Sri SAI RAM ENGINEERING COLLEGE
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Sairam INSTITUTIONS

SAIRAM DIGITAL RESOURCES

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ENVIRONMENTAL SCIENCE AND ENGINEERING

UNIT NO 3

NATURAL RESOURCES

3.4 ENERGY RESOURCES: Growing energy needs,renewable and non-renewable energy resources,use of alternate energy resources.Case studies- Land resources as a resource,land degradation,man induced landslides,soil erosion and desertification-role of an individual in conservation of natural resources Equitable resource/sustainable

SCIENCE & HUMANITIES

Energy resources

Growing energy needs.

- Development in different sectors relies largely upon energy.
- Agriculture, industry, mining, transportation, lighting, cooling and heatin in buildings all need energy.
- With the demands of growing population the world is facing further energy deficit.
- In developed countries like U.S.A and Canada an average person consumes 300 GJ per year.
- By contrast, an average man in a poor country like Bhutan, Nepal or Ethiopia consumes less than 1 GJ per year.
- This clearly shows that our life-style and standard of living are closely related to energy needs.

RENEWABLE AND NONRENEWABLE RESOURCES

Life on earth depends upon a large number of things and services provided by nature, which are known as energy resources.

Energy Resources are of two kinds.

I. Renewable resources: which are non exhaustive and can be regenerated within a given span of time eg. Forests, wildlife, wind energy, biomass en

ergy etc. Solar energy is also a renewable form of energy as it is an inexhaustible source of energy.

II. Non-renewable resources which cannot be regenerated eg. Fossil fuels like coal,petroleum etc. Once we exhaust these reserves, the same cannot be replenished.Even our renewable resources can become non-renewable if we exploit them to such extent their rate of consumption exceeds their rate of regeneration.

I. Solar energy:

a. Sun releases enormous quantity of energy in the form of heat and light.

b. The solar energy received by the near earth space is approximately1.4 kJ/s/m2 known as solar constant.

c. Now we have several techniques for harnessing solar energy.

d. Solar heat collectors, solar cells, solar cooker, solar water heater, solar furnace and solar power plant are some important solar energy harvesting devices.

II. Wind Energy:

a. The high speed winds have a lot of energy in them as kinetic energy due to their motion.

b. Wind energy is very useful as it does not cause any air pollution.

c. After the installation cost, the wind energy is very cheap.

III. Hydro power:

a. The water flowing in a river is collected by constructing a big dam where the water is stored and allowed to fall from a height.

b. The blades of turbine located at the bottom of the dam move with the fast moving water which in turn rotates the generator and produces electricity.

c. Hydro power does not cause any pollution.

d. Hydro power projects help in controlling floods, used for irrigation, navigation etc.

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IV. Tidal energy:

a. Ocean tides produced by gravitational forces of sun and moon contain enormous amounts of energy.

b. The tidal energy is harnessed by constructing a tidal barrage.

c. During high tide, the water flows into the reservoir of the barrage and turns the turbine, which in turn produces electricity by rotating the generators.

d. During low tide, when the sea-level is low, the sea water stored in the barrage reservoir flows out into the sea and again turns the turbines.

V. Ocean thermal energy (OTE):

a. The energy available due to the difference in the temperature of water at the surface of the tropical oceans and at deeper levels is called OTE.

b. This energy is used to boil liquid like ammonia.

c. The high pressure vapours of the liquid formed by boiling are then used to turn the turbine of a generator and produce electricity

VII. Biomass energy:

a. Biomass is the organic matter produced by the plants or animals which include wood, crop, residues, cattle dung agricultural wastes etc

b. The burning of biogas cause air pollution and produce a lot of ash.

c. It is therefore more useful to convert biomass into biogas or bio fuels

VIII. Biogas:

a. Biogas is a mixture of methane, carbon dioxide, hydrogen and hydrogen sulphide.

b. Biogas is produced by anaerobic degradation of animal wastes in the presence of water.

c. Anaerobic degradation means break down of organic matter by bacteria in the absence of oxygen.

d. Biogas has many advantages. It is clean, non-polluting and cheap.

e. There is direct supply of gas from the plant and there is no storage problem

CASE STUDIES

WIND ENERGY IN INDIA

India is generating 1200Mw electricity using the wind energy.The largest wind farm of our country is near Kanyakumari in Tamilnadu,which generates 380Mw electricity.

HYDROGEN-FUEL CELL CAR

General motor company of China discovered the experimental cars,which run on electric motors fueled by hydrogen and oxygen.This car produces no emission,only water droplets and water vapour come out of the exhaust pipe.This motor company hopes that its cars will be commercially available by 2010.

IX. Bio fuels:

a. Biomass can be fermented to alcohols like ethanol and methanol which can be used as fuels.

b. Gasohol is common fuel in Brazil and Zimbabwe for running cars and buses.

c. Methanol is very useful since it burns at a lower temperature than gasoline or diesel.

d. Due to its high calorific value, hydrogen can serve as an excellent fuel.

e. Moreover it is non-polluting and can be easily produced.

f. Presently H2 is used in the form of liquid hydrogen as a fuel in spaceships.

Non -Renewable energy resources:

I. Coal:

a. Coal was formed 255-250 million years ago in the hot, damp regions of the earth during the carboniferous age.

b. The ancient plants along the banks of rivers were buried after death into the soil and due to the heat and pressures gradually got converted into peat and coal over million years of time.

c. When coal burnt it produces carbon dioxide, which is a green house gas responsible for causing enhanced global warming.

II. Petroleum:

a. It is the life line of global economy.

b. Petroleum is a cleaner fuel as compared to coal as it burns completely and leaves no residue.

c. It is also easy to transport and use.

d. Crude petroleum is a complex mixture of alkane hydrocarbons.

e. Hence it has to be refined by the process of fractional distillation, during which we get large variety of products namely, petroleum gas, kerosene,petrol, diesel, fuel oil, lubricating oil, paraffin wax etc.

f. The petroleum gas is easily converted to liquid form under pressure as LPG

III. Natural gas:

a. It is mainly composed of methane with small amounts of propane and ethane.

b. It is used as a domestic and industrial fuel in thermal power plants for generating electricity.

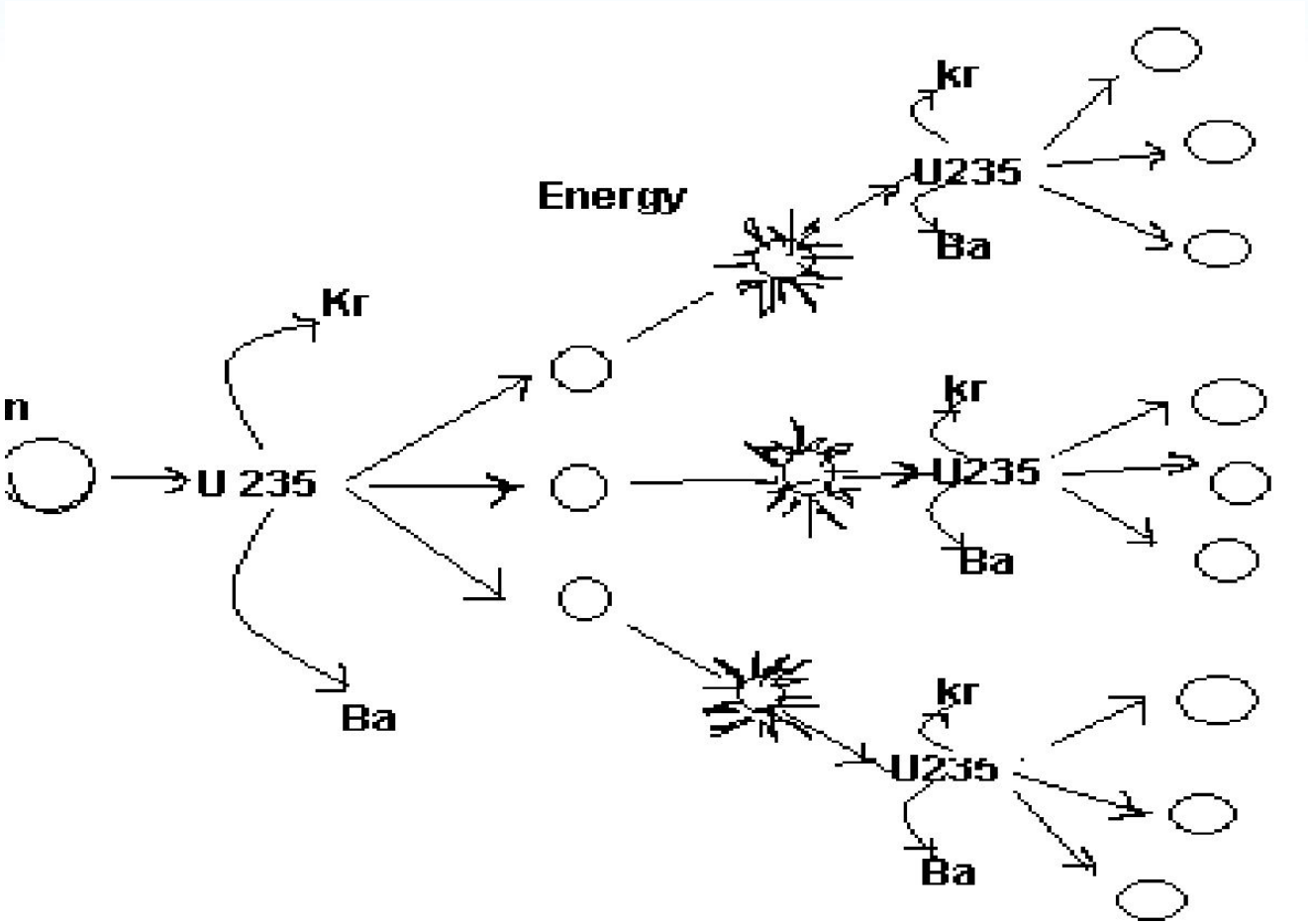
c. It is used as a source of hydrogen gas in fertilizer industry and as a source of carbon in tier industry.

IV. Nuclear energy:

Nuclear energy is known for its high destructive power. Nuclear energy can be generated by two types of reactions:

(i) **Nuclear fission:** It is the nuclear reaction in which heavy isotopes are split into lighter nuclei on bombardment by neutrons. Fission reaction of U235 is given below.

$$92U235 + 0n1 \rightarrow 36Kr92 + 56Ba141 + 3\ 0n1 + \text{energy}$$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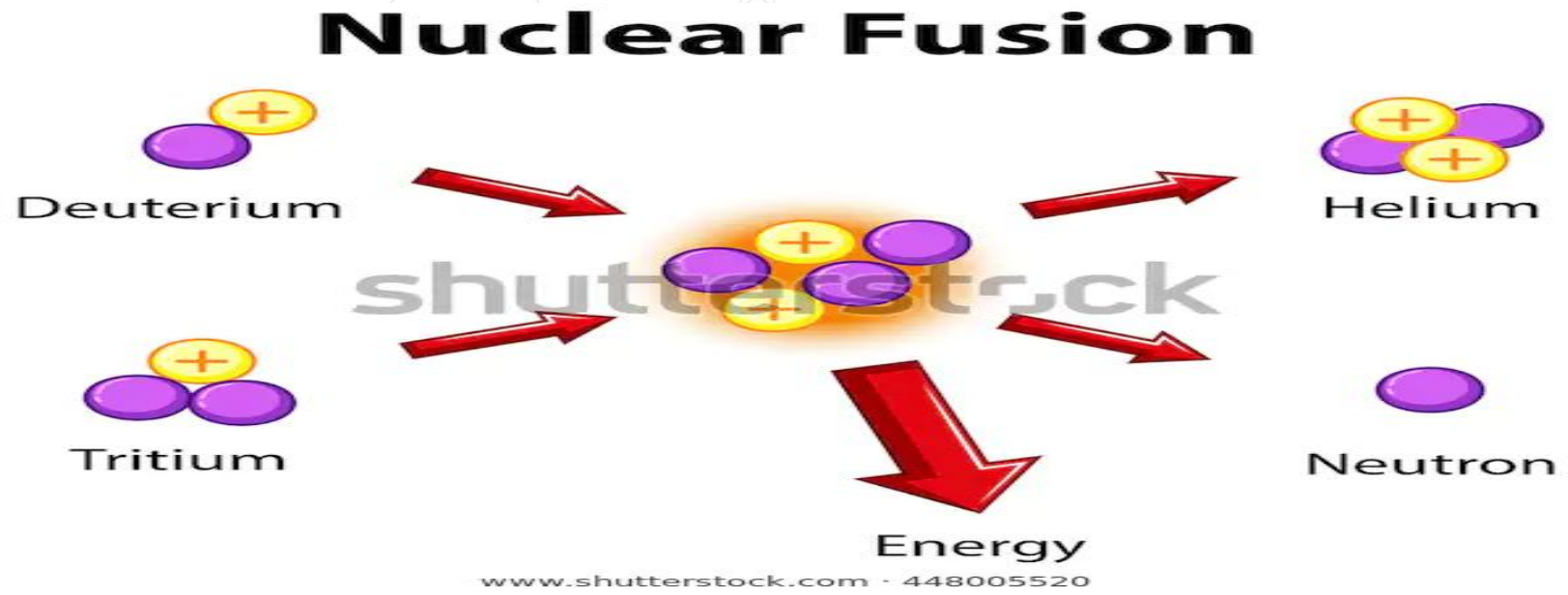
(ii) Nuclear fusion: Here two isotopes of a light element are forced together at extremely high temperatures (1 billion ºC) until they fuse to form a heavier nucleus releasing enormous amount of energy in the process.

$$1H2+1H2 \rightarrow 3He2+0n1+energy$$

Nuclear energy has tremendous potential but any leakage from the reactor may cause devastating nuclear pollution. Disposal of the nuclear waste is also a big problem.



Why Alternate (Renewable) Energy Sources are required?

- The importance of solar energy can be emphasized particularly in view of the fact that fossil fuels and other conventional sources are not free from environmental implications.
- Least pollution, safety and security snags and are universally available have the best enhance of large scale utilization in future
- Hydro-electric power generation is expected to upset the ecological balance existing on earth
- Besides space heating, hydel power plants critically pollute the aquatic and terrestrial biota.
- Radioactive pollutants released from nuclear power plants are chronically hazardous.

- The commissioning of boiling water power reactors (BWRS) have resulted in the critical accumulation of large number of long lived radionuclides in water
- The dangerous radio waste cannot be buried in land without the risk of polluting soil and underground water.
- Nor the waste can be dumped into the rivers without poisoning aquatic life and human beings as well
- The burning of coal, oil, wood, dung cakes and petroleum products has well debated environmental problems. The smoke so produced causes respiratory and digestive problems leading to lungs, stomach and eye diseases.
- The disposal of fly ash requires large ash ponds and may pose a severe problem considering the limited availability of land. Thus the non-conventional sources of energy are needed.

Objectives

- To provide more energy to meet the requirements of increasing population.
- To reduce environmental pollution
- To reduce safety and security risks associated with the use of nuclear energy

Land Resources

Land as a resource

- We depend upon land for our food, fibre, and fuel wood.About 200-1000 years are needed for the formation of one inch or 2.5cm 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

- With increasing population growth the demands for land for producing food, fibre and fuel wood is also increasing.
- Hence there is more and more pressure on limited land resources which are getting degraded due to over-exploitation.
- 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.

Man induced landslides

- Various anthropogenic activities like hydroelectric projects, large dams,reservoirs, construction of roads and railway lines, construction of buildings, mining etc are responsible for clearing of large forested areas.
- Earlier there were few reports of landslides between Rishikesh and Byasi on Badrinath Highway area. But, after the highway was constructed, 15 landslides occurred in a single year.
- During the construction of roads, mining activities etc. huge portions of fragile mountainous areas are cut or destroyed by dynamite and thrown into adjacent valleys and streams.
- These land masses weaken the already fragile mountain slopes and lead to landslides.
- They also increase the turbidity of various nearby streams, there byreducing their productivity.

LAND DEGRADATION

LANDSLIDE

Soil erosion

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:

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

b) Accelerate erosion: This is mainly caused by man made activities and therate of erosion is much faster than the rate of formation of soil.Overgrazing, deforestation and mining are some important activities causing accelerated erosion

There are two types of agents which cause soil erosion. They are climatic agents and biotic agents.

I. Climatic Agents – Water and Wind:

Water affects soil erosion in the form of rain. **Water induced soil erosion** is of following types:

a) **Sheet erosion:** When there is uniform removal of a thin layer of soil from a large surface area, it is called sheet erosion.

b) **Rill erosion:** when there is rainfall and rapidly running water produces finger shaped grooves or rills over the area, it is called rill erosion.

c) **Gully erosion:** When the rainfall is very heavy, deeper cavities or gullies are formed, which may be U or V shaped.

Slip erosion: This occurs due to heavy rainfall on slopes of hills and mountains.

d) **Stream bank erosion**: During the rainy season, when fast running streams take a turn in some other direction, they cut the soil and make caves in the bank

SOILEROSION

SOILEROSION BY WATER

Wind erosion is responsible for the following three types of soil movements:

a) **Saltation:** This occurs under the influence of direct pressure of stormy wind and the soil particles of 1-1.5 mm diameter move up in vertical direction.

b) **Suspension**: Here fine soil particles (less than 1mm diameter) which are suspended on the air are kicked up and taken away to distant places.

c) **Surface creep:** Here the large particles (5-10 mm diameter) creep over the soil surface along with wind.

II. Biotic Agents:

a. Excessive grazing, mining, and deforestation are the major biotic agents responsible for soil erosion.

b. Deforestation without reforestation, overgrazing by cattle, surface mining without land reclamation, irrigation techniques that lead to salt build- up,water logged soil, make the top soil vulnerable to erosion.

Soil conservation practices:

In order to prevent soil erosion and conserve the soil the following practices are employed.

1. Conventional till farming:

a. In traditional method the soil is broken up and smoothed to make a planting surface.

b. This disturbs the soil and makes it susceptible to erosion.

c. Conservational till farming, popularly known as no-till-farming causes minimum disturbance to the top soil.

d. Here special tillers break up and loosen the subsurface soil without turning over the top soil.

e. The tilting machines make slits in the soil and inject seeds, fertilizers, and little water in the slit, so that crop grows successfully.

2. Contour farming:

a. On gentle slopes, crops are grown in rows across, rather up and down.

b. This practice is knows as contour farming.

c. It helps to hold soil and slow down loss of soil through run-off water.

CONVENTIONAL TILLING

CONTOUR FARMING

TERRACE FARMING

3. Terracing:

a. It is used on still steeper slopes are converted into a series of broad terraces which run across the contour.

b. Terracing retains water for crops at all levels and cuts down soil erosion.

4. Strip cropping :

a. Here strops of crops are alternated with strips of soil saving crops like grasses or grass- legume mixture.

b. What ever run-off comes from the cropped soil is retained by the strip of cover- crop and this reduces soil erosion.

5. Alley cropping:

a. It is a form of inter – cropping in which crops are planted between rows of trees or shrubs. This is also called **Agro forestry**.

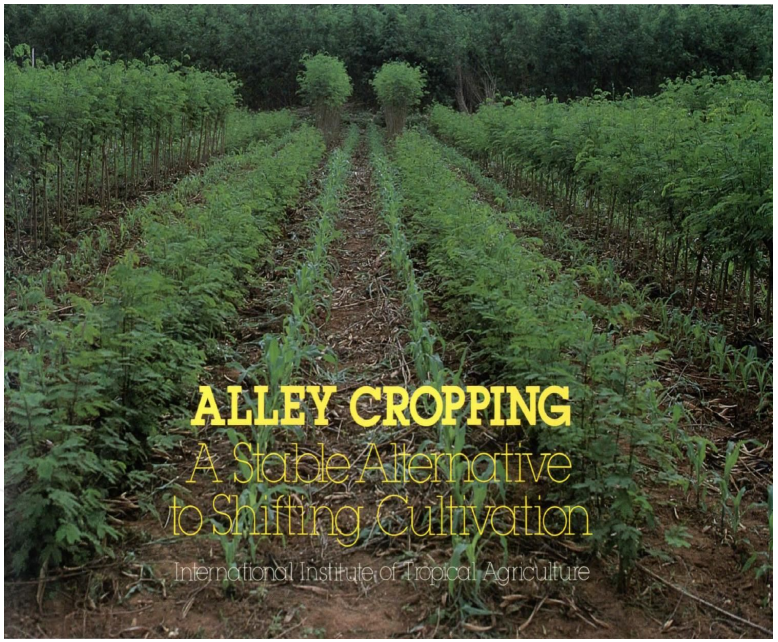
b. Even when the crop is harvested, the soil is not fallow because trees and shrubs still remain on the soil holding the soil particles and prevent soil erosion.

6. Wind breaks or shelterbelts:

a. The trees are planted in long rows along the cultivated land boundary so that wind is blocked.

b. The wind speed is substantially reduced which helps in preventing wind erosion of soil.

STRIP FARMING



Desertification

Desertification is characterized by devegetation and loss of vegetal over,depletion of groundwater, salinization and severe soil erosion.Desertification leads to the conversion of irrigated croplands to desert like conditions in which agricultural productivity falls. Moderate desertification produce 10-25% drop in productivity.Severe desertification cause 25-50% drop while very severe desertification results in 50% drop in productivity.

Causes of Desertification: The major man made activities responsible for desertification are as follows.

I. Deforestation:

a. Deforestation means destruction of forests.

b. The total forests area of the world in 1900 was estimated to be 7,000million hectares which was reduced to 2890 million ha in 1975 fell down to just 2,300 million ha by 2000.

c. Deforestation rate is relatively less in temperature countries, but it is very alarming in tropical countries.

II. Overgrazing:

a. Overgrazing can limit livestock production.

b. Over grazing occurs when too many animals graze for too long and exceed the carrying capacity of a grass land area.

c. Overgrazing removes the grass cover.

d. The humus content of the soil is decreased and it leads to poor, dry, compacted soil.

e. The soil roots are very good binders of soil.

f. When the grasses are removed, the soil becomes loose and susceptible to the action of wind and water.

g. The dry barren land reflects more of the suns heat, changing wind patterns leading to further desertification.

III. Mining and quarrying:

a. Mining operation requires removal of vegetation along with underlying soil mantle and overlying rock masses. This results in destruction of landscape in the area.

Global Efforts to Prevent Desertification

- **The Bonn Challenge:** To bring 150 million hectares of the world's deforested and degraded land into restoration by 2020, and 350 million hectares by 2030.
- **Goal 15 of Sustainable Development Goals (SDG), 2030:** It declares that "we are determined to protect the planet from degradation, including through sustainable consumption and production."
- **United Nations Convention to Combat Desertification (UNCCD):** It was established in 1994, the **sole legally binding international agreement linking environment and development** to sustainable land management.
- The World Day to Combat Desertification and Drought is observed every year on **17th June.**
- **Great Green Wall:** Initiative by **Global Environment Facility (GEF)**, where eleven countries in **Sahel-Saharan Africa** have focused efforts to fight against land degradation and revive native plant life to the landscape.

Way Forward

Ending desertification is the best chance the world has to stabilize the effects of climate change, save wildlife species and protect our well-being. Protecting the forest is our mutual responsibility, which should be carried out by people and governments worldwide.

videolink

landslide.,soil erosion

https://youtu.be/mknStAMia0Q

Desertification

https://youtu.be/w9RxnuBiFbg

THANK YOU