countries such as India, this temperature difference is as high as 20\*C - 30\*C at a depth of 1,000 metres or so. Work is in progress to utilize this temperature gradient to generate electricity.

Currently most devices to trap the oceanic energy for power generation are uneconomical.

**GEOTHERMAL ENERGY**

We know that the earth is very hot in its interior. The temperature increases at the rate of 20\*C - 75\*C per KM as we go down from the surface. So if one digs around 19,000 feet below ground the temperature of the rock would be hot enough to boil water. This heat offers a large potential of a non-conventional source of energy called geo thermal energy (Greek: Geo = Earth, Thermal= Heat)

In recent times scientific and technological efforts have been made to harness the geothermal energy of hotspots to generate electricity. The initial investment in exploitation, drilling and erection of geothermal power plant is too high. Most of the geothermal power units that have come up in different regions of the world are relatively small having a low energy output.

**NUCLEAR ENERGY**

Nuclei of atoms of some heavy metals such as Uranium, Thorium and Radium are unstable. Unstable Nuclei of atoms of these metals can be broken into two or more smaller nuclei by artificial method. In the process large quantities of energy are released. This process is called nuclear fission and the energy produced is called Nuclear energy. It is produced as a result of the conversion of the atomic mass into energy. Even a small quantity of mass can produce a tremendous amount of energy. Thus 1 ton of uranium can produce as much energy as over 12 million tons of oil.

Nuclear reactions are artificially brought about under fully controlled conditions in specifically erected furnaces called Atomic Reactors or Nuclear Reactors. A nuclear power plant is a device to produce power (i.e. electricity) from the energy of the nuclear fission. Nuclear energy from fission can be used for other purposes as well.

Nuclear energy can also be obtained by another kind of nuclear reaction called Nuclear Fusion. In nuclear fusion small nuclei of two (or more) lighter nuclei of low mass fuse together under specifically controlled conditions to form a larger nucleus releasing enormous amount of energy during fusion process. It is known that energy production in sun and stars is due to nuclear fusion reactions. In the sun hydrogen nuclei fuse together to form helium nuclei under very high temperature and pressure conditions. What is better about the nuclear fusion is that it creates less radioactive waste material than nuclear fission and the energy released in the process of nuclear fusion is much greater than the nuclear fission.

**Advantages of Nuclear Energy**

* Available resources of nuclear energy are almost inexhaustible.
* It is very clean energy source as no pollutant of air, water or soil is emitted during the generation and use of nuclear energy.
* Though initial installation cost over nuclear power plant is very high, the operating cost is relatively low.

**India’s Nuclear Program**

India’s Nuclear Program was formulated by Dr.Homi Jehangir Bhabha with the establishment of Atomic Energy Establishment in 1956. It was renamed Bhabha Atomic Research Centre, BARC after Dr. Bhabha’s death in 1966.

Today India has 10 power reactors in operation. In parallel, the country has also setup facilities for fabrication of fuel, manufacture of precision reactor component and production of heavy water. The objective is to achieve 20,000 MW of nuclear generation capacity by 2020.

India is emerging as an important country in nuclear power generation through development of nuclear reactor and related fuel cycle technologies for Thorium utilization. The future of the nuclear programme (including Nuclear Power Generation Programme) is bright.

**Note:** An exhaustive Study Learning Material has been prepared on various aspects of **ENERGY** including meaningful description of all the Conventional and Non-Conventional Energy Sources. The prepared material covers the answer of most of the important topics suggested to be prepared for Paper VII (Energy and Environment) of M.A/M.Sc. Environmental Sciences Part I Annual Examination 2020.Examinees are advised to plan their answer in the examination according to demand of the question asked to answer.