SYLLABUS

Environmental Studies (22447)

Teaching Scheme			Credit (L+T+P)	Examination Scheme											
				Theory						Practical					
L	T	P		Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
3	-	-	3	90 Min	70*#	28	30*	00	100	40	--	--	--	--	--	--

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub - topics
Unit - I Environment	1a. Discuss the scope of Environment. 1b. Describe various types of environment. 1c. Describe the importance of enviornment studies. 1d. Discuss about the need of public awarenss about environment. 1e. Describe various environmental issues.	1.1 Definitions, need of environmental studies. 1.2 Segments of environment Atmosphere, Hydrosphere, Lithosphere, Biosphere. 1.3 Environmental Issues - Green house effects, Climate change, Global warming, Acid rain Ozone layer depletion, Nuclear accidents. 1.4 Concept of 4R (Reduce, Reuse, Recycle and Recover). 1.5 Public awarness about environment.
Unit - II Energy Resources	2a. List various natural resources. 2b. Describe Renewable, Nonrenewable and Cyclic resources. 2c. State the causes and effects of depletion of resources. 2d. State advantages and disadvantages of forms of energy. 2e. Select appropriate solutions of efficient use of energy. 2f. State the impacts of overuse of natural resources.	2.1 Natural Resources-Forest Resources, Water Resources, Energy Resources, Land resources, Mineral resources. 2.2 Renewable, Non-renewable and Cyclic Resources. 2.3 Causes and effects of depletion of resources. 2.4 Energy forms (Conventional and non conventional). 2.5 Present global energy use and future demands. 2.6 Energy conservation. 2.7 Over use of natural resources and its impacts on environment.

Unit - III **Ecosystem and Biodiversity**	3a. State the aspects and division of ecosystem. 3b. State the general characteristics and function of ecosystem. 3c. List levels of biodiversity. 3d. Enlist the endangered species. 3e. Describe value of biodiversity. 3f. Suggest methods biodiversity conservation.	3.1 Ecosystem - Definition , Aspects of ecosystem, Division of ecosystem, General characteristics of ecosystem, Functions of ecosystem. 3.2 Biodiversity- Definitions, Levels, Value and loss of biodiversity. 3.3. Biodiversity assessment initiatives in India. 3.4 Threats and Hotspots of biodiversity. 3.5 Conservations of biodiversity- objects, various laws.
Unit-IV **Environmental Pollution**	4a. Define pollution. 4b. State the sources of pollution. 4c. State the effects of land pollution on environment and lives. 4d. State various units and their functions of water treatment plant. 4e. State the needs of water conservation. 4f. State the impacts of sewage. 4g. State various units and their functions of sewage treatment plant. 4h. State sources and effects of air pollution. 4i. Describe various methods to prevent air pollution. 4j. State sources and effects of noise pollution. 4k. Describe preventive measures for noise pollution. 4l. State characteristics of solid waste. 4m. State the impacts of solid waste. 4n. Describe incineration, RDF and sanitary land filling. 4o. State the standards limiting / controlling values of various types of pollution.	4.1 Definition of pollution, types Natural and Artificial (Man-made). 4.2 Soil / Land Pollution - Causes and effects on environment and lives, presentive measures. 4.3 Water pollution - Sources of water (surface and sub surface), source of water pollution effect on environemnt and lives, preventive measures, BIS water quality standards, flow diagram of water treatment plant, Water conservation. 4.4 Waste water - Generation (domestic and industrial), Impacts, flow diagram of sewage treatment plant, CPCB norms of sewage discharge. 4.5 Air pollution - Causes, effects prevention, Ambient air quality standards. 4.6 Noise pollution - Sources, effects, prevention, noise levels at various zones of the city. 4.7 Municipal Solid Waste, Bio-medical waste and E-waste - Sources, generation, characteristics, effects, and method to manage.

Unit-V **Social Issues and Environmental Education**	5a. Elaborate article (48-A) and (51-QA (g)) 5b. Enlist various acts on environment and its provisions. 5c. State the roles and responsibilities of CPCB. 5d. Define sustainable development, and EIA. 5e. Describe rain water harvesting and ground water recharge. 5f. Differentiate between formal and non formal education.	5.1 Article (48-A) and (51-A (g)) of Indian Constitution regarding environment, Environmental, protection and prevention acts, CPCB and MPCB norms and responsibilities, The role ofNGOs. 5.2 Concept of sustainable development, EIA and environmental morality. 5.3 Management Measures - Rain Water harvesting, Ground water recharge, Green Belt Development, Use of Renewable energy, water shed management, interlinking of rivers. 5.4 Role of information technology in environment and human health.

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UNIT - I

1 Environment

Introduction

Environment is everything that is around us. The world environment derived from French word Environner. It can be living or non-living things. It includes physical, chemical and other natural forces. Living things live in their environment. They constantly interact with it and adapt themselves to conditions in their environment. In the environment there are different interactions between animals, plants, soil, water, and other living and non-living things. An example of interactions between non-living and living things is plants getting their minerals from the soil and making food using sunlight. Predation, an organism eating another, is an example of interaction between living things.

Natural Environment

In biology and ecology, the environment is all of the natural materials and living things, including sunlight. If those things are natural, it is a natural environment.

Environment includes the living and nonliving things that an organism interacts with, or has an effect on it. Living elements that an organism interacts with are known as biotic elements: animals, plants, etc., abiotic elements are non living things which include air, water, sunlight etc. Studying the environment means studying the relationships among these various things.

Historical Environment

A person's environment is the events and culture that the person lived in. Environment is everything around us. A person's beliefs and actions depend on his environment. It's simple definition is : Interaction between human and environment in the past.

1.1 Definition and Need of Environmental Studies.

Definition :

Environment means Surrounding in which we are living. Environment includes all those things on which we are directly or indirectly dependent for our survival, whether it is living component like animals, plants or non living component like soil, air water.

OR

'The term environment is used to describe, in the aggregate, all the external forces, influences and conditions, which affect the life, nature, behaviour and the growth, development and maturity of living organisms.'

Environmental Science : Environmental science is defined as an interdisciplinary academic field that integrates various academic fields (particularly sciences) to study the structure and function of our life-supporting environment and to understand causes, effects, and solutions of different environmental problems.

Environmental Studies : Environmental studies are the scientific study of the environmental system and the status of its inherent or induced changes on organisms. It includes not only the study of physical and biological characters of the environment but also the social and cultural factors and the impact of man on environment.

Need of environmental studies :

1. **Environment issues :** It has been well recognized that environment issues like global warming and ozone depletion, acid rain, marine pollution and biodiversity are not merely national issues but are

global issues and hence must be tackled with international efforts and cooperation.

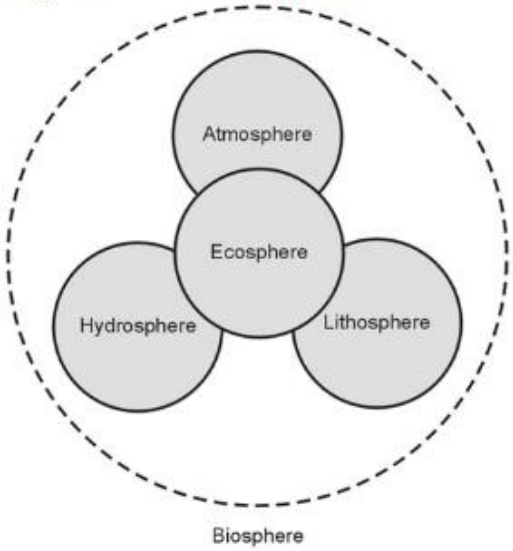
2. **Pollution :** World census reflects that one in every seven persons in this planted lives in India. Evidently with 16 per cent of the world's population and only 2.4 per cent of its land area, there is a heavy pressure on the natural resources including land. Agricultural experts have recognized soils health problems like deficiency of micronutrients and organic matter, soil salinity and damage of soil structure.
3. **Alternative Solution :** It is essential, especially for developing countries to find alternative paths to an alternative goal. We need a goal as under :
   (a) A goal, which ultimately is the true goal of development an environmentally sound and sustainable development.
   (b) A goal common to all citizens of our earth.
   (c) A goal distant from the developing world in the manner it is from the over-consuming wasteful societies of the "developed" world.
4. **To save humanity from extinction :** It is incumbent upon us to save the humanity from extinction. Consequent to our activities constricting the environment and depleting the biosphere, in the name of development.
5. **To understand the impacts of development on environment :** Industrial growth, urbanization, expansion of telecommunication and transport systems, hi-tech agriculture and expansion of housing will result in many people will move out of urban centers to reduce pollution resulting from overpopulation. The goal is to achieve all this sustainably without compromising the future generation's ability to satisfy their own needs.
6. **To discover sustainable ways of living :** Environmental science is more concerned with discovering ways to live more sustainably. This means utilizing present resources in a manner that conserves their supplies for the future.
7. **To utilize natural resources efficiently :** Natural resources bring a whole lot of benefits to a country. A country's natural resources may not be utilized efficiently because of low-level training and lack of management skills. Environmental science teaches us to use natural resources efficiently.
8. **Need for public awareness :** It is essential to make the public aware of the formidable consequences of the Environmental Degradation, if not retorted and reformative measures undertaken would result in the extinction of life. We are facing various environmental challenges. It is essential to get the country acquainted with these challenges so that their acts may be eco-friendly.

1.2 Segments of Environment - Atmosphere, Hydrosphere, Lithosphere, Biosphere.

Segments of Environment :

The environment consists of various segments which includes

1. Atmosphere
2. Hydrosphere
3. Lithosphere
4. Biosphere



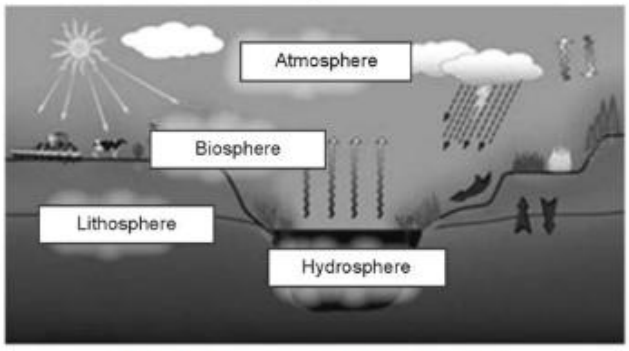


Fig. 1.2.1 Segments of environment

1. Atmosphere :

- The atmosphere of Earth is the layer of gases, commonly known as air, that surrounds the planet Earth and is retained by Earth's gravity.
- The atmosphere of Earth protects life on Earth by creating pressure allowing for liquid water to exist on the Earth's surface, absorbing ultraviolet solar radiation, warming the surface through heat retention (greenhouse effect), and reducing temperature extremes between day and night.
- It acts as a source for CO_2 for plant photosynthesis and O_2 for respiration.
- It acts as a source for nitrogen for nitrogen fixing bacteria and ammonia producing plants.
- By volume, dry air contains 78.09 % nitrogen, 20.95 % oxygen, 0.93 % argon, 0.04 % carbon dioxide, and small amounts of other gases. Air also contains a variable amount of water vapor, on average around 1 % at sea level, and 0.4 % over the entire atmosphere.
- The atmosphere has a mass of about 5.15×1018 kg, three quarters of which is within about 11 km (36,000 feet) of the surface. The atmosphere becomes thinner and thinner with increasing altitude, with no definite boundary between the atmosphere and outer space.

2. Hydrosphere : A **hydrosphere** is the total amount of water on a planet. The **hydrosphere** includes water that is on the surface of the planet, underground, and in the air. A planet's **hydrosphere** can be liquid, vapor, or ice. On Earth, liquid water exists on the surface in the form of oceans, lakes and rivers.

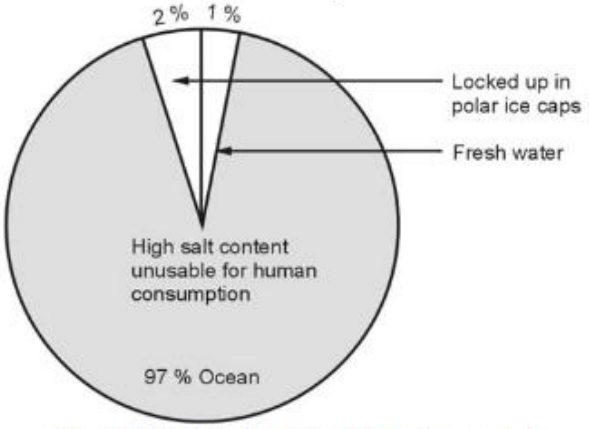


Fig. 1.2.2 Distribution of earths water supply

As can be seen, only 1% of the total water supply is available as fresh water in the form of rivers, lakes, streams and ground water for human consumption and other uses. The extent of the use of available fresh water for various purposes is shown in the following figure 1.2.3

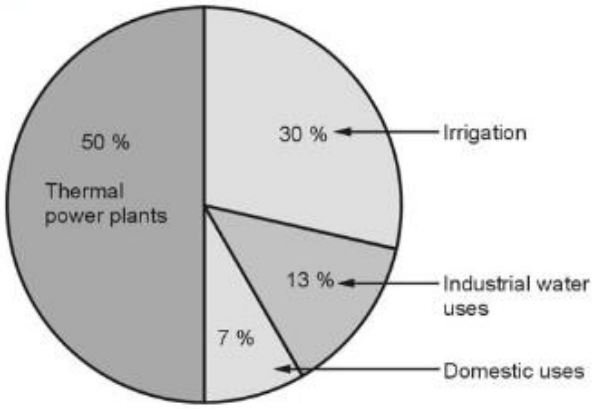


Fig. 1.2.3 Major use of fresh water

The major problem with global water supply is it's non-uniform distribution, since people in areas with low precipitation often consume more than people in regions with more rainfall.

3. Lithosphere :

- The **lithosphere** is the solid shell of the planet Earth. That means the crust, plus the part of the upper mantle that behaves elastically on long time scales.
- Under the lithosphere is the asthenosphere, the weaker, hotter, and deeper part of the upper mantle. This part can flow.
- The lithosphere provides a conductive lid atop the convecting mantle: it reduces heat transport through the Earth, A lithosphere is the rigid, outermost shell of a terrestrial-type planet or natural satellite that is defined by its rigid mechanical properties. On Earth, it is composed of the crust and the portion of the upper mantle that behaves elastically on time scales of thousands of years or greater. The outermost shell of a rocky planet, the crust, is defined on the basis of its chemistry and mineralogy.

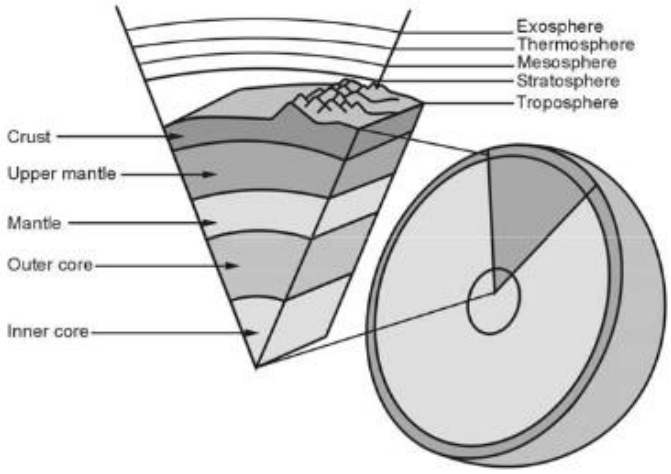


Fig. 1.2.4 Layers of Earth

Types of lithosphere :

1. Oceanic lithosphere, which is associated with oceanic crust and exists in the ocean basins. Oceanic lithosphere is typically about 50–100 km thick
2. Continental lithosphere, which is associated with continental crust. Continental lithosphere has a range in thickness from about 40 km to perhaps 200 km, of which about 40 km is crust.

4. Biosphere :

- The biosphere is the global ecological system integrating all living beings and their relationships, including their interaction with the elements of the lithosphere, geosphere, hydrosphere, and atmosphere.
- In a general sense, biospheres are any closed, self-regulating systems containing ecosystems.

1.3 Environmental Issue – Greenhouse Effect, Climate Change, Global Warming, Acid Rain, Ozone Layer Depletion and Nuclear Accident

Our Mother Earth is currently facing lot of environmental concerns. The environmental problems like global warming, acid rain, air pollution, urban sprawl, waste disposal, ozone layer depletion, water pollution, climate change and many more affect every human, animal and nation on this planet. Over the last few decades, the exploitation of our planet and degradation of our environment have gone up at an alarming rate. As our actions have been not in favor of protecting this planet, we have seen natural disasters striking us more often in the form of flash floods, tsunamis and cyclones.

1. Greenhouse effect :

- The greenhouse effect is a natural process that warms the Earth's surface. When the Sun's energy reaches the Earth's atmosphere, some of it is reflected back to space and the rest is absorbed and re-radiated by greenhouse gases.

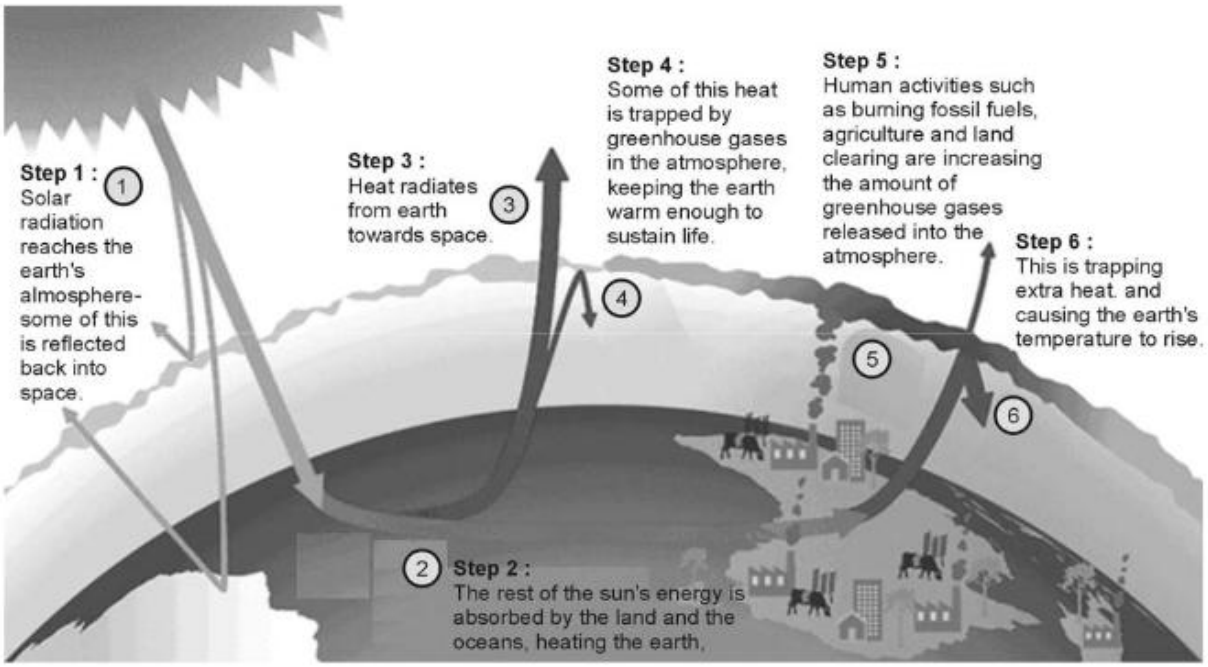


Fig 1.3.1 Greenhouse effect

- Greenhouse gases include water vapour, carbon dioxide, methane, nitrous oxide, ozone and some artificial chemicals such as chlorofluorocarbons (CFCs).
- The absorbed energy warms the atmosphere and the surface of the Earth. This process maintains the Earth's temperature at around 33 degrees Celsius warmer than it would otherwise be, allowing life on Earth to exist.
- The problem we now face is that human activities – particularly burning fossil fuels (coal, oil and natural gas), agriculture and land clearing – are increasing the concentrations of greenhouse gases.

Step 1 : Solar radiation reaches the Earth's atmosphere - some of this is reflected back into space.

Step 2 : The rest of the sun's energy is absorbed by the land and the oceans, heating the Earth.

Step 3 : Heat radiates from Earth towards space.

Step 4 : Some of this heat is trapped by greenhouse gases in the atmosphere, keeping the Earth warm enough to sustain life.

Step 5 : Human activities such as burning fossil fuels, agriculture and land clearing are increasing the amount of greenhouse gases released into the atmosphere.

Step 6 : This is trapping extra heat, and causing the Earth's temperature to rise.

2. **Climate change :** Climate change has emerged as the most pressing global challenge of the 21st century. There is today an increasing understanding that climate change transcends political boundaries and affects the whole global population, making them stakeholders to the solutions too. However, despite the ubiquity of climate change, its more immediate impacts are felt differently by different groups of people. Developing countries, with their low adaptive capacities and high dependence on climatic variables, are highly susceptible to climate-induced tragedies.

a) Rising Concentrations : The effect is that the atmosphere retains more of the Sun's heat, warming the Earth's surface. While the pattern of future warming is very much open to debate, it is indisputable that the surface of the Earth has warmed, on average, 0.3 to 0.6 °C since the late 19th century when reliable temperature measurements began. Under the existing scenarios of economic growth and development leading to greenhouse gas emissions, on a worldwide average, temperatures would rise by 1 to 3.5 °C by the year 2100, and global mean sea level by about 15 to 95 cm.

b) **Extreme Weather Events :** In addition, most of the ill effects of climate change are linked to extreme weather events, such as hot or cold spells of temperature, or wet or dry spells of rainfall, or cyclones and floods. Predictions of the nature and distributions of such events in a changed climate are even more uncertain- to the extent that virtually no authoritative predictions exist at all. While there are costs as well as benefits associated with climate change, the scientific consensus is clearly that the overall effects are likely to pose a significant burden on the global community.

3. **Global Warming :** ***Global warming is the phenomenon of increasing average air temperatures near the surface of Earth over the past one to two centuries.***

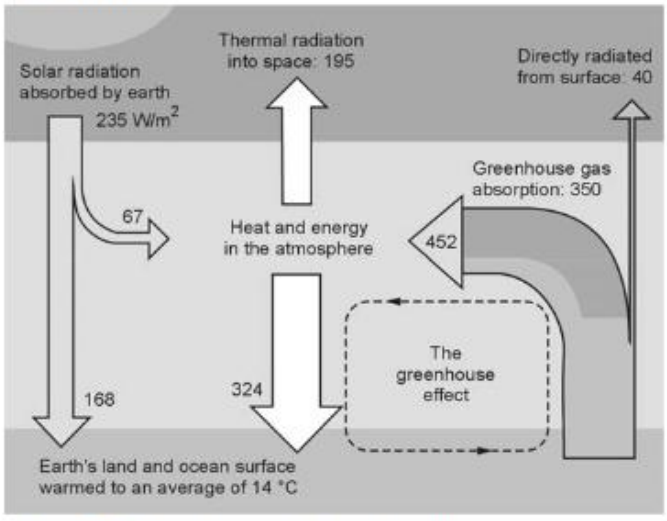


Fig. 1.3.2 Greenhouse effect schematic showing energy flow between space, the atmosphere and earth surface

Greenhouse gases trap heat radiating from Earth to space.This heat, in the form of infrared radiation, gets absorbed and emitted by these gases in the planet's atmosphere warming the lower atmosphere and the surface.

The major greenhouse gases are water vapour, which causes about 36 - 70 % of the greenhouse effect; carbon dioxide (CO_2), which causes 9 - 26 %; methane (CH_4), which causes 4 - 9 %; and ozone (O_3), which causes 3 - 7 %.

a) Causes of global warming -

- **Carbondioxide (CO_2) :** Carbondioxide is also a gas that traps heat. Although it is the weakest greenhouse gas among those listed here, it is by far the most produced. Burning of wood, gas and use of oil and other materials in factories produce this gas, which has increased in amount by 30% in the last 150 years and is perhaps currently the greatest threat as a greenhouse gas
- **Methane :** Methane is second most important. Methane has half the warming effect of CO_2. Levels of atmosphere methane have risen 145 % in the last 100 years. Methane is derived from sources such as rice paddies, bovine flatulence, bacteria in bogs and fossil fuel production.
- **Nitrous Oxide :** Another greenhouse gas is nitrous oxide (N_20), colorless, non-flammable gas with sweetish odour, commonly known as laughing gas, and sometimes used as an anaesthetic. Nitrous oxide is naturally produced by oceans and rainforests. Man-made sources of nitrous oxide include nitric acid production, the use of fertilizers in agriculture, cars with catalytic converters and the burning of organic matter. Nitrous Oxide broken down in the atmosphere by chemical reactions that involve sunlight.
- **Sulfur Hexafluoride (SF_6) :** This is a potent gas that may be found in insulation, circuit breaking and other electrical equipment, and even air soled sneakers. It is also used to melt magnesium and in loudspeakers. The problem with this gas arises when it is released from such products. Having the thermal energy-trapping potential (EPA) of 25,000 times that of carbon dioxide, its portion in the atmosphere is increasing at the rate of 8 % per year
- **Chlorofluorocarbons :** These are gases often used for aerosols in the past and linger in the sphere, trapping heat. They were banned by the United States for this purpose 10 Chlorofluorocarbons (CFCs) also threaten to react with and deplete the con which protects the Earth from harmful solar radiation.
- **Nitrous Oxide (N_2O) :** This is a gas found naturally in soil and natural bodies of water. Although this is beneficial amount of nitrous oxide, use of this gas in fertilizers and manufacturing has increased its amount in the atmosphere.

b) Effects of Global Warming :

- There will be a warming of the Earth's surface and lower atmosphere and cooling of stratosphere.
- The warming trend over the earth's surface is varied. Warming in the tropies is smaller than the global mean by about 2°C-30°C, depending on seasonal changes, while in other latitudes the average warming might account for 5°C-10°C increase in temperatures.
- Precipitation patterns will be changed. Some areas will become wetter and some areas dryer.
- Seasonal patterns will change due to the changing of temperature and precipitation patterns
- Soil moisture regimes will be changed due to the changes in evaporation and precipitation
- With the decrease in cloud cover over Eurasia in summer-which will enhance the solar heating of the surface and increase the land-sea temperature contrast tropical monsoons will be driven with more severity and intensity.
- Wind direction and wind stress over the sea surface will be changed , which will alter ocean currents and cause change in nutrients mixing zones and productivity of oceans .

4. Acid Rain : ***Acid rain is a rain or any other form of precipitation that is unusually acidic, meaning that it has elevated levels of hydrogen ions. It can have harmful effects on plants, aquatic animals and infrastructure. Phenomenon of acid rain discovered by Rober Angus Smith.***

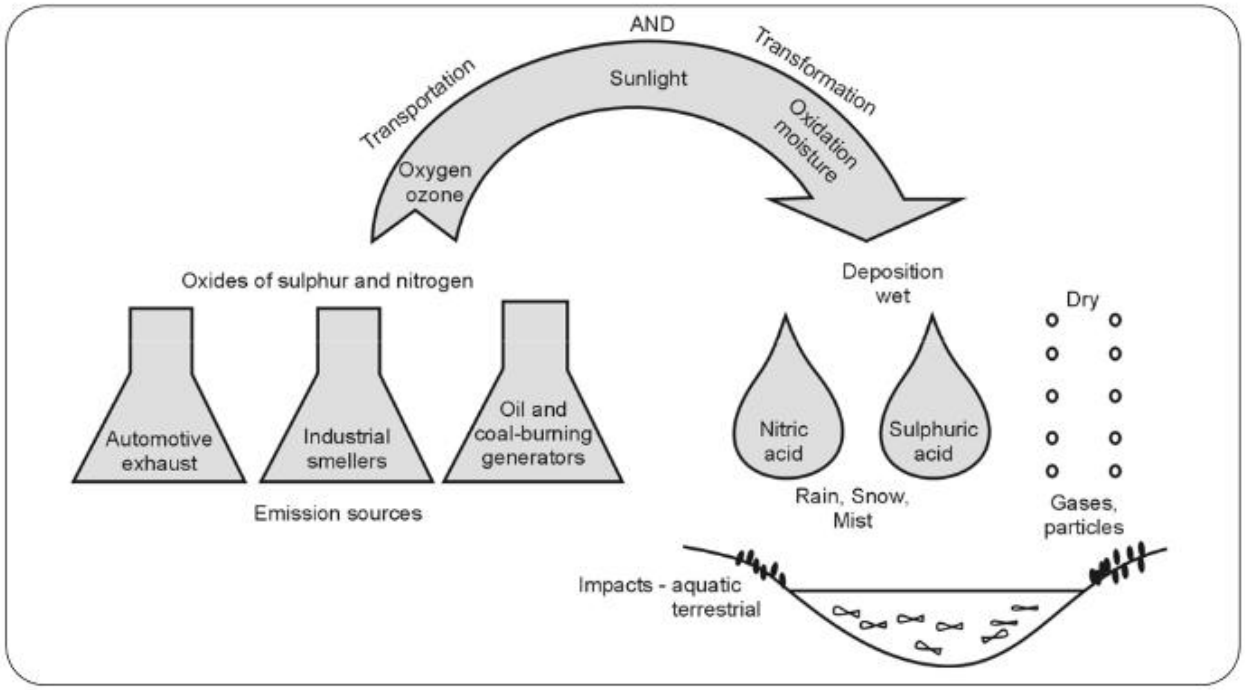


Fig 1.3.3 : The origin of acid rain deposition

- Unpolluted rain is already slightly acidic because of the presence in air of carbon dioxide, which combines with water to form carbonic acid. This rain has a pH value of 5.6, However, rain is seldom unpolluted. When rain is contaminated with sulphuric and nitric acids the pH falls below 5 .6. This is what we refer to as acid rain.
- Acid rain is caused by emissions of **sulphur dioxide** and **nitrogen oxide**, which react with the water molecules in the atmosphere to produce acids.
- In wet deposition, acidic pollutants are deposited by snow, fog and mist, as well as rain. They may also be deposited directly from the atmosphere as gases or particles without any association with precipitation.
- This is called dry deposition. Thus, while the term acid rain will do for general reference to the problem, more precise terms for this form of pollution are acidic precipitation, or, more generally, acidic deposition.
- In some areas wet and dry deposition of acids are about equal. In Newfoundland, however, there is about six times as much wet deposition as dry deposition.

Effect of acid rain :

- Acid rain makes waters acidic, and causes them to absorb the aluminum that makes its way from soil into lakes and streams. This combination makes waters toxic to crayfish, clams, fish, and other aquatic animals.
- Acid rain also damages forests, especially those at higher elevations. It robs the soil of essential nutrients and releases aluminum in the soil, which makes it hard for trees to take up water. Trees' leaves and needles are also harmed by acids.
- The effects of acid rain, combined with other environmental stressors, leave trees and plants less able to withstand cold temperatures, insects, and disease.

5. **Ozone depletion :** In 1913, Henri Buisson and Charles Fabry discovered the ozone layer and later its properties were studied by G.M.B. Dobson. ***Ozone depletion is a major environmental problem because it increases the amount of ultraviolet (UV) radiation that reaches Earth's surface, which increases the rate of skin cancer, eye cataracts, and genetic and immune system damage.***

- The main cause of ozone depletion and the ozone hole is manufactured chemicals, especially manufactured halocarbon refrigerants, solvents, propellants and foam-blowing agents (chlorofluorocarbons (CFCs), HCFCs, halons), referred to as ozone-depleting substances (ODS).
- These compounds are transported into the stratosphere by the winds after being emitted from the surface.
- Once in the stratosphere, they release halogen atoms through photodissociation, which catalyze the breakdown of ozone (O_3) into oxygen (O_2). Both types of ozone depletion were observed to increase as emissions of halocarbons increased.
- Ozone depletion and the ozone hole have generated worldwide concern over increased cancer risks and other negative effects.
- The ozone layer prevents most harmful UVB wavelengths of ultraviolet light (UV light) from passing through the Earth's atmosphere.
- These wavelengths cause skin cancer, sunburn and cataracts, which were projected to increase dramatically as a result of thinning ozone, as well as harming plants and animals.

6. Nuclear Accidents : Nuclear energy was developed by man as an alternate source of clean and cheap energy when compared to fossil fuels. Along with the benefits of nuclear energy there have been a number of accidents which harm many lives. Nuclear energy can be both beneficial and harmful, depending on the way in which it is used. For example X-rays which are used to examine bone fracture is useful. Nuclear bombs are harmful for both organisms and environment. The first nuclear bomb bombard to the twin cities of Japan Hiroshima and Nagasaki. The devastation that nuclear bombs caused to Hiroshima and Nagasaki is terrible. The radioactive waste from nuclear energy has caused, and continues to cause serious environmental damages. The first controlled fission of an atom was carried out in Germany in 1938. Nuclear fission is the splitting of the nucleus of the atom. A nuclear is defined by the International Atomic Energy Agency (IAEA) as ***"An event that has led to significant consequences to people, the environment or the facility."*** Examples include lethal effects to individuals, radioactive isotope to the environment, or reactor core melt." The prime example of a "major nuclear accident" is one in which a reactor core is damaged and significant amounts of radioactive isotopes are released, such as in the Chernobyl disaster in 1986.

Types of nuclear accidents :

a) Nuclear meltdown : A nuclear meltdown is a severe nuclear reactor accident that results in reactor core damage from overheating. It has been defined as the accidental melting of the core of a nuclear reactor, and refers to the core's either complete or partial collapse. A core melt accident occurs when the heat generated by a nuclear reactor exceeds the heat removed by the cooling systems to the point where at least one nuclear fuel element exceeds its melting point.

b) Criticality accidents : A criticality accident occurs when a nuclear chain reaction is accidentally allowed to occur in fissile material, such as enriched uranium or plutonium. The reactor was supposed to be in a controlled critical state, but control of the chain reaction was lost. The accident destroyed the reactor and left a large geographic area uninhabitable.

c) Decay heat : Decay heat accidents are where the heat generated by the radioactive decay causes harm. In a large nuclear reactor, a loss of coolant accident can damage the core: for example, at Three Mile Island a recently shutdown PWR reactor was left for a length of time without cooling water. As a result, the nuclear fuel was damaged, and the core partially melted. The removal of the decay heat is a significant reactor safety concern, especially shortly after shutdown. Failure to remove decay heat may cause the reactor core temperature to rise to dangerous levels and has caused nuclear accidents.

d) Equipment failure : Equipment failure is one possible type of accident. A related cause of accidents is failure of control software.

e) **Human error :** Many of the major nuclear accidents have been directly attributable to operator or human error. Two types of mistakes were deemed most serious: errors committed during field operations, such as maintenance and testing, that can cause an accident; and human errors made during small accidents that cascade to complete failure.

1.4 Concept of 4R (Reduce, Reuse, Recycle and Recover)

1. **Reduce :** Minimizing the consumption of raw material true improvement in the design the products may allow a significant reduction in the design of products and in the amount of waste generated when the reached through end of the life cycle.

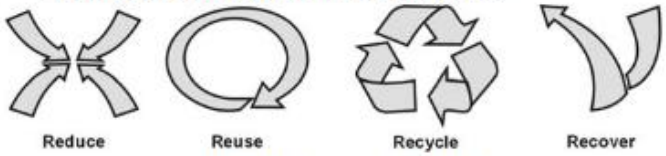


Fig. 1.4.1 Concept of 4R

2. **Reuse :** This is mainly applied to packaging goods been defined as any operation by which the packaging items are refilled or used for the same purpose for which they were made with or without the support of auxiliary products. Consumer and industries encourage promoting the reuse of Goods and packaging instead of disposal. This option can be applied for container such as bottles, bags, etc.
3. **Recycle :** This allows the waste to be reintroduced into the consumption cycle Generally and secondary applications because in many cases the recycle products of lower quality then the virgin ones. The recycling must be applied only when the amount of energy consumed in the recycling process is lower than the energy required for the production of new materials. Plastics can be recycled by using two different approaches Mechanical Recycling, Feedstock recycling.
4. **Recovery :** When the recycling of waste is not feasible or there is no market for the recycle product incarnation can be used to generate energy from the waste combustion heat. Alternatively they can be used as fuel in number of applications like power plants, Industrial furnaces and cement industries.

1.5 Public Awareness about Environment.

- Public awareness of the environment means the ability to emotionally understand the surrounding world, including the laws of the natural environment, sensitivity to all the changes occurring in the environment
- Understanding of cause-and-effect relationships between the quality of the environment and human behavior, an understanding of how the environment works as a system, and a sense of responsibility for the common heritage of the Earth, such as natural resources - with the aim of preserving them for future generations.
- To know and understand what is good and what is better, and at the same time commit a wrong doing, is socially more injurious than committing a wrong doing in ignorance. Therefore, building, in a society, a new system of values with the aim of creating environmental public awareness.
- Environmental public awareness comes from a result of general knowledge, specialist knowledge of a particular problem and also sensitivity to, and a sense of, responsibility for the environment.
- Environmental public awareness is shaped throughout the whole life of particular people living in a given local community, performing specific work and having definite personal characteristics which have a deciding effect on their sense of responsibility and ability to emotionally perceive the environment as having value in itself.

Multiple Choice Questions

Q.1 Environmental education is important only at ____.

a primary school stage

b secondary school stage

c collage stage

d all stages

Q.2 Biosphere is _____

a The solid shell of inorganic materials on the surface of the Earth

b The thin shell of organic matter on the surface of earth comprising of all the living things

c The sphere which occupies the maximum volume of all the spheres

d All of the above

Q.3 Which of the following is not influenced by human activities ?

a Depletion of ground water

b Destruction of mangroves and wetlands

c Increased extinction rate of species

d None of the above

Q.4 Which of the following conceptual sphere of the environment is having the least storage capacity for matter ?

a Atmosphere b Lithosphere

c Hydrosphere d Biosphere

Q.5 The largest reservoir of nitrogen an our planet is :

a Ocean b Atmosphere

c Biosphere d Fossil fuels

Q.6 The world Environment derived from French word

a Environ b Environnering

c E – Environner d Envo

Q.7 _____ is greenhouse gas.

a CO_2 b H_2S

c N_2 d None of the above

Q.8 _____ cause acid rain .

a CO_2 b SO_2

c N_2 d None of the above

Q.9 Ozone depletion is harmful to ____.

a Digestion b Reproduction

c Skin d None of the above

Q.10 All the environment crisis are solely due to ____.

a Population b Water Quality

c Air Quality d None of the above

Q.11 The environment consists of various segments such as Atmosphere, hydrosphere, lithosphere and _____

a Hemisphere b O_2 sphere

c Soil sphere d Biosphere

Q.12 The _____is the protective blanket of gases which is surrounding the earth. It protects the earth from the hostile environment of outer space.

a Hemisphere b Atmosphere

c Lithosphere d Biosphere

Q.13 _____ of the total water supply is available as fresh water in the form of rivers, lakes, streams and ground water for human consumption and other uses.

a 1 % b 2 %

c 3 % d 4 %

Q.14 The lithosphere consists of upper mantle and the _____

a atmosphere b crust

c thrust d none of the above

Q.15 Atmosphere allows transmission of significant amounts of radiation only in the regions of ____

a 100 –200 nm b 200 –500 nm

c 300 –2500 nm d None of the above

Q.16 Atmosphere acts as a source for __for plant photosynthesis and _____ for respiration.

a O_2 and CO_2 b CO_2 and N_2

c NO_2 and CO_2 d CO_2 and O_2

Q.17 _____ acts as a source for nitrogen for nitrogen fixing bacteria and ammonia producing plants.

a Atmosphere b Lithosphere

c Hydrosphere d Nanosphere

Q.18 The _____ is a collective term given to all different forms of water.

a Atmosphere b Lithosphere

c Hydrosphere d Nanosphere

Q.19 The _____ refers to the kingdom of living organisms and their interactions with the environment

a Atmosphere b Lithosphere
c Hydrosphere d Biosphere

Q.20 The biosphere is very large and complex and is divided into smaller units called _____.

a Organisms b Ecosystems
c Module d None of these

Q.21 _____ is a natural process that warms the Earth's surface.

a Greenhouse effect b Global warming
c Deforestation d None of these

Q.22 How is the greenhouse effect experienced on earth ?

a Global worming b Pollution
c Both a. and b d None of the above

Q.23 Which of the following gases is/are responsible for global warming ?

a Carbon dioxide (CO_2) b Water vapour (H_2O)
c Both a. and b. d None of the above

Q.24 In desert areas, there is large difference between day and night temperatures mainly because of

a Presence of carbon dioxide in air as it acts as barrier for emanating infrared radiation from the earth surface
b Presence of water vapour in air as it acts as barrier for emanating infrared radiation from the earth surface
c Absence of carbon dioxide in air as it acts as barrier for emanating infrared radiation from the earth surface
d Absence of water vapour in air as it acts as barrier for emanating infrared radiation from the earth surface

Q.25 The radiation energy from the sun is produced by

a Fission reaction b Fusion reaction
c Both a. and b. d None of the above

Q.26 Which of the following mentioned GHGs has the highest atmospheric lifetime ?

a Carbon tetrafluoride b Nitrous oxide
c Methane d CFC

Q.27 Which of the following greenhouse gas is contributed by cattle farming ?

a Nitrous oxide b Methane
c Carbon monoxide d All of the mentioned

Q.28 Volcanic eruptions contribute to the global greenhouse phenomenon.

a True b False

Q.29 Gas molecules that absorb thermal infrared radiation and are present in large quantity to change climate system are known as

a alpha radiations b beta radiations
c ozone gases d greenhouse gases

Q.30 Greenhouse gases which is present in very high quantity is

a Propane b Ethane
c Carbon dioxide d Methane

Q.31 Exchange of outgoing and incoming radiations that keeps Earth warm is known as

a Greenhouse effect b Radiation effect
c Infrared effect d Ozone layer depletion

Q.32 Wavelength of infrared radiations is

a Greenhouse effect b Radiation effect
c Infrared effect d Ozone layer depletion

Q.33 Greenhouse gases effect on earth's atmosphere is increased by

a CFCs (chlorofluorocarbons)
b air conditioners
c perfumes
d burning fossil fuels

Q.34 If atmosphere doesn't act like greenhouse, temperature of earth would become _____.

a too pleasant to enjoy b too cold to survive
c too hot to survive d too terrible to survive

Q.35 Waves that pass through glass walls of greenhouse are in form of

a gamma rays b x-rays
c infrared waves d radio waves

Q.36 Global warming effects

a forests around the globe
b temperature of the globe
c wind and moisture of the globe
d water around the globe

Q.37 The gases that contribute to the greenhouse effect on Earth are, in order of greatest to smallest in importance,

a CO_2, H_2O, CH_4 b H_2O, CO_2, CH_4
c CH_4, CO_2, H_2O d H_2O, CH_4, CO_2

Q.38 The order of the atmospheric layers, starting from closest to the surface to the top of the atmosphere, is

a Mesosphere, Troposphere, Thermosphere, Stratosphere
b Troposphere, Stratosphere, Mesosphere, Thermosphere
c Thermosphere, Mesophere, Troposphere, Stratosphere
d Troposphere, Mesosphere, Stratosphere, Thermosphere

Q.39 By how much has atmospheric carbon dioxide concentration increased ever since the Industrial Revolution ?

a 20 % b 10 %
c 40 % d 60 %

Q.40 Which is the most abundant greenhouse gas in the atmosphere ?

a Carbon dioxide b Water vapour
c Methane d Nitrogen

Q.41 Which of the following is the largest sink for carbon dioxide gas ?

a Forests b Oceans
c Ice sheets d Grasslands

Q.42 Apart from Earth, which other celestial body(s) exhibits greenhouse gas effect ?

a Venus b Mars
c Titan d All of the mentioned

Q.43 Which of the following radiations of the sun do greenhouse gases trap ?

a Visible radiations b Infrared radiations
c UV radiations d All the radiations

Q.44 Clouds help in cooling down the planet and do not contribute to greenhouse effect. True or false ?

a True b False

Q.45 What does GWP in the context of greenhouse gases indicate ?

a Global Warming Parameters
b Gradual Warming Pattern
c Global Warming Patterns
d Global Warming Potential

Q.46 At what concentration (in ppm), is nitrogen present in the atmosphere ?

a 780,840 b 390,420
c 78,084 d 900,000

Q.47 The planetary boundary layer belongs to which of the following atmospheric layers ?

a Exosphere
b Ionosphere
c Stratosphere
d None of the mentioned

Q.48 What would have been the average temperature of Earth without greenhouse gases ?

a 0 °C b – 7 °C
c – 9 °C d – 19 °C

Q.49 Ever since the industrial revolution, by how much has the average temperature of the Earth increased ?

a 0.24 °C b 0.6 °C
c 1.2 °5C d 1.8 °C

Q.50 How much of the sun's radiation energy is absorbed by the greenhouse gases to warm the planet ?

a 75 PW b 1750 GW
c 1500 MW d 150 TW

Q.51 What is the emissivity of the Earth's surface ?

a 0.457 b 0.578
c 0.135 d 1.42

Q.52 The Earth is still said to be in the "ice age" period.

a True b False

Q.53 Below which of the following pH is rain regarded as 'acid rain' ?

a 7 b 7.3
c 5.6 d 6

Q.54 Glass containers are generally not preferred for sampling rain water. Why ?

a Glass containers are expensive
b Glass containers are not easy to maintain
c Glass containers affect the pH of the rain water
d All of the mentioned

Q.55 Which of the following gases are main contributors to acid rain ?

a Carbon dioxide and carbon monoxide
b Sulphur dioxide and carbon dioxide
c Sulphur dioxide and nitrogen dioxide
d Sulphur dioxide and nitrous oxide

Q.56 Which place in India receives the highest annual rainfall ?

a Mawsynram b Cherrapunji
c Siju d Phyllut

Q.57 Who discovered the phenomenon of acid rain ?

a George Brown b James T. Stewart
c Robert Angus Smith d Charles David

Q.58 Which of the following is/are natural contributor(s) to sulphur dioxide in the atmosphere ?

a Sea sprays b All of the mentioned
c Decaying vegetation d Volcanic eruption

Q.59 What is the pH required for the survival of aquatic animals and plants ?

a 7 b 7.5
c 6.5 d 4.8

Q.60 The acidic air pollutants reach the Earth's surface because of wet deposition only.

a True b False

Q.61 Which of the following gases is responsible for the yellowing of the Taj Mahal ?

a Organic carbon b Black carbon
c Brown carbon d All of the mentioned

Q.62 What is the average concentration of ozone in the ozone layer of the atmosphere ?

a Nearly 100 % b Greater than 90 %
c Between 10-50 % d Less than 10 ppm

Q.63 Who discovered the ozone layer ?

a Henri Buisson & Charles Fabry
b Carl Sagan & Charles Fabry
c G.M.B Dobson
d Carl Sagan &G.M.B Dobson

Q.64 Which of the following devices can be used to measure ozone in the stratosphere from the ground ?

a Spectrometer b Photometer
c Spectrophotometer d Spectro-ozonometer

Q.65 The ozone layer absorbs what range of wavelengths of the sun's radiation ?

a 0.80 nm – 1.50 nm b 200 nm – 315 nm
c 450 nm – 570 nm d 600 nm – 750 nm

Q.66 Who discovered the formation of ozone from photochemical reactions ?

a G.M.B Dobson b Sydney Chapman
c Carl Sagan d Henri Buisson

Q.67 Between what altitudes, is the ozone layer found in highest concentrations ?

a 10-20 km b 20-40 km
c 40-55 km d 55-70 km

Q.68 Nitrogen also helps in preventing UV rays from reaching the Earth.

a True b False

Q.69 Which of the following UV radiations is responsible for causing sun burns and skin cancer ?

a UV-A b UV-B

c UV-C d All of the mentioned

Q.70 The long UV-B radiations are important for vitamin D production of the skin.

a True b False

Q.71 In which season is the ozone found at its maximum level in the northern hemisphere ?

a Winter b Summer

c Spring d Autumn

Q.72 When was the ozone hole discovered ?

a 1974 b 1964

c 1994 d 1984

Q.73 The ozone hole is a phenomenon that has occurred in :

a Arctic region

b Northern temperate region

c Southern temperate region

d None of the mentioned

Q.74 Which of the following chemicals are responsible for the depletion of the stratospheric ozone layer ?

a Refrigerants b Propellants

c Foam-blowing agents d All of the mentioned

Q.75 What does EESC stand for in context of ozone depleting compounds ?

a Equivalent Effective Stratospheric Chlorine

b Equivalent Effective Stratospheric Chlorofluorocarbons

c Equivalent Energy Saving Compounds

d Energy Effective Stratospheric Compounds

Q.76 The Montreal Protocol bans the production of which of the following chemical substances ?

a Chlorine, bromine, CFCs, freons

b Carbon tetrachloride, halons, trichloroethane, CFCs

c CFCs, bromine, halons, freons

d CFCs, halons, freons

Q.77 Where was the first use of nuclear bombs which cause death to the millions of lives ?

a Karachi

b Melbourne and Sydney

c Hiroshima and Nagasaki

d Tokyo

Q.78 Where was the first control fission of an atom carried out ?

a India b Japan

c Russia d Germany

Q.79 Which was the first country to develop atomic bomb ?

a Russia b United States

c China d Japan

Q.80 State true or false. Nuclear energy is only harmful.

a True b False

Q.81 _____ defined as the accidental melting of the core of a nuclear reactor, and refers to the core's either complete or partial collapse

a Nuclear meltdown b Decay heat

c Human error d None of these

Q.82 Which of the following is not cause of Nuclear accident _____

a Nuclear meltdown b Decay heat

c Human error d Volcanic eruption

Q.83 Which State in India nuclear accident took place ?

a Tamil Nadu b Karnataka

c Gujarat d Rajasthan

Q.84 Which one of the following medical condition caused by the high exposure of radiation ?

a Kidney stone b AIDS

c Mutation d Blood pressure

Q.85 What is the main purpose of nuclear energy ?

a To kill the enemy nation

b To waste the excessive energy

c To use it as an alternate source of energy

d To cause mutation for people who are working

Q.86 Approximately how many percentage of electricity produced by nuclear power in the world ?

a 10 b 14

c 17 d 20

Q.87 Which is the main source of nuclear radiations ?

a Nuclear power plant b Sunlight

c Atmospheric air d Volcanoes

Q.88 Which radioactive cause cancer in thyroid gland ?

a U-235 b U-238

c I-132 d C-12

Q.89 State true or false. The use of nuclear energy in war had devastating effects on humans and on the earth.

a True b False

Q.90 What does it mean to reduce ?

a Use something over and over again.

b Use less of something, creating smaller amounts of waste.

c Make something into something new.

d Make something ugly into something beautiful.

Q.91 Reducing, Reusing, and Recycling make the Earth cleaner.

a True b False

Q.92 What does it mean to reuse ?

a Cleaning up a mess.

b Make something into something new.

c Use less of something, creating smaller amounts of waste.

d Use something over and over again.

Q.93 Recycling is something only adults can do.

a True b False

Q.94 Which of the following is NOT a recyclable material ?

a Paper b Plastic

c Food d Metal

Q.95 Plastic bags are better for the environment than reusable bags.

a True b False

Q.96 You can reduce your water usage by shutting off the water while you brush your teeth and taking shorter showers.

a True b False

Q.97 Which of the following is bad for the environment ?

a Recycling b Littering

c Reducing d Reusing

Q.98 No garbage can be recycled.

a True b False

Q.99 How much energy could 1 recycled tin can save ?

a Enough to power a cell phone for 18 hours.

b Enough to power a TV for 3 hours.

c Enough to power a TV for 8 hours.

d None of these

Q.100 It takes more energy to create paper than it does to recycle paper.

a True b False

Q.101 The human activity, among the following, which causes maximum environmental pollution having regional and global impact, is

a Industrialization b Urbanization

c Agriculture d None of these

Q.102 Objective of environmental studies is to

a Create environmental ethics that foster awareness about the ecological inter - dependence of economic, social and political factors in a human community and the environment

b Acquiring skills to help the concerned individuals in identifying and solving environmental problems

c Raise consciousness about environmental conditions

d All of the above

Q.103 The perfect equilibrium existing in the biosphere between the various organisms is known as

a Ecological cycle

b Ecological balance

c Environmental balance d None of these

Q.104 Word "Environment" is derived from :

a French b English

c German d Italy

Q.105 'World Environmental Day' is celebrated every year on :

a 5 July b 5 June

c 5 August d 18 June

Q.106 'Earth's Day' is celebrated every year on :

a 22 July b 13 June

c 13 August d 22 April

Q.107 Reducing the amount of future climate change is called :

a Mitigation b Geo- engineering

c Adaptation d None of these

Q.108 Climate represents _____

a The long-term average weather and its statistical variation for a given region

b Weather averaged over a year

c It is a measure of variations in the amount of precipitation

d None of the above

Q.109 Energy sources that do not increase carbon emissions include –

a Solar cells b Wind mills

c Nuclear power plants d All of the above

Q.110 How does climate change (global warming) affect human health ?

a By increasing illnesses such as heat stress , cardiovascular disease and kidney disease

b By increasing respiratory illnesses such as asthma and allergies

c By increasing insect borne infections such as dengue fever

d All of the above

Q.111 _____ is the artificial modification of Earth's climate systems through two primary ideologies, Solar Radiation Management (SRM) and Carbon Dioxide Removal (CDR).

a Adaptation b Geo- engineering

c Synchronization d Mitigation

Answer Keys for Multiple Choice Questions

Q.1	d	**Q.2**	d	**Q.3**	d
Q.4	a	**Q.5**	b	**Q.6**	a
Q.7	a	**Q.8**	b	**Q.9**	c
Q.10	a	**Q.11**	d	**Q.12**	b
Q.13	a	**Q.14**	b	**Q.15**	c
Q.16	d	**Q.17**	a	**Q.18**	c
Q.19	d	**Q.20**	b	**Q.21**	a
Q.22	a	**Q.23**	c	**Q.24**	d
Q.25	b	**Q.26**	a	**Q.27**	b
Q.28.	b	**Q.29**	d	**Q.30**	c
Q.31	a	**Q.32**	d	**Q.33**	d
Q.34	b	**Q.35**	c	**Q.36**	c
Q.37	b	**Q.38**	b	**Q.39**	c
Q.40	b	**Q.41**	b	**Q.42**	d
Q.43	b	**Q.44**	b	**Q.45**	d
Q.46	a	**Q.47**	d	**Q.48**	d
Q.49	b	**Q.50**	a	**Q.51**	a
Q.52	a	**Q.53**	c	**Q.54**	c
Q.55	d	**Q.56**	a	**Q.57**	c
Q.58	b	**Q.59**	d	**Q.60**	b
Q.61	d	**Q.62**	d	**Q.63**	a
Q.64	c	**Q.65**	b	**Q.66**	a

Q.67	b	**Q.68**	a	**Q.69**	b
Q.70	a	**Q.71**	c	**Q.72**	d
Q.73	d	**Q.74**	d	**Q.75**	a
Q.76	b	**Q.77**	c	**Q.78**	d
Q.79	b	**Q.80**	b	**Q.81**	a
Q.82	d	**Q.83**	a	**Q.84**	c
Q.85	c	**Q.86**	c	**Q.87**	a
Q.88	c	**Q.89**	a	**Q.90**	b
Q.91	a	**Q.92**	d	**Q.93**	b
Q.94	c	**Q.95**	b	**Q.96**	a
Q.97	b	**Q.98**	b	**Q.99**	b
Q.100	a	**Q.101**	a	**Q.102**	d
Q.103	b	**Q.104**	a	**Q.105**	b
Q.106	d	**Q.107**	a	**Q.108**	a
Q.109	c	**Q.110**	d	**Q.111**	b

❑❑❑

UNIT - II

2 Energy Resources

Introduction

Natural resources are materials and components (something that can be used) that can be found within the environment. Every man-made product is composed of natural resources (at its fundamental level). A natural resource may exist as a separate entity such as fresh water, air, as well as a living organism such as a fish, or it may exist in an alternate form that must be processed to obtain the resource such as metal ores, rare earth metals, petroleum and most forms of energy.

Biotic Natural Resources

Examples of biotic natural resources :

- Birds
- Ferns
- Flowering plants
- Fruits
- Fungi
- Insects
- Lichens
- Mammals
- Microbes
- Mosses
- Natural gas
- Petroleum
- Reptiles
- Shrubs
- Trees
- Worms

Biotic Resources Grown as Crops

- Basil
- Bay
- Brussels sprouts
- Carrot
- Catnip
- Cauliflower
- Celery
- Cotton
- Corn
- Garlic
- Oat
- Okra
- Parsley
- Peanuts
- Peas
- Rice
- Rye
- Sorghum
- Squash
- Sugarcane
- Sunflower
- Wheat
- Zucchini

Biotic Resources in the Ocean

- Crustaceans and lobsters
- Fish
- Octopi
- Seaweed and kelp
- Shrimp
- Whales and dolphins

Abiotic Natural Resources

Here are examples of abiotic natural resources :

- Barites
- Bauxite
- Chromite
- Coal
- Copper
- Diamond
- Gravel
- Gold
- Iron ore
- Lead
- Marble
- Limestone
- Nickel
- Platinum
- Pumice
- Salt
- Sand
- Silver
- Sulfur
- Talc
- Vanadium
- Zinc

Natural Energy Resources

- Biofuels - Fuels made from plants and animals
- Geothermal energy - Energy generated from and stored in the earth
- Hydroelectric power - Water drives the turbines that produce electricity either in dams or tides
- Natural gas - This is a fossil fuel
- Nuclear energy - Created by splitting the atom
- Solar energy - The sun's rays heat solar cells that make electricity
- Wind power - The wind turn the turbines that make electricity

Natural Resources by Country

Here are examples of natural resources from select countries around the world :

Australia

- Bauxite
- Coal
- Copper
- Diamonds
- Gold Lead
- Iron ore
- Mineral sands
- Natural gas
- Nickel
- Petroleum
- Silver
- Tin
- Tungsten
- Uranium
- Zinc

Brazil

- Bauxite
- Gold
- Hydropower
- Iron ore
- Manganese
- Nickel Petroleum
- Phosphates
- Platinum
- Timber
- Tin
- Uranium

Canada

- Coal
- Copper
- Diamonds
- Fish

- Gold
- Hydropower
- Iron ore
- Lead
- Molybdenum
- Natural gas
- Nickel
- Petroleum
- Potash
- Silver
- Timber
- Wildlife
- Zinc

China

- Aluminum
- Antimony
- Coal
- Iron ore
- Lead
- Mercury
- Magnetite
- Manganese
- Molybdenum
- Natural gas
- Petroleum
- Tin
- Tungsten
- Uranium
- Vanadium
- Zinc

Egypt

- Asbestos
- Gypsum
- Iron ore
- Lead
- Limestone
- Manganese
- Natural gas
- Phosphates
- Petroleum
- Talc
- Zinc

France

- Antimony
- Arsenic
- Bauxite
- Coal
- Feldspar
- Fluorspar
- Fish
- Gypsum
- Iron ore
- Potash
- Timber
- Uranium
- Zinc

Greenland

- Coal
- Diamonds
- Fish
- Gold
- Hydropower
- Iron ore
- Lead
- Molybdenum
- Niobium
- Platinum
- Seals
- Tantalite
- Uranium
- Whales
- Zinc

India

- Arable land
- Bauxite
- Chromite
- Coal
- Diamonds
- Iron ore
- Limestone
- Manganese
- Mica
- Natural gas
- Petroleum
- Titanium ore

Italy

- Arable land
- Asbestos
- Barite
- Coal
- Feldspar
- Fish
- Fluorspar
- Marble
- Mercury
- Potash
- Pumice
- Pyrite
- Zinc

Kenya

- Diatomite
- Fluorspar
- Gemstones
- Gypsum
- Hydropower
- Limestone
- Salt
- Soda ash
- Wildlife
- Zinc

Mexico

- Copper
- Gold
- Lead
- Natural gas
- Petroleum
- Silver
- Timber
- Zinc

New Zealand

- Coal
- Gold
- Hydropower
- Iron ore
- Limestone
- Natural gas
- Sand
- Timber

Norway

- Copper
- Fish
- Hydropower
- Iron ore
- Lead
- Natural gas
- Nickel
- Petroleum
- Pyrites
- Timber
- Titanium
- Zinc

Seychelles

- Cinnamon trees
- Copra
- Fish

South Africa

- Antimony

- Chromium
- Coal
- Copper
- Gem diamonds
- Gold
- Iron ore
- Manganese
- Natural gas
- Nickel
- Phosphates
- Platinum
- Salt
- Tin
- Uranium
- Vanadium

Sri Lanka

- Clay
- Gems
- Graphite
- Hydropower
- Limestone
- Mineral sands
- Phosphates

Sweden

- Arsenic
- Copper
- Feldspar
- Gold
- Hydropower
- Iron ore
- Lead
- Silver
- Timber
- Tungsten
- Uranium
- Zinc

Thailand

- Arable land
- Fish
- Fluorite
- Gypsum
- Lead
- Lignite
- Natural gas
- Rubber
- Tantalum
- Timber
- Tin
- Tungsten

Ukraine

- Arable land
- Coal
- Graphite
- Iron ore
- Kaolin
- Magnesium
- Manganese
- Mercury
- Natural gas
- Nickel
- Oil
- Salt
- Sulfur
- Timber
- Titanium

United Kingdom

- Arable land
- Chalk
- Clay
- Coal
- Gold
- Gypsum

- Iron ore
- Lead
- Limestone
- Natural gas
- Potash
- Petroleum
- Salt
- Silica sand
- Slate
- Tin
- Zinc

United States

- Bauxite
- Coal
- Copper
- Lead
- Gold
- Iron
- Mercury
- Molybdenum
- Natural gas
- Nickel
- Petroleum
- Phosphates
- Potash
- Silver
- Timber
- Tungsten
- Uranium
- Zinc

2.1 Natural Resource - Forest Resources, Water Resources, Energy Resources, Land Resources, Mineral Resources

Forest Resources

Forest types of India

- Wet Evergreen forest.
- Semi Evergreen forest.
- Moist Deciduous forest.
- Dry Deciduous forest.
- Littoral and Swamp forest / Mangrove forest.
- Dry Evergreen forest.
- Thorn forest.
- Sub tropical broad leaved forest.

Forests are among the most diverse and widespread ecosystems on earth, and have many functions: they provide timber and other forest products; have cultural values; deliver recreation benefits and ecosystem services, including regulation of soil, air and water; are reservoirs for biodiversity; and act as carbon sinks. The forest area differs from state to state in India. Madhya Pradesh stands at the top in the total forest area, followed by the Arunachal Pradesh, Chhattisgarh, Maharashtra, and Odisha. One-fourth of the total forest covered area of the country is in the north-eastern states.

Major Causes of Deforestation

- Expansion of Agriculture
- Extension of Cultivation on Hill Slopes
- Cattle Ranching
- Firewood Collection
- Timber Harvesting
- Shifting Cultivation
- Government Policies : As discussed earlier, the policy followed by Colonial ruler and the policy of government in free India.

Water Resources

Water resources are sources of water that are useful or potentially useful to humans. It is important because it is needed for life to exist. Many uses of water include agricultural, industrial, household, recreational and environmental activities. Virtually all of these human uses require fresh water. Only 2.5 % of water on the Earth is fresh water, and over two thirds of this is frozen in glaciers and polar ice caps.

Water demand already exceeds supply in many parts of the world, and many more areas are expected to experience this imbalance in the near future. It is

estimated that 70 % of world-wide water use is for irrigation in agriculture.

Climate change will have significant impacts on water resources around the world because of the close connections between the climate and hydrologic cycle. Due to the expanding human population competition for water is growing such that many of the world's major aquifers are becoming depleted. Many pollutants threaten water supplies, but the most widespread, especially in underdeveloped countries, is the discharge of raw sewage into natural waters.

Some of the water resources are

- Drought, floods and shortage of drinking water.
- Surface and ground water storage.
- Hydro power potential.
- Rivers.
- Lakes.
- Wetlands.
- Water supply and sanitation.

Energy Resources

Energy is the capacity to do work and is required for life processes. An energy resource is something that can produce heat, power life, move objects, or produce electricity. Matter that stores energy is called a fuel.

Most of the energy we use today come from fossil fuels (stored solar energy). But fossils fuels have a disadvantage in that they are non-renewable on a human time scale, and cause other potentially harmful effects on the environment. In any event, the exploitation of all energy sources (with the possible exception of direct solar energy used for heating), ultimately rely on materials on planet Earth.

There are 5 fundamental sources of energy :

1. Nuclear fusion in the Sun (solar energy)
2. Gravity generated by the Earth and Moon.
3. Nuclear fission reactions.
4. Energy in the interior of the Earth.
5. Energy stored in chemical bonds.

Solar Energy : Solar Energy arrives from the Sun by electromagnetic radiation. It can be used directly for heat and converted to electricity for other uses. It is a nearly unlimited source, it is renewable, and largely, non-polluting.

Gravity Generated by the Earth and Moon : Gravitational pull of the Moon on the Earth causes tides. Tidal flow can be harnessed to drive turbines. This is also a nearly unlimited source of energy and is largely non-polluting.

Nuclear Fission Reactions : Radioactive Uranium is concentrated and made into fuel rods that generate large amounts of heat as a result of radioactive decay. This heat is used to turn water into steam. Expansion of the steam can then be used to drive a turbine and generate electricity

Energy in the Interior of the Earth : Decay of radioactive elements has produced heat throughout Earth history. It is this heat that causes the temperature to increase with depth in the Earth and is responsible for melting of mantle rocks to form magmas. Magmas can carry the heat upward into the crust.

Energy Stored in Chemical Bonds : Energy stored in chemical bonds drives chemical reactions. When the reactions take place this energy is either released or absorbed. If it is absorbed, it is stored in the chemical bond for later use. If it is released, it can produce useful heat energy. electricity and light.

Land Resources :

Land is a naturally occurring finite resource. It provides the base for survival of living beings. It holds everything that constitutes terrestrial ecosystems. Increased demand on land in modern times due to the rise in human population and resultant activities has resulted in degradation of land quality and quantity, decline in crop production, and competition for land.

Land and Land Resources refer to a delineable area of the earth's terrestrial surface, encompassing all attributes of the biosphere immediately above or below this surface, including those of the near-surface climate, the soil and terrain forms, the surface hydrology (including shallow lakes, rivers, marshes and swamps), the near-surface

sedimentary layers and associated groundwater and geo-hydrological reserve, the plant and animal populations, the human settlement pattern and physical results of past and present human activity (terracing, water storage or drainage structures, roads, buildings, etc.)

Mineral Resources : Mineral resources are non-renewable and include metals (e.g. iron, copper and aluminum), and non-metals (e.g. salt, gypsum, clay, sand, phosphates). Minerals are valuable natural resources being finite and non-renewable.

Types of Mineral Resources :

A) Fuel Minerals

i) Coal

ii) Crude Oil (Petroleum)

iii) Natural Gas

B) Metallic and Non-metallic Minerals

2.2 Renewable, Non-renewable Resources and Cyclic Resources

2.2.1 Renewable Resources

The resources which can be renewed and reproduced by physical, chemical or mechanical processes are known as renewable or replenishable resources. These resources are able to increase their abundance through reproduction and utilization of simple substances. Examples of such resources are- water, forests and wildlife, plants etc.

Renewable Resources can be further classified as **Living Renewable Resources** and **Non-Living Renewable Resources.**

Examples of renewable resources though they **do not have life cycle** but **can be recycled** are wood and wood-products, pulp products, natural rubber, fibers (e.g. cotton, jute, animal wool, silk and synthetic fibers) and leather.

- **Living Renewable (biological) resources** are those renewable resources which come from living (biotic) sources .
- Examples - forests, plants.
- **Non-Living Renewable resources** are those renewable resources which come from non-living (abiotic) sources like land, water, air.

  Examples - metals, minerals, wind, sun etc.

2.2.2 Non-renewable Resources

A non-renewable resource is a natural resource that is used up faster than it can be made by nature. It cannot be produced, grown or generated on a scale which can sustain how quickly it is being consumed. Once it is used up, there is no more available for the future. Fossil fuels (such as coal, petroleum and natural gas), types of nuclear power (uranium) and certain examples.

2.2.3 Cyclic Resources

The resources which can be used again and again passing through some processes are known as cyclic resources. An example of cyclic resource may be water, coal.

Difference between renewable and non-renewable resources

Parameters	Renewable Resources	Non-renewable Resources
Definition	A **renewable resource** is one that naturally replaces itself at a rate near or equal to the rate at which you're using it.	**Non-renewable** resource does not replace itself at the rate it is being used.
Classification	Renewable resources can be further divided in **two types :** Living Renewable Resources and Non-Living Renewable Resources	Non-Renewable Resources can be further classified into **two types :** Recyclable and Non-Recyclable resources
Advantages	i) Renewable energy is beneficial because we do not have to worry about its depletion. ii) Renewable energies such as wind and hydropower provides for cleaner, environmentally friendlier power sources.	i) Non-renewable resources are easy to use as these are relatively cheap to mine and to convert into energy
Disadvantages	Technologies to utilize renewable resources is very costly and do not give much efficiency.	The non-renewable resources are fast depleting and causing a lot of environmental pollution
Examples	Hydropower, Wind, Solar energy etc	Coal, Oil, Natural gas etc.

2.3 Causes and Effects of Depletion of Resources

Resource depletion is the consumption of a resource faster than it can be replenished. Natural resources are commonly divided between renewable resources and non-renewable resources. The major causes of resource depletion are listed below.

1. Overpopulation
2. Over-consumption and waste
3. Deforestation and the destruction of ecosystems
4. Mining
5. Technological and industrial development
6. Soil erosion
7. Pollution and contamination of resources

- **Overpopulation** - With increasing population, demands of the country increase which further results in depletion of resources
- **Over-consumption and waste** - As the standards of living of people improves, they tend to consume more and waste even more.
- **Deforestation and the destruction of ecosystems** - Forests are cut annually, to make space for multiplexes, residential complexes etc. This not only destroys trees (and wood as a resource) but also destroys home of thousands of species of animals.
- **Mining** - Mining of minerals and oil-minerals and metals are in high demand in today's world. This is a very big problem as ores are being depleted day by day.

- **Technological and industrial development** - Technology advances and so the need of resources increases.
- **Soil erosion** - Because of deforestation, soil erosion takes place. Thus, soil gets devoid of important minerals and resources.
- **Pollution and contamination of resources** - Water pollution, soil pollution is increasing at an alarming rate today due to negligent attitude of people towards the environment. Pollution has a direct effect on contamination of resources available in nature.

Effects of Natural Resources Depletion

The depletion of natural resources has adverse effect not only on the human life but the environment too. Some of these are as listed below :

- **Resource Scarcity :** Resources like fossil fuels, timber, water and arable land become scarce because of over-consumption and degradation, mostly in the areas of tremendous population growth.
- **Rising Prices :** When natural resources become scarce, food, fuel and energy prices rise. Even the price of renewable resources increases if they need to be shipped to reach areas where these have been depleted.
- **Water Shortages :** When infrastructure development and population growth increase, water shortages occur. As of today, almost 1 billion people lack access to clean water.

Solutions to Prevent / Reduce Natural Resource Depletion

The likely solutions to reduce the resource depletion are as follows :

- **Reduced Use of Fossil Fuels :** We can conserve fossil fuels by using less gasoline and electricity. Driving less and saying yes to carpooling are simple ways to conserve gasoline. Buying a vehicle having high fuel mileage and purchasing energy star appliances can also contribute to conservation of fossil fuels.
- **Keep Water Clean :** Water may seem like a never-ending resource which is found everywhere, but due to population growth, the access to clean water for large populations decreases. Water can be saved by taking small steps in and around our home. Some of these include checking for water leaks and replacing or fixing leaky faucets.
- **Preserve Trees and Forests :** To satisfy the world's need for paper alone, approximately 4 billion trees get cut down per year. Thus, preventing the deforestation is very necessary. One can greatly contribute in this context by using less paper, using more cloth towels and not paper ones or by switching to an online-only subscription of your favourite newspaper. During a visit to a local forest, one should act responsibly and make sure that campfires are safely maintained.
- **Protect Coastal Ecosystems :** Coastal ecosystems are very important for maintaining biodiversity, but they are also extremely valuable for industries like fishing and tourism industries. Seafood consumers should keep in mind how their purchasing decisions can affect the environment. Reefs are extremely sensitive to disturbances. Diving or snorkelling around a reef should be done while treating the reefs with care and respect.

2.4 Energy Forms (Conventional and Non-conventional)

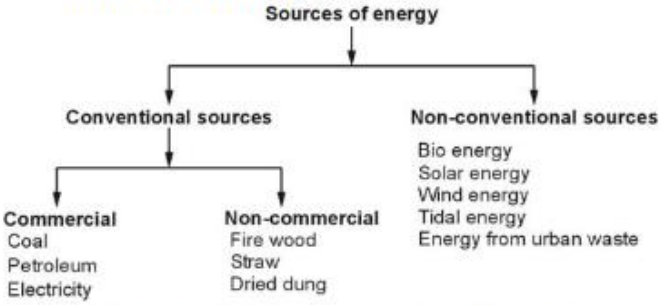


Fig. 2.4.1 Classification of energy resources

Conventional Sources of Energy :

These sources of energy are also called non renewable sources. These sources of energy are in limited quantity except hydro-electric power. These are further classified as commercial energy and non-commercial energy :

Commercial Energy Sources :

These are coal, petroleum and electricity. These are called commercial energy because they have a price and consumer has to pay the price to purchase them.

a) **Coal and Lignite :** Coal is the major source of energy. Coal deposits in India are 148790 million tonnes. Total lignite reserves found at Neyveli are 3300 million tonnes. In 1950-51, annual production of coal was 32 million tonnes. In 2005-06, annual production of coal was 343 million tonnes.

Lignite production was 20.44 million tonnes in 2005-06. According to an estimate, coal reserves in India would last about 130 years. India is now the fourth largest coal producing country in the world. Coal deposits are mainly found in Orissa, Bihar, Bengal and Madhya Pradesh. It provides employment to 7 lakh workers.

b) **Oil and Natural Gas :** In these days oil is considered as the most important source of energy in India and the world. It is widely used in automobiles, trains, planes and ships etc. In India it is found in upper Assam, Mumbai High and in Gujarat. The resources of oil are small in India.

In 1950-51, the total production of oil in India was 0.3 million tonnes. It increased to 32.4 million tonnes in 2000-01. Despite tremendous increase in oil production, India still imports 70 % of oil requirements from abroad. In 1951, there was only one oil refinery in Assam. After independence 13 such refineries were set up in public sector and their refining capacity was 604 lakh tonnes. After implementation of economic reforms, private refineries are also engaged in oil refining. As per current rate of consumption, oil reserves in India may last about 20 to 25 years.

Non-Conventional Sources of Energy :

Besides conventional sources of energy there are non-conventional sources of energy. These are also called **renewable sources of energy**. Examples are bio energy, solar energy, wind energy and tidal energy. Govt. of India has established a separate department under the Ministry of Non-conventional Energy Sources for effective exploitation of non-conventional energy.

The various sources are given below :

1. **Solar Energy :** Energy produced through the sunlight is called solar energy. Under this programme, solar photovoltaic cells are exposed to sunlight and in the form of electricity is produced. Photovoltaic cells are those which convert sun light energy into electricity. In year 1999-2000, 975 villages were illuminated through solar energy. Under Solar Thermal Programme, solar energy is directly obtained. Sunlight is converted into thermal power. Solar energy is used for cooking, hot water and distillation of water etc.
2. **Wind Energy :** This type of energy can be produced by harnessing wind power. It is used for operating water pumps for irrigation purposes. Approximately 2756 wind pumps were set up for this purpose. In seven states, wind power operated power houses were installed and their installed capacity was 1000 MW. India has second position in wind power energy generation.
3. **Tidal Energy :** Energy produced by exploiting the tidal waves of the sea is called tidal energy. Due to the absence of cost effective technology, this source has not yet been tapped.
4. **Bio Energy :** This type of energy is obtained from organic matter.

It is of two kinds :

i) **Bio Gas :** Bio Gas is obtained from Gobar Gas plant by putting cow dung into the plant. Besides producing gas this plant converts gobar into manure. It can be used for cooking, lighting and generation of electricity. 26.5 lakh bio gas plants had been established by the year 2003-04. They produce more than 225 lakh tonnes of manure. About 1828 large community bio gas plants have been established in the country.

ii) **Bio Mass :** It is also a source of producing energy through plants and trees. The purpose of bio mass programme is to encourage afforestation for energy. So that fuel for the generation of energy based on gas technique and fodder for the cattle could be obtained, 56 MW capacity for the generation of bio mass energy has been installed.

5. **Energy from Urban Waste :** Urban waste poses a big problem for its disposal. Now it can be used for generation of power. In Timarpur (Delhi) a power station of 3.75 capacity has been set up to generate energy from the garbage.

2.5 Present Global Energy Use and Future Demands

Global energy consumption is defined as the total energy used by an individual or organizations from around the world. Disparity between countries in the amount of per capita energy consumption typically reflects income level or climate.

Country (Consumers)	Percent of World Energy Consumed
United States	21 %
China	16
Russia	6
Japan	5

Table 2.5.1 Global energy consumption

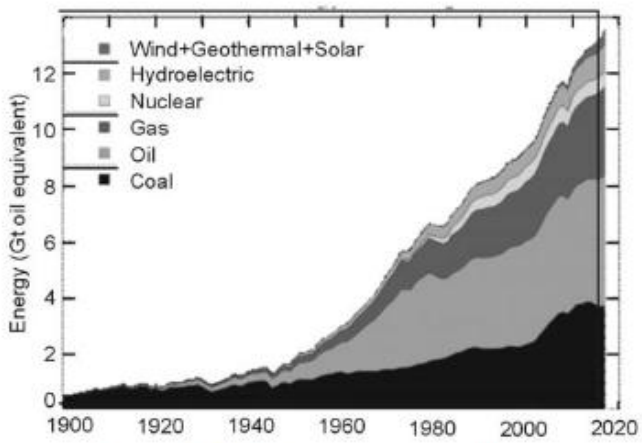


Fig. 2.5.1 Global energy consumption

Energy Consumption by source

Fossil fuels

The twentieth century saw a rapid twenty-fold increase in the use of fossil fuels. Between 1980 and 2006, the worldwide annual growth rate was 2 %. According to the US Energy Information Administration's 2006 estimate, the estimated 471.8 EJ total consumption in 2004, was divided with fossil fuels supplying 86 % of the world's energy :

Coal

In 2000, China accounted for 28 % of world coal consumption, other Asia consumed 19 %, North America 25 % and the EU 14%. The single greatest coal-consuming country is China. Its share of the world coal production was 28 % in 2000 and rose to 48 % in 2009. In contrast to China's ~70 % increase in coal consumption, world coal use increased 48 % from 2000 to 2009. In practice, the majority of this growth occurred in China and the rest in other Asia. China's energy consumption is mostly driven by the industry sector, the majority of which comes from coal consumption.

World annual coal production increased 1,905 Mt or 32 % in 6 years in 2011 compared to 2005, of which over 70 % was in China and 8 % in India. Coal production was in 2011 7,783 Mt, and 2009 6,903 Mt, equal to 12.7 % production increase in two years.

Oil

Oil became the dominant fuel during the twentieth century. The growth of oil as the largest fossil fuel was further enabled by steadily dropping prices from 1920 until 1973. After the oil shocks of 1973 and 1979, during which the price of oil increased from 5 to 45 US dollars per barrel, there was a shift away from oil. Coal, natural gas and nuclear became the fuels of choice for electricity generation and conservation measures increased energy efficiency. In the U.S. the average car more than doubled the number of miles per gallon. Japan, which bore the brunt of the oil shocks, made spectacular improvements and now has the highest energy efficiency in the world. From 1965 to 2008, the use of fossil fuels has continued to grow and their share of the energy supply has increased. From 2003 to 2008, coal was the fastest growing fossil fuel.

It is estimated that between 100 and 135 billion tons of oil has been consumed between 1850 and the present.

Natural Gas

In 2009, the world use of natural gas grew 31 % compared to 2000. 66 % of this growth was outside EU, North America, Latin America, and Russia. Others include the Middle East, Asia, and Africa. The gas supply increased also in the previous regions: 8.6 % in the EU and 16 % in the North America 2000-2009.

Nuclear power

As of 1st July 2016, the world had 444 operable grid-electric nuclear power reactors with 62 others under construction. Since commercial nuclear energy began in the mid 1950s, 2008 was the first year that no new nuclear power plant was connected to the grid, although two were connected in 2009.

Annual generation of nuclear power has been on a slight downward trend since 2007, decreasing 1.8 % in 2009 to 2558 TWh, and another 1.6 % in 2011 to 2518 TWh, despite increases in production from most countries worldwide, because those increases were more than offset by decreases in Germany and Japan. Nuclear power met 11.7 % of the world's electricity demand in 2011.

Renewable energy

Renewable energy is generally defined as energy that comes from resources that are not significantly depleted by their use, such as sunlight, wind, rain, tides, waves and geothermal heat. Renewable energy is gradually replacing conventional fuels in four distinct areas : electricity generation, hot water/space heating, motor fuels, and rural (off-grid) energy services. At the national level, at least 30 nations around the world already have renewable energy contributing more than 20 percent of energy supply. National renewable energy markets are projected to continue to grow strongly in the coming decade and beyond.

2.6 Energy Conservation : Why ?

We must conserve energy because of a number of reasons. These are explained below :

Demand exceed Supply

There is an increasing demand for energy due to increasing population, industrialization, traffic on roads and automation in home, office and farms. We must have observed that the ever increasing population is creating an increasing demand for energy. Increasing number of people need more houses to live in and this leads to increased felling of trees to provide timber and furnishing. At the same time, more coal, kerosene and gas are needed to cook the food for more people. More people today need more electricity to light their home, to run their coolers and geysers, to run washing machines, computers, etc., which results in increased use of power leading to power cuts.

By conservation and wise use of energy available

Energy saved is energy generated

Now, imagine that there is an energy bank. Whatever energy we save in our daily activities gets accumulated in this energy bank so that we can use it in future. As our 'energy savings' grow, there will be less pressure to produce more energy. Similarly, the energy that we save could be used elsewhere. For example, if we decide to have a daytime wedding in the family, with no decorative lights, the electricity we save could perhaps prevent a couple of power cuts in the city.

Every person's motto today should be -

Save on Something (S.O.S.)

Fuels are limited

Fuels are the most common sources of energy and deposits of coal, gas and oil are limited. A look at the chart given below will tell us where we stand today in terms of their availability to us in the years to come.

Fuel	Known supplies (in years)	When likely to run out
Natural Gas	about 30	AD.2035
Oil	about 50	AD.2055
Coal	about 280	AD.2285

Table 2.6.1 Fuel supply distribution

After this what ? We can see that oil and natural gas are likely to run out during your own life time. The choice is before us ! Either we carry on as we are or we must plan the use of fuels so that we conserve them for future use.

Conservation of Energy : How ?

By now, we all have realized the fact that we are facing a very real possibility of some of these energy resources drying up during our lifetime. Conservation of energy has to be the order of the day. Each and every one of us has to unite and collectively take action to preserve and conserve energy. Each one of us has to think, "Is there anything which I can do?"Yes, there are many small ways in which we can contribute our share of efforts in energy conservation. Energy can primarily be conserved :

At home

In the farm or workplace

On the road

Energy Conservation at Home :

a) Power :

Take a look at your last power bill. It need not have been as much as it is. Just a little care, a little alertness on your part could have brought it down . How ?

Switch off lights and fan while leaving a room.

Change over to energy efficient tubelights from power consuming bulbs.

Remember! A40 watt tube light gives twice as much light as a 100watt incandescent bulb. This means a savings of 60 % power in addition to more light!

Replace traditional choke so tube lights with electronic chokes. They consume one third energy.

Keep lights and fixtures clean and dirt free.

b) Fuel :

As for power, We can adopt many simple ways in which to cut down fuel bills. Those of us who use LPG or gas cylinders for cooking at home are already aware of the way in which gas prices have been shooting up recently. Kerosene prices are not far behind. So what can we do to reduce our fuel bills ? Here are some tips.

Use ISI marked cooking stoves only.

Replace traditional wood stoves with the 'unnat chullah' (smokeless chullah) developed by the Government. These are 20-25% more heat efficient.

Use solar cookers as far as possible.

Avoid cooking in open pans. Use a pressure cooker and save your fuel.

Use separator pressure cooker to cook more than one dish at a time.

Use copper bottom or sandwich bottom pans which are more heat sensitive.

Switch on the gas after putting the pan on and switch off before removing the pan.

Energy conservation in the farm and workplace :

Farmers are increasingly using farm machinery like tractors, threshers, water pumps, etc. An effort must be made by farmers too to conserve energy, which means they must try to get maximum work done with the use of least possible energy.

Maintain tractors well. Poor maintenance leads to 25 % loss of diesel.

Prevent leakage of diesel.

Switch off the engine when the tractor is not in use.

Drive in appropriate gear.

Keep the air filter clean to reduce wear and tear of the engine.

Replace old tyres.

Plan the use of tractor on the field. Digging in length wise direction rather than width wise, saves diesel in the field.

Energy Conservation at Workplace :

The feeling people generally have is - "Who cares about energy conservation at the office. After all, I'm not paying for it!"But this is where we go wrong. Ultimately it is we who pay for all the energy that is wasted in the office-in the form of energy shortages, higher price to be paid for energy, more taxes.

Energy Conservation on Road :

Many more people own vehicles today than they did ten years ago. Vehicles are used to go to the office as well as for family outings. This has resulted in a tremendous increase in the use of petrol, diesel and compressed natural gas(CNG). What do you suggest to control the use of petrol, diesel and CNG ?We could consider the following :

Use a carpool instead of individual cars to travel to work

Adopt petrol saving measures such as -

Constant speed

Drive at as low minimize the use of brake and clutch

Maintain proper air pressure in the tyres.

Prevent leakage of fuel at all costs

Keep the engine well tuned.

Encourage installation of light sensitive switches and solar panels for street lights.

2.7 Overuse of Natural Resources and it's Impact on Environment

Environmental consequences across the entire supply chain. In short, raw material extraction and processing always impact on the environment, resulting as they do in soil degradation, water shortages, biodiversity loss, damage to ecosystem functions and global warming exacerbation. And that's not all.

Natural resources exploitation, exploration, mining and processing have caused different types of environmental damages which include ecological disturbances, destruction of natural flora and fauna, pollution of air, water and land, instability of soil and rock masses, landscape degradation, desertification and global warming. The environmental damage has in turn resulted in waste of arable land as well as economic crops and trees. Since much of the damage is inevitable if the natural resources must be developed, both the government and the natural resource industry must be involved in taking precautionary and remedial measures that can minimize the ill-effects of natural resources exploitation. Emphasis should shift from waste disposal to waste minimization through sorting, recycling, bioremediation, afforestation, sewage treatment and pollution control, while the government should provide the regulatory legislation with appropriate sanctions or where these regulatory bodies already exist, the enforcement of laws and policy implementation is of paramount importance. The oil and gas industries, mining companies and other natural resources exploitation bodies are expected to carry out mandatory precautions, remedies or compensation for damage done.

Multiple Choice Questions :

Q.1 Which one of the following is an example of non-renewable resources ?

[a] Wind [b] Water
[c] Vegetation [d] Coal and minerals

Q.2 Which of the following is a renewable resource ?

[a] Soil [b] Water
[c] Flora and fauna [d] All the above

Q.3 ____of stratosphere provides protection to our life.

[a] Nitrogen [b] Hydrogen
[c] Ozone [d] Argon

Q.4 The life supporting gases such as O_2, CO_2 and N_2 are chiefly concentrated in the_____.

[a] troposphere [b] exosphere
[c] homosphere [d] stratosphere

Q.5 Which of the following soil is the best for plant growth ?

[a] Sandy soil [b] Clay
[c] Gravel [d] Loamy soil

Q.6 Both power and manure are provided by _____.

[a] thermal plants [b] nuclear plants
[c] biogas plants [d] hydroelectric plants

Q.7 In the atmosphere, the layer above the troposphere is _____.

[a] stratosphere [b] exosphere
[c] mesosphere [d] thermosphere

Q.8 _____ is the major raw material for biogas.

[a] Plant leaves [b] Cow dung
[c] Mud [d] Grass

Q.9 A biosphere reserve conserves and preserves_____.

[a] wild animals [b] wild land
[c] natural vegetation [d] all the above

Q.10 Atomic energy is obtained by using ores of_____.

[a] copper [b] uranium
[c] neither (a) nor (b) [d] both (a) and (b)

Q.11 Sanctuaries are established to_____.

[a] rear animals for milk [b] entrap animals
[c] protect animals [d] none of the above

Q.12 The death of the last individual of a species is called _____.

a extinction b clad
c neither (a) nor (b) d species diversity

Q.13 Which one of the following is not a fossil fuel ?

a Natural gas b Petrol
c Coal d Uranium

Q.14 Biogas generation is mainly based on the principle of _____.

a fermentation b degradation
c putrification d both (a) and (b)

Q.15 Red Data Book provides a list of _____.

a advanced plants
b rare, endangered or endemic species
c disease resistant animals d none of the above

Q.16 Floods can be prevented by_____.

a afforestation b cutting the forests
c tilling the land d removing the top soil

Q.17 Which of the following is a green house gas ?

a Nitrogen dioxide b Sulphur dioxide
c Carbon dioxide d Carbon monoxide

Q.18 Floods can be prevented by

a afforestation b removing top soil
c deforestation d agriculture

Q.19 Narmada bachao andolan was to _____.

a clean narmada b expand narmada
c save narmada d none of above

Q.20 Which of the following is best method from environment point of view ?

a Reduce b Recycle
c Reuse d All of above

Q.21 The full form of UV rays is _____.

a Ultra violet b Ultra violent
c Ultra valve d Ultimate violet

Q.22 Synthetic material / chemical which depleted Ozone layer is _____.

a CFCs b CFLs
c CO_2 d none of above

Q.23 What is coliform ?

a Group of bacteria b Group of viruses
c Group of micro oragnisms d Group of diseases

Q.24 What is the name given for replenishment of forest ?

a Afforestation b Silviculture
c Deforestation d Sericulture

Q.25 Why should we conserve forest and wild life ?

a To protect biodiversity
b To maintain ecosystem
c To maintain balance
d To continue food chain

Q.26 Water harvesting is a method which _____.

a increase ground water level
b not practiced in modern days
c has no relation with ground water
d decrease ground water level

Q.27 Energy we use to heat our homes, drive our cars and run our computers comes from _____.

a artificial resources b natural resources
c renewable resources
d non renewable resources

Q.28 Way we consume these renewable resources, it effects their _____.

a efficiency b power
c availability d cost

Q.29 To preserve resources for future, we have to ____.

a look for more b save them
c consume more of them
d use them more frequently

Q.30 Most natural resources we consume at our homes or in our cars are ____.

a renewable b non renewable
c infinite d free

Q.31 For travelling short distances, best way to conserve natural resources is _____.

a by driving b by flying
c by taking lift d by cycling

Q.32 What strategies has been taken by government for conservation of natural resources ?

a Implementation of laws
b Minimizing human activities
c Less use of coal d all of them

Q.33 When natural resources are changed into another product by people is known as

a secondary activities b primary activities
c nutrient cycling d tertiary activities

Q.34 Resources that people use are concentrated on the

a ocean shelf b continental Shelf
c ocean d water earth

Q.35 Natural resources and wild life are destroyed in which building which source of energy ?

a Solar energy b Wind energy
c Hydro energy d Nuclear energy

Q.36 The resources which are found everywhere are known as _____.

a ubiquitous
b non-renewable resource
c human made resources
d none of the above

Q.37 The following is (are) the non-renewable resources _____.

a Coal b Petroleum
c Natural gas d All of the above

Q.38 Balancing the need to use resources and also conserve them for the future is called _____.

a sustainable development
b resource conservation
c resource development
d human resource development

Q.39 The resources can be conserved by reducing ____

a reducing consumption b recycling
c reusing d all of the above

Q.40 Land covers _____ percent of the total area of the earth's surface

a 20 b 25 c 30 d 35

Q.41 The total percent of land of world under forest is

a 26 b 31
c 36 d 41

Q.42 The thin layer of grainy substance covering the surface of the earth is called _____.

a soil b sand
c mineral d organic matter

Q.43 The following is (are) not a factor(s) of soil formation

a Organic matter b Soil texture
c Minerals d All

Q.44 The major factor(s) of soil formation is (are)

a the nature of the parent rock
b climatic factors
c time taken for the composition of soil formation
d all of the above

Q.45 The following factor(s) is (are) responsible for degradation of soil

a Chemical fertilizers b Landslides
c Floods d All of the above

Q.46 The process in which bare ground between plants is covered with a layer of organic matter like straw, is called _____.

a mulching b contour carriers
c shelter belts d intercropping

Q.47 The process in which different crops are grown in alternate rows and are sown at different times to protect the soil from rain wash, is known as ____.

a crop rotation b intercropping
c terrace farming d contour cropping

Q.48 All forms of water that comes down on earth, including rain, snow, hail etc. is known as _____

a calcification b fixation
c precipitation d accumulation

Q.49 The ocean covers _____ percentage of earth's surface.

a 51 % b 61 %
c 71 % d 91 %

Q.50 Green revolution is associated with _____.

a sericulture b agriculture
c fish culture d silvicultur

Q.51 The components of LPG are _____ .

a Methane & Hexane b Propane & Butane
c Ethane & Methane d Propane & Ethane

Q.52 Major consumer of wood from forest is _____.

a thermal power plant b paper industry
c chemistry industry d none

Q.53 The portion of the earth and its environment which can support life is known as _____.

a crust b biosphere
c exosphere d atmosphere

Q.54 What is troposphere ?

a Portion of air
b Portion of water
c Lowest layer of atmosphere where we survive
d Portion of sky

Q.55 The main energy source for the environment is _____.

a solar energy b chemical energy
c bioelectric energy d electrical energy

Q.56 Which gas is likely to be reduced in the atmosphere by deforestation ?

a Carbon dioxide b Nitrogen
c Oxygen d Sulphur dioxide

Q.57 What are rodenticides ?

a That kill fishes b That kill insects
c That kill rats d That kill crocos

Q.58 Which of the following is most responsible for world water crisis ?

a Dams b Floods
c Drought d Population growth

Q.59 The resources that can be replaced by natural ecological cycle is called _____.

a renewable b non-renewable
c exhaustible d natural

Q.60 The amount of solar radiation reaching the surface of the earth is called _____.

a solar flux b reflected light
c minerals d solvents

Q.61 The most harmful of ultraviolet radiations are _____.

a UV-C b UV-B
c UV-A d All the above

Q.62 Grassland of USA is referred to as _____.

a Prairies b Steppes
c Pampas d Veldts

Q.63 Extensive planting of trees to increase forest cover is called _____.

a afforestation b agroforestry
c deforestation d social forestry

Q.64 Soil erosion can be prevented by _____.

a deforestation b afforestation
c overgrazing d removal of vegetation

Q.65 A renewable source of energy is _____.

a petroleum b coal
c nuclear fuel d trees

Q.66 'Smog' is a mixture of _____.

a smoke and fog b snow and fog
c snow and dust
d sulphur dioxide and fog

Q.67 Moisture in the air is known as _____.

a water b fog
c snow d humidity

Q.68 The capacity to do work is termed as _____.

a power b force
c strength d energy

Q.69 Ozone layer is present in _____.

a troposphere b stratosphere
c mesosphere d ionosphere

Q.70 Ozone Umbrella is located in which layer of atmosphere _____.

[a] troposphere [b] stratosphere
[c] mesosphere [d] ionosphere

Q.71 The unit of total water content of the soil is known as _____.

[a] Holard [b] Chraserd
[c] Echard [d] All of the above

Q.72 Pedology ?

[a] Study of water [b] Study of air
[c] Study of soil [d] None

Q.73 What is deforestation ?

[a] Product of forest [b] Destruction of forest
[c] Forest protection [d] None

Q.74 Deforestation generally decreases _____.

[a] global warming [b] drought
[c] soil erosion [d] rainfall

Q.75 Which among the following result in the formation of soil ?

[a] Radiation [b] Weathering
[c] Erosion [d] Pollution

Q.76 Mulching helps in _____.

[a] soil fertility
[b] moisture conservation
[c] improvements soil structure
[d] soil sterility

Q.77 Atmospheric humidity is measured by _____.

[a] Auxanometer [b] Photometer
[c] Hygrometer [d] None

Q.78 Boiling water reactor and pressurised water reactors are _____.

[a] nuclear reactor [b] solar reactor
[c] OTEC [d] biogas reactor

Q.79 The first controlled fission of an atom was carried out in Germany in _____.

[a] 1920 [b] 1928
[c] 1925 [d] 1938

Q.80 BTU is measurement of _____.

[a] volume [b] area
[c] heat content [d] temperature

Q.81 Crude oil is _____.

[a] colourless
[b] odourless
[c] smelly yellow to black liquid
[d] odourless yellow to black liquid

Q.82 The process that converts solid coal into liquid hydrocarbon fuel is called _____.

[a] liquefaction [b] carbonation
[c] catalytic conversion [d] cracking

Q.83 The one thing that is common to all fossil fuels is that they _____.

[a] were originally formed in marine environment
[b] contain carbon
[c] have undergone the same set of geological processes during their formation
[d] represent the remains of one living organisms

Q.84 Common energy source in Indian villages is ____.

[a] electricity
[b] coal
[c] sun
[d] wood and animal dung

Q.85 The outermost layer of the earth is _____.

[a] magma [b] mantle
[c] crust [d] solid iron core

Q.86 Both power and manure is provided by _____.

[a] nuclear plants [b] thermal plants
[c] biogas plants [d] hydroelectric plant

Q.87 Fuel cells are _____.

[a] carbon cell [b] hydrogen battery
[c] nuclear cell [d] chromium cell

Q.88 A fuel cell, in order to produce electricity, burns _____.

[a] Helium [b] Nitrogen
[c] Hydrogen [d] None of the above

Q.89 Which among the following is not an adverse environmental impact of tidal power generation ?

[a] Interference with spawing and migration of fish

[b] Pollution and health hazard in the estuaries due to blockage of flow of polluted water into the sea

[c] Navigational hazard

[d] None of the above

Q.90 Identify the non-renewable energy resource from the following :

[a] Coal [b] Fuel cells

[c] Wind power [d] Wave power

Q.91 Which of the following is a disadvantage of most of the renewable energy sources ?

[a] Highly polluting

[b] High waste disposal cost

[c] Unreliable supply

[d] High running cost

Answer Keys for Multiple Choice Questions

Q.1	d	**Q.2**	d	**Q.3**	c
Q.4	a	**Q.5**	d	**Q.6**	c
Q.7	a	**Q.8**	b	**Q.9**	a
Q.10	b	**Q.11**	c	**Q.12**	a
Q.13	d	**Q.14**	a	**Q.15**	b
Q.16	a	**Q.17**	c	**Q.18**	a
Q.19	c	**Q.20**	d	**Q.21**	a
Q.22	a	**Q.23**	a	**Q.24**	c
Q.25	a	**Q.26**	a	**Q.27**	b
Q.28	c	**Q.29**	b	**Q.30**	b
Q.31	d	**Q.32**	a	**Q.33**	a
Q.34	b	**Q.35**	c	**Q.36**	a
Q.37	d	**Q.38**	a	**Q.39**	d
Q.40	c	**Q.41**	b	**Q.42**	a
Q.43	c	**Q.44**	d	**Q.45**	d
Q.46	a	**Q.47**	b	**Q.48**	c
Q.49	c	**Q.50**	b	**Q.51**	b
Q.52	b	**Q.53**	c	**Q.54**	c
Q.55	a	**Q.56**	c	**Q.57**	c
Q.58	c	**Q.59**	a	**Q.60**	a
Q.61	a	**Q.62**	a	**Q.63**	a
Q.64	b	**Q.65**	d	**Q.66**	a
Q.67	a	**Q.68**	d	**Q.69**	b
Q.70	b	**Q.71**	a	**Q.72**	c
Q.73	b	**Q.74**	d	**Q.75**	b
Q.76	b	**Q.77**	c	**Q.78**	a
Q.79	d	**Q.80**	c	**Q.81**	c
Q.82	a	**Q.83**	b	**Q.84**	d
Q.85	c	**Q.86**	c	**Q.87**	b
Q.88	c	**Q.89**	d	**Q.90**	a
Q.91	c				

❑❑❑

UNIT - III

3 Ecosystem and Biodiversity

Introduction

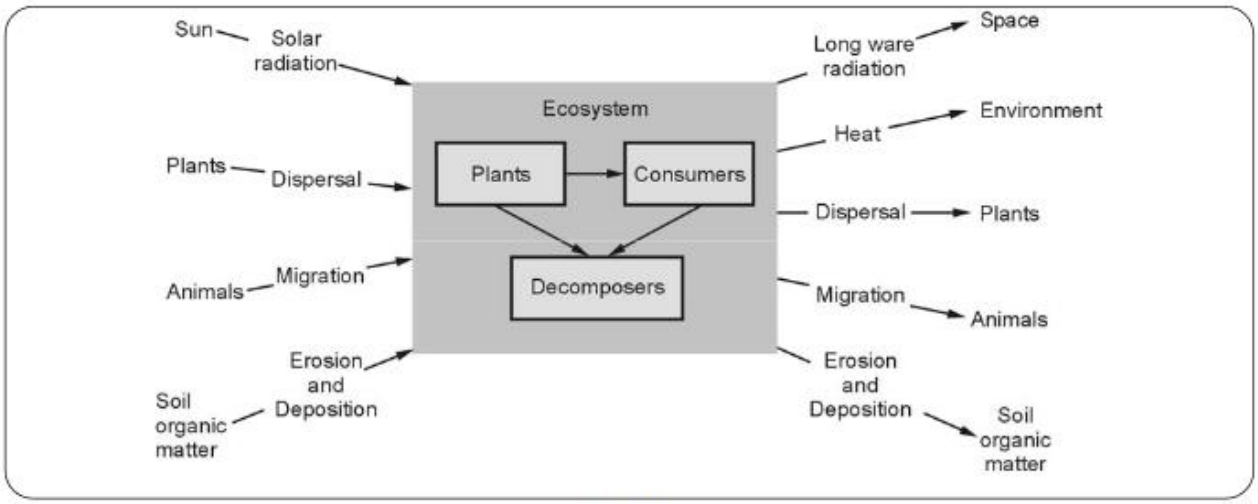


Fig. 3.1

An ecosystem is a community of living organisms in conjunction with the nonliving components of their environment, interacting as a system. These biotic and abiotic components are linked together through nutrient cycles and energy flows. Energy enters the system through photosynthesis and is incorporated into plant tissue. By feeding on plants and on one-another, animals play an important role in the movement of matter and energy through the system. They also influence the quantity of plant and microbial biomass present. By breaking down dead organic matter, decomposers release carbon back to the atmosphere and facilitate nutrient cycling by converting nutrients stored in dead biomass back to a form that can be readily used by plants and other microbes.

Ecosystems are controlled by external and internal factors. External factors such as climate, parent material which forms the soil and topography, control the overall structure of an ecosystem but are not themselves influenced by the ecosystem. Unlike external factors, internal factors are controlled, for example, decomposition, root competition, shading, disturbance, succession, and the types of species present.

3.1 Ecosystem - Definition, Aspects of Ecosystem, Division of Ecosystem, General Characteristics of Ecosystem, Functions of Ecosystem.

Definition :

A biological community of interacting organisms and their physical environment.

An ecosystem is a large community of living organisms (plants, animals and microbes) in a particular area. The living and physical components are linked together through nutrient cycles and energy flows.

Aspects of Ecosystem :

The ecosystem functions through several biogeochemical cycles and energy transfer mechanisms. The ecosystem

which consists of its non-living or Abiotic features such as air, water, climate and soil. Its Biotic components are the various plants and animals. Both these aspects of the ecosystem interact with each other through several functional aspects to form Nature's ecosystems. Plants, herbivores and carnivores can be seen to form food chains. All these chains are joined together to form a 'web of life' on which man depends. Each of these uses energy that comes from the sun and powers the ecosystem.

Structural and Functional aspect of an Ecosystem :

Structural Aspects

Components that make up the structural aspects of an ecosystem include :

1. Inorganic aspects - C, N, CO_2, H_2O.
2. Organic compounds - Protein, Carbohydrates, and Lipids - link abiotic to biotic aspects.
3. Climatic regimes - Temperature, Moisture, Light & Topography.
4. Producers - Plants.
5. Macro consumers - Phagotrophs - Large animals.
6. Micro consumers - Saprotrophs, absorbers - Fungi.

Functional aspects

1. Energy cycles.
2. Food chains.
3. Diversity - Inter linkages between organisms.
4. Nutrient cycles - Biogeochemical cycles.
5. Evolution.

Processes of ecosystems : This figure with the plants, zebra, lion, and so forth illustrates the two main ideas about how ecosystems function : ecosystems have energy flows and ecosystems cycle materials. These two processes are linked, but they are not quite the same.

Energy enters the biological system as light energy, or photons, is transformed into chemical energy in organic molecules by cellular processes including photosynthesis and respiration, and ultimately is converted to heat energy. This energy is dissipated, meaning it is lost to the system as heat; once it is lost it cannot be recycled. Without the continued input of solar energy, biological systems would quickly shut down. Thus the earth is an open system with respect to energy.

Elements such as carbon, nitrogen, or phosphorus enter living organisms in a variety of ways. Plants obtain elements from the surrounding atmosphere, water, or soils. Animals may also obtain elements directly from the physical environment, but usually they obtain these mainly as a consequence of consuming other organisms. These materials are transformed biochemically within the bodies of organisms, but sooner or later, due to excretion or decomposition, they are returned to an inorganic state. Often bacteria complete this process, through the process called decomposition or mineralization.

During decomposition these materials are not destroyed or lost, so the earth is a **closed system** with respect to elements (with the exception of a meteorite entering the system now and then). The elements are cycled endlessly between their biotic and Abiotic states within ecosystems. Those elements whose supply tends to limit biological activity are called **nutrients.**

Producer, Consumer and Decomposers :

Every living organism is in some way dependent on other organisms. Plants are food for herbivorous animals which are in turn food for carnivorous animals. Thus there are different tropic levels in the ecosystem.

Plants are the 'producers' in the ecosystem as they manufacture their food by using energy from the sun. In the forest these form communities of plant life. In the sea these include tiny algal forms to large seaweed.

The **herbivores animals** are **primary consumers** as they live on the producers. In a forest, these are the Insects, Amphibia, Reptiles, Birds and Mammals. The herbivorous animals include for example Hare, Deer and Elephants that live on plant life. In grasslands, there are herbivores such as the blackbuck that feed on grass. In the semi-arid areas, there are species such as the Chinkara or Indian gazelle.

At a higher tropic level, there are **carnivores animals, or secondary consumers,** which live on herbivorous animals.

In our forests, the Carnivores animals are Tigers, Leopards, Jackals, Foxes and Small Wild Cats.

Decomposers or Detrivores are a group of organisms consisting of small animals like worms, insects, bacteria and fungi, which break down dead organic material into smaller particles and finally into simpler substances that are used by plants as nutrition. Decomposition thus is a vital function in nature, as without this, all the nutrients would be tied up in dead matter and no new life could be produced.

The components of the ecosystem are seen to function as a unit when consider the following aspects :

1. Productivity; 2. Decomposition;
3. Energy flow and 4. Nutrient cycling.

1. **Productivity :** A constant input of solar energy is the basic requirement for any ecosystem to function and sustain. Primary production is defined as the amount of biomass or organic matter produced per unit area over a time period by plants during photosynthesis. It is expressed in terms of weight (g^{-2}) or energy (kcal m^{-2}). The rate of biomass production is called productivity. It is expressed in terms of $g^{-2}yr^{-1}$ or (kcal m^{-2}) yr^{-1} to compare the productivity of different ecosystems. It can be divided into Gross Primary Productivity (GPP) and Net Primary Productivity (NPP). Gross primary productivity of an ecosystem is the rate of production of organic matter during photosynthesis. A considerable amount of GPP is utilised by plants in respiration. Gross primary productivity minus respiration losses (R), is the Net Primary Productivity (NPP).

   Net primary productivity is the available biomass for the consumption to heterotrophs (herbivores and decomposers). Secondary productivity is defined as the rate of formation of new organic matter by consumers.Primary productivity depends on the plant species inhabiting a particular area. It also depends on a variety of environmental factors, availability of nutrients and photosynthetic capacity of plants.

2. **Decomposition :** Decomposers break down complex organic matter into inorganic substances like carbon dioxide, water and nutrients and the process is called decomposition. Dead plant remains such as leaves, bark, flowers and dead remains of animals, including fecal matter, constitute detritus, which is the raw material for decomposition. The important steps in the process of decomposition are fragmentation, leaching, catabolism, humification and mineralisation.

   Detritivores (e.g., earthworm) break down detritus into smaller particles. This process is called fragmentation. By the process of leaching, watersoluble inorganic nutrients go down into the soil horizon and get precipitated as unavailable salts. Bacterial and fungal enzymes degrade detritus into simpler inorganic substances. This process is called as catabolism.

   It is important to note that all the above steps in decomposition operate simultaneously on the detritus (Fig. 3.1.1). Humification and mineralisation occur during decomposition in the soil.

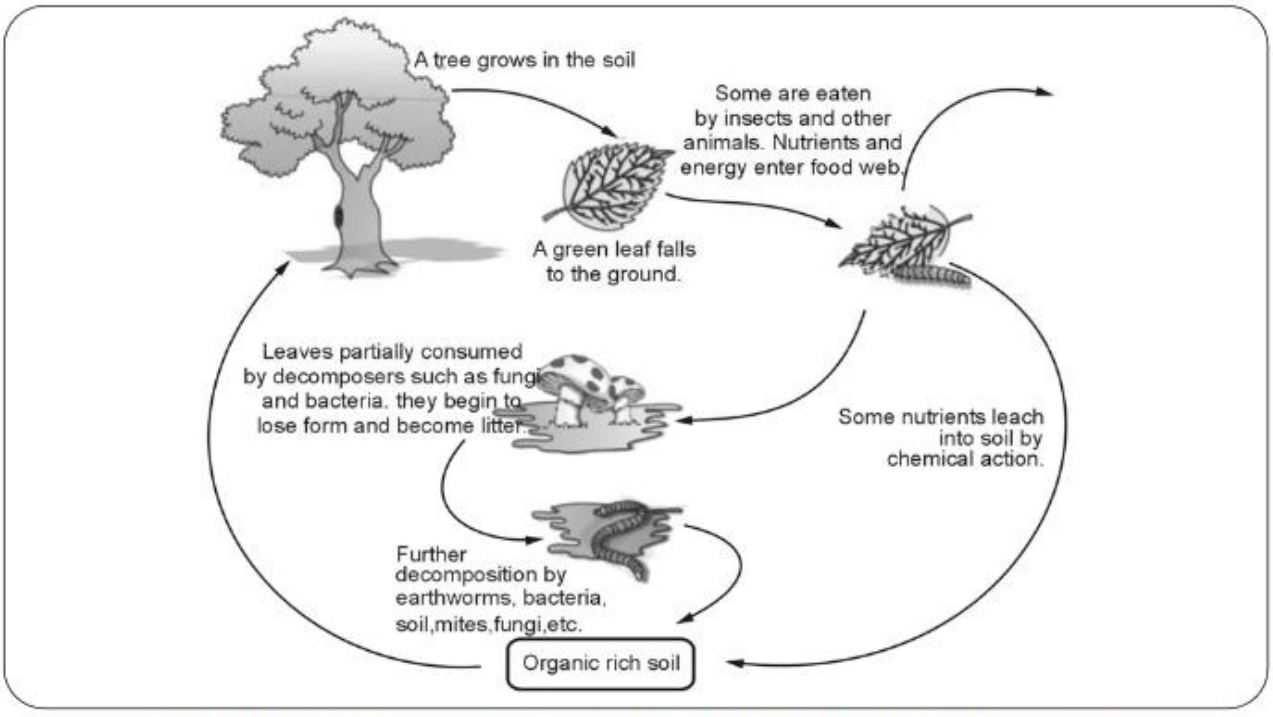


Fig. 3.1.1 Diagrammatic representation of decomposition cycle in a terrestrial ecosystem.

3. **Energy Flow :** Except for the deep sea hydro-thermal ecosystem, sun is the only source of energy for all ecosystems on Earth. The incident solar radiation less than 50 per cent of it is Photo Synthetically Active Radiation (PAR). All organisms are dependent for their food on producers, either directly or indirectly. So you find unidirectional flow of energy from the sun to producers and then to consumers.

   The green plant in the ecosystem-terminology are called producers. In a terrestrial ecosystem, major producers are herbaceous and woody plants. Likewise, primary producers in an aquatic ecosystem are various species like phytoplankton, algae and higher plants.

   All animals depend on plants (directly or indirectly) for their food needs. They are hence called consumers and also heterotrophs. If they feed on the producers, the plants, they are called primary consumers, and if the animals eat other animals which in turn eat the plants (or their produce) they are called secondary consumers. Likewise, you could have tertiary consumers too. Obviously the primary consumers will be herbivores. Some common herbivores are insects, birds and mammals in terrestrial ecosystem and molluscs in aquatic ecosystem. The consumers that feed on these herbivores are carnivores, or more correctly primary carnivores (though secondary consumers). Those animals that depend on the primary carnivores for food are labelled secondary carnivores. A simple Grazing Food Chain (GFC) is depicted below :

   Grass (Producer) → Goat (Primary Consumer) → Man (Secondary consumer)

Organisms occupy a place in the natural surroundings or in a community according to their feeding relationship with other organisms. Based on the source of their nutrition or food, organisms occupy a specific place in the food chain that is known as their trophic level. Producers belong to the first trophic level, herbivores (primary consumer) to the second and carnivores (secondary consumer) to the third (Fig. 3.1.2).

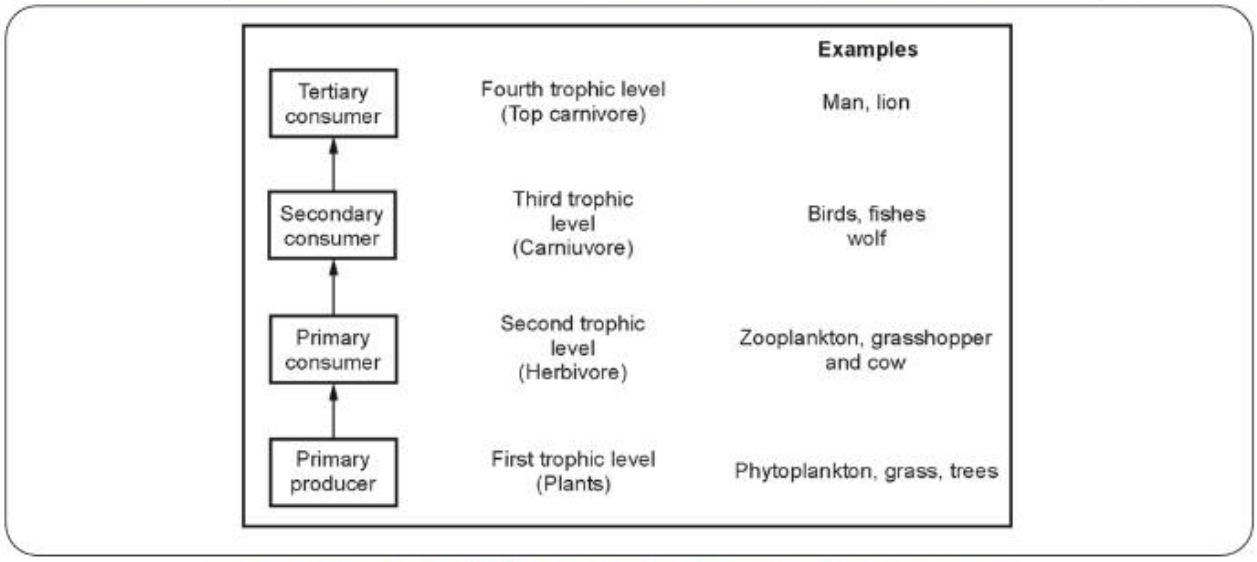


Fig. 3.1.2 Diagrammatic representation of trophic levels in an ecosystem

4. **Nutrient Cycle :** The movement of nutrient elements through the various components of an ecosystem is called nutrient cycling. Another name of nutrient cycling is biogeochemical cycles (bio: living organism, geo: rocks, air, water). Nutrient cycles are of two types : (a) gaseous and (b) sedimentary.

   Thereservoir for gaseous type of nutrient cycle (e.g., nitrogen, carbon cycle) exists in the atmosphere and for the sedimentary cycle (e.g., sulphur and phosphorus cycle), the reservoir is located in Earth's crust.

Environmental factors, e.g., soil, moisture, pH, temperature, etc., regulate the rate of release of nutrients into the atmosphere. The function of the reservoir isto meet with the deficit which occurs due to imbalance in the rate of influx and efflux.Simplified model of carbon cycle in the biosphere as shown in Fig. 3.1.3

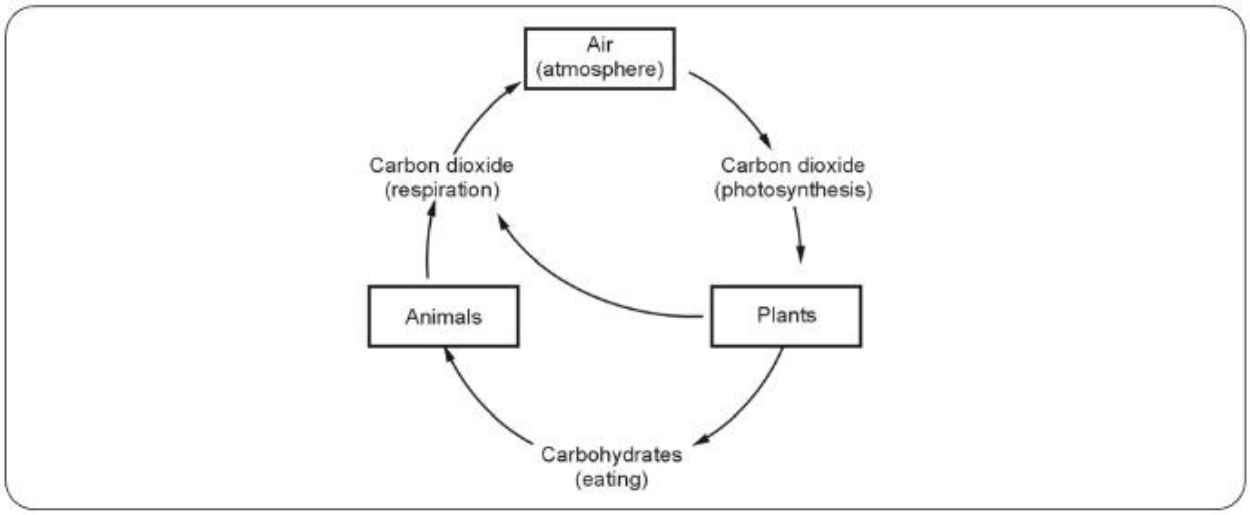


Fig. 3.1.3 Carbon cycle

Division of ecosystem :

An ecosystem is a community made up of living organisms and nonliving components such as air, water, and mineral soil. Ecosystems can be studied in two different ways. The living (biotic) and non-living (abiotic) components interact through nutrient cycles and energy flows as shown in Fig. 3.1.4.

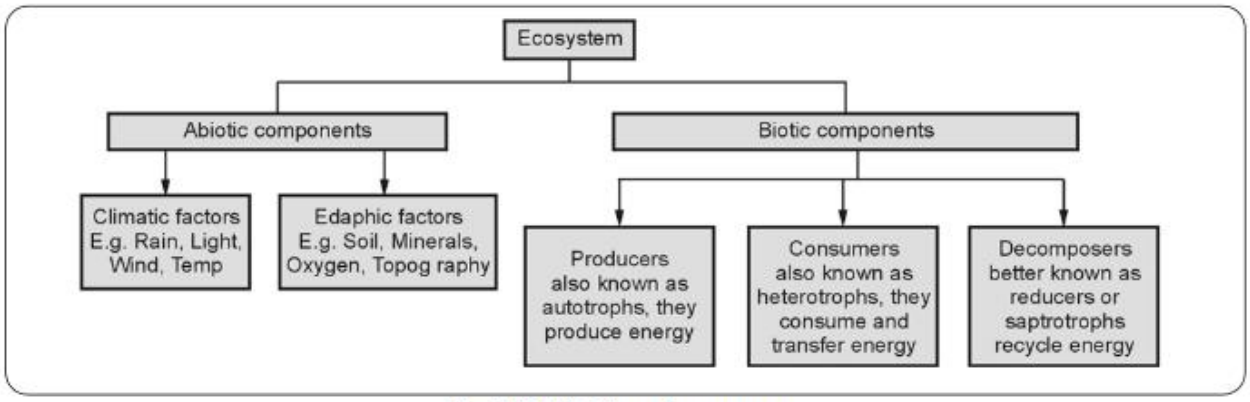


Fig. 3.1.4 Division of ecosystem

1. **Abiotic Components :** The non-living factors or the physical environment prevailing in an ecosystem form the abiotic components. They have a strong influence on the structure, distribution, behavior and inter-relationship of organisms.

Abiotic components are mainly of two types :

a) Climatic factors :

Which include rain, temperature, light, wind, humidity etc.

b) Edaphic factors :

Which include soil, pH, topography minerals etc.

2. **Biotic components :** The living organisms including plants, animals and micro-organisms (Bacteria and Fungi) that are present in an ecosystem form the biotic components. On the basis of their role in the ecosystem the biotic components can be classified into three main groups :
   a) Producers b) Consumers
   c) Decomposers or Reducers.

a) Producers : Producers make their own food. They do not have to obtain energy from other organisms. They obtain their energy from the sun and make food with that energy through the process of photosynthesis. Producers may also be called **autotrophs**. Most producers are plants, but there are some small organisms that produce food through photosynthesis as well. Producers are at the beginning of any simple food chain.

b) Consumers : Consumers can not make food. They must be find food and eat it to obtain energy. Therefore, they depend on the producers for their food. They are known as **heterotrophs** (i.e. heteros = other, trophos = feeder)

The consumers are of four types, namely :

i) Primary Consumers or First Order Consumers or Herbivores : These are the animals which feed on plants or the producers. They are called herbivores. Examples are rabbit, deer, goat, cattle etc.

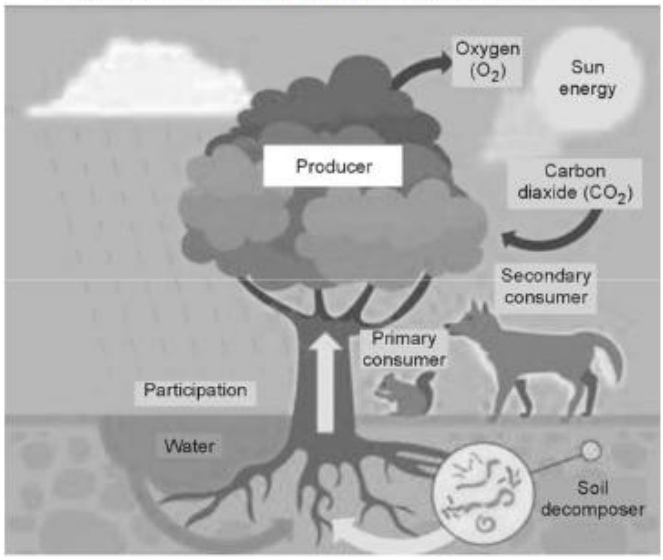
ii) Secondary Consumers or Second Order Consumers or Primary Carnivores : The animals which feed on the herbivores are called the primary carnivores. Examples are cats, foxes, snakes etc.

iii) Tertiary Consumers or Third Order Consumers : These are the large carnivores which feed on the secondary consumers. Example are Wolves.

iv) Quaternary Consumers or Fourth Order Consumers or Omnivores : These are the largest carnivores which feed on the tertiary consumers and are not eaten up by any other animal. Examples are lions and tigers.

c) Decomposers or Reducers : Bacteria and fungi belong to this category. They breakdown the dead organic materials of producers (plants) and consumers (animals) for their food and release to the environment the simple inorganic and organic substances produced as by-products of their metabolisms.

These simple substances are reused by the producers resulting in a cyclic exchange of materials between the biotic community and the abiotic environment of the ecosystem. The decomposers are known as Saprotrophs (i.e., sapros = rotten, trophos = feeder) .Figure shows relationship within the ecosystem.



General Characteristics of Ecosystem :

1. The ecosystem is a major structural and functional unit of ecology.
2. The structure of an ecosystem is related to its species diversity; the more complex ecosystems have high species diversity.
3. The function of the ecosystem is related to energy flow and material cycling through and within the system.
4. The relative amount of energy needed to maintain an ecosystem depends on its structure. The more complex the structure, the lesser the energy it needs to maintain itself.
5. Ecosystems mature by passing from less complex to more complex states. Early stages of such succession have an excess of potential energy and a relatively high energy flow per unit biomass. Later (mature)

stages have less energy accumulation and its flow through more diverse components.

6. Both the environment and the energy fixation in any given ecosystem are limited and cannot be exceeded without causing serious undesirable effects.
7. Alterations in the environments represent selective pressures upon the population to which it must adjust Organisms which are unable to adjust to the changed environment must needs vanish.
8. The ecosystem is an integrated unit or zone of variable size, comprising vegetation, fauna, microbes and the environment. Most ecosystems characteristically possess a well-defined soil, climate, flora and fauna (or communities) and have their own potential for adaptation, change and tolerance.
9. The functioning of any ecosystem involves a series of cycles, e.g., the water cycle and the cycles of various nutrients. These cycles are driven by energy flow, the energy being the solar energy Continuation of life demands a constant exchange and return of nutrients to and from (amongst) the different components of the ecosystem.

Functions of Ecosystem :

1. **Gas regulation :** Relates to the influence of natural and managed systems in relation to biogeochemical processes including greenhouse gases, photo-chemical smog and Volatile Organic Compounds (VOCs).
2. **Climate regulation :** Influence of land cover and biological mediated processes that regulate atmospheric processes and weather patterns which in turn create the microclimate in which different plants and animals (including humans) live and function.
3. **Disturbance regulation :** The capacity of the soil, regolith and vegetation to buffer the effects of wind, water and waves through water and energy storage capacity and surface resistance.
4. **Water regulation :** The influence of land cover, topography, soils, hydrological conditions in the spatial and temporal distribution of water through atmosphere, soils, aquifers, rivers, lakes and wetlands.
5. **Soil retention :** Minimizing soil loss through having adequate vegetation cover, root biomass, retaining rocks and soil biota.
6. **Nutrient regulation :** The role of ecosystems in the transport, storage and recycling of nutrients.
7. **Biological control :** The interactions within biotic communities that act as restraining forces to control populations of potential pests and disease vectors. This function consists of natural and biological control mechanisms.
8. **Supporting function :** Preservation of natural and semi natural ecosystems as suitable living space for wild biotic communities and individual species. This function also includes the provision of suitable breeding, reproduction, nursery, refugia and corridors (connectivity) for species.
9. **Soil formation :** Soil formation is the facilitation of soil formation processes. Soil formation processes include the chemical weathering of rocks and the transportation and accumulation of inorganic and organic matter.
10. **Water supply :** The role of ecosystems in providing water through sediment trapping, infiltration, dissolution, precipitation and diffusion.

3.2 Biodiversity - Definition, Levels, Value and Loss of Biodiversity

Biodiversity boosts ecosystem productivity where each species, no matter how small, all have an important role to play. For example, A larger number of plant species means a greater variety of crops. Greater species diversity ensures natural sustainability for all life forms.

Definition :

Biodiversity means the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part; this includes diversity within species, between species and of ecosystems.

Levels of Biodiversity :

Biodiversity is usually explored at three levels - genetic diversity, species diversity and ecosystem diversity (Fig. 3.2.1).The various levels of organization within biodiversity express different features of the complexity and value of biodiversity and interact with each other through ecological processes.

Levels of bio diversity

Includes three hierarchical levels ;

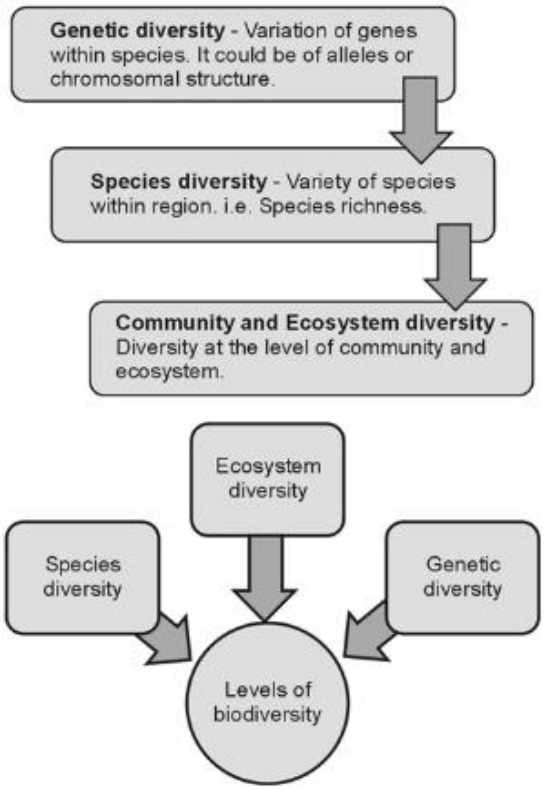


Fig. 3.2.1 Levels of biodiversity

1. **Genetic diversity :** Genetic diversity is the variety of genes within a species. Each species is made up of individuals that have their own particular genetic composition. This means a species may have different populations, each having different genetic compositions. To conserve genetic diversity, different populations of a species must be conserved.

   Genes are the basic units of all life on Earth. They are responsible for both the similarities and the differences between organisms.

2. **Species diversity :** Species (and their subspecies and populations) are generally considered to be the only self-replicating units of genetic diversity that can function as independent units. In the case of most living organisms, each species generally represents a complete, self-generating, unique ensemble of genetic variation, capable of interbreeding and producing fertile offspring. Some animals and many plants can also exchange genes through hybridization, which sometimes results in new species

3. **Ecosystem diversity :** Ecosystem diversity is the variety of ecosystems in a given place. An ecosystem is a community of organisms and their physical environment interacting together. An ecosystem can cover a large area, such as a whole forest, or a small area, such as a pond.

   An ecosystem is a community of organisms and their physical environment interacting together. An ecosystem may be as large as the Great Barrier Reef or as small as the back of a spider crab's shell, which provides a home for plants and other animals, such as sponges, algae and worms.

Value of Biodiversity :

There are main five types of biodiversity as given

1. **Consumptive value :** Direct utilisation of timber, food, fuel-wood and fodder by local communities. Provides forest dwellers with all their daily needs, food, building material, fodder, medicines. They know the qualities and different uses of wood from different species of trees, that they use as food, construction material or medicines.

2. **Productive use value :** This comprises of marketable goods. Biotechnologists search for potential genetic properties in plants and animals that can be used to develop varieties of crops and livestock plantation programs. Pharmacist search for raw material from which new drugs can be identified. Industrialists search for storehouse to develop new products. Agricultural scientists developing better crops by utilizing genetic engineering.

3. **Social value :** Biodiversity has been preserved by traditional societies. These societies valued it as a resource and believed that its depletion would be a great loss to their society. In India, Tulsi, peepal, cow, snake are worshipped.
4. **Ethical and Moral values :** It is based on importance of protecting all forms of life. Most religious and secular creeds believe that all forms of life have the right to exist on earth.Basic philosophy, "Live and let others Live".
5. **Aesthetic value :** It involves appreciation of the presence of biodiversity for its inherent value and beauty, as well as for the contribution it makes to our knowledge, aesthetics, imagination and creativity.

Loss of biodiversity :

Loss of biodiversity refers to the extinction of human, plant or animal species worldwide. It also includes the decrease in the number of a species in a certain habitat. The environmental degradation that leads to the loss can be either reversible or effectively permanent. Though, it has been noticed that global extinction so far is irreversible. Fig. 3.2.2 shows different causes of loss of biodiversity.

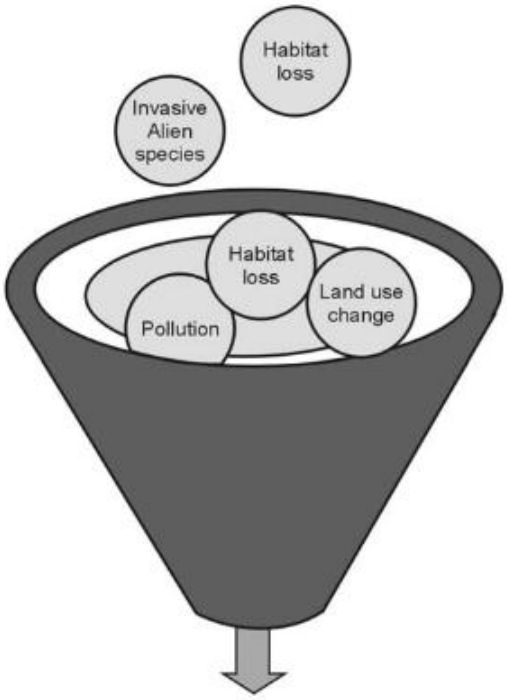


Figure 3.2.2 Loss of biodiversity

Causes of loss of biodiversity :

- **Destruction of habitat :** The natural habitat of animals is destroyed by man for the purpose of settlement, agriculture, mining, industries, construction of highways, and so on. As a result of this, the species must either adapt to the changes in the environment or move to other places. If not, they become target to predation, starvation, disease and eventually die.
- **Hunting :** Hunting of wild animals is done for the commercial utilisation of their products. These include hides and skin, fur, meat, tusk, cosmetics, perfumes, pharmaceuticals and decoration purposes. In recent years, 95 % of the black rhino population in Africa has been exterminated by poachers for their horn.
- **Exploitation of selected species :** Exploitation of medicinally important plants results in their disappearance from their natural habitat. Examples of the plants which are ruthlessly collected for laboratory and other works are the pitcher plant, Nepenthes khasiana, Drosera sp., Psilotum sp. Isoetessp etc.
- **Habitat fragmentation :** An "unnatural separation of expansive tracts of habitats into spatially segregated fragments" that is too limited to maintain their different species for the future, is known as habitat fragmentation. The landmass is broken into smaller units which eventually lead to the extinction of species.
- **Pollution :** Pollution makes survival difficult for the species as it alters their natural habitat. Water pollution is injurious to the biotic components of coastal ecosystems. Toxic wastes entering the water bodies disturb the food chain. In addition, materials like insecticides, pesticides, sulphur and nitrogen oxides, and acid rain also adversely affect the plant and animal species.
- **Natural calamities :** Floods, draught, forest fires, earth-quakes and other natural calamities sometimes take a heavy toll of plant and animal life. These trap a large number of animals while frittering away soil nutrients.

3.3 Biodiversity Assessment Initiatives in India

Among the biologically rich nations, India stands among the top 10 or 15 countries for its great variety of plants and animals, many of which are not found elsewhere. India has 350 different mammals (rated eight highest in the world), 1,200 species of birds (eighth in the world), 453 species of reptiles (fifth in the world) and 45,000 plant species, of which most are angiosperms, (fifteenth in the world). These include especially high species diversity of ferns (1022 species) and orchids (1082 species). India has 50,000 known species of insects, including 13,000 butterflies and moths. It is estimated that the number of unknown species could be several times higher.

The Ministry of Environment, Forest and Climate Change (MoEFCC) is the nodal agency in the administrative structure of the Central Government for the planning, promotion, co-ordination and overseeing the implementation of India's environmental and forestry policies and programmes.

The primary concerns of the Ministry are implementation of policies and programmes relating to conservation of the country's natural resources including its lakes and rivers, its biodiversity, forests and wildlife, ensuring the welfare of animals, and the prevention and abatement of pollution. While implementing these policies and programmes, the Ministry is guided by the principle of sustainable development and enhancement of human well-being.

The Ministry also serves as the nodal agency in the country for the United Nations Environment Programme (UNEP), South Asia Co-operative Environment Programme (SACEP), International Centre for Integrated Mountain Development (ICIMOD) and for the follow-up of the United Nations Conference on Environment and Development (UNCED). The Ministry is also entrusted with issues relating to multilateral bodies such as the Commission on Sustainable Development (CSD), Global Environment Facility (GEF) and of regional bodies like Economic and Social Council for Asia and Pacific (ESCAP) and South Asian Association for Regional Co-operation (SAARC) on matters pertaining to the environment.

The broad objectives are :

- Conservation and survey of flora, fauna, forests and wildlife
- Prevention and control of pollution
- Afforestation and regeneration of degraded areas
- Protection of the environment and
- Ensuring the welfare of animals

These objectives are well supported by a set of legislative and regulatory measures, aimed at the preservation, conservation and protection of the environment.

Besides the legislative measures, the National Conservation Strategy and Policy Statement on Environment and Development 1992; National Forest Policy 1988; Policy Statement on Abatement of Pollution 1992; and the National Environment Policy 2006.

3.4 Threats and Hotspots of Biodiversity

Treats of biodiversity : Biodiversity is under serious threat as a result of human activities. The main dangers worldwide are population growth and resource consumption, climate change and global warming, habitat conversion and urbanisation, invasive alien species, over-exploitation of natural resources and environmental degradation. Major five threats of biodiversity as given

1. **Climate change :** Changes in climate throughout our planet's history have, of course, altered life on Earth in the long run ecosystems have come and gone and species routinely go extinct. But rapid, manmade climate change speeds up the process, without affording ecosystems and species the time to adapt. For example, rising ocean temperatures and diminishing Arctic sea ice affects marine biodiversity and can shift vegetation zones, having global implications.
2. **Deforestation and habitat loss :** Deforestation is a direct cause of extinction and loss of biodiversity. An estimated 18 million acres of forest are lost each year, due in part to logging and other human practices, destroying the ecosystems on which many species depend.

3. **Overexploitation :** Overhunting, overfishing and over-harvesting contribute greatly to the loss of biodiversity, killing off numerous species over the past several hundred years. Poaching and other forms of hunting for profit increase the risk of extinction; the extinction of an apex predator or, a predator at the top of a food chain can result in catastrophic consequences for ecosystems.
4. **Invasive species :** The introduction of non-native species into an ecosystem can threaten endemic wildlife (either as predators or competing for resources), affect human health and upset economies.
5. **Pollution :** From the burning of fossil to dumping 19 billion pounds of plastic into the ocean every year, pollution completely disrupts the Earth's ecosystems. While it may not necessarily cause extinction, pollutants do have the potential to influents species' habits. For example, acid rain, which is typically caused by the burning of fossil fuels, can acidify smaller bodies of water and soil, negatively affecting the species that live there by changing breeding and feeding habits.

Hotspots of biodiversity :

Biodiversity is a critically important part of the Earth's natural capital. Hot spots are the areas that are severely threatened by human activities. It contains some endemic plants and animals.

The earth's biodiversity is distributed in specific ecological regions. There are over a thousand major Eco regions in the world. Of these, 200 are said to be the richest, rarest and most distinctive natural areas. These areas are referred to as the Global 200.

It has been estimated that 50,000 endemic plants which comprise 20 % of global plant life, probably occur in only 18 'hot spots' in the world. Countries which have a relatively large proportion of these hot spots of diversity are referred to as 'mega diversity nations'.

The rate at which the extinction of species is occurring throughout our country remains scure. It is likely to be extremely high as our wilderness areas are shrinking rapidly. Our globally accepted national 'hot spots' are in the forests of the North-East and the Western Ghats, which are included in the world's most biorich areas.

The Andaman and Nicobar Islands are extremely rich in species and many subspecies of different animals and birds have evolved. Among the endemic species i.e. those species found only in India, a large proportion are concentrated in these three areas. The Andaman and Nicobar Islands alone have as many as 2200 species of flowering plants and 120 species of ferns. Out of 135 genera of land mammals in India, 85 (63 %) are found in the Northeast. The Northeast States have 1,500 endemic plant species. A major proportion of amphibian and reptile species, especially snakes, are concentrated in the Western Ghats, which is also a habitat for 1,500 endemic plant species.

Coral reefs in Indian waters surround the Andaman and Nicobar Islands, Lakshadweep Islands, the Gulf areas of Gujarat and Tamil Nadu. They are nearly as rich in species as tropical evergreen forests.

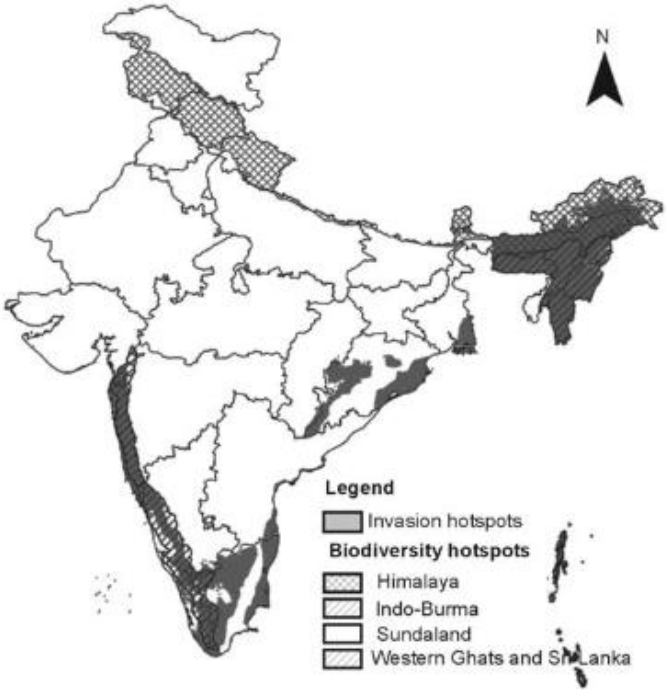


Fig. 3.4.1 Hotspot of biodiversity in India

3.5 Conservation of Biodiversity Objects, Various Law

Conservation of biodiversity objects :

1. To maintain essential ecological processes and life supporting systems.
2. To preserve the diversity of species.
3. To make sustainable utilization of species and ecosystems.
4. To conserve all the possible varieties (old or new) of food, forage and timber plants, live stock, agriculture animals and microbes
5. To conserve all the economically important organisms in protected areas .
6. To give priority to preserve unique ecosystems.
7. To prevent poaching and hunting of wildlife .
8. To create public awareness regarding biodiversity and its importance for the living organisms.
9. To protect useful animals, plants and their wild relatives both in their natural habitat (in-situ) and in zoological botanical gardens (ex-situ)

Various laws of biodiversity conservation :

The need for protection and conservation of environment and sustainable use of natural resources is reflected in the constitutional framework of India and also in the international commitments of India. The Constitution under Part IVA (Art 51A-Fundamental Duties) casts a duty on every citizen of India to protect and improve the natural environment including forests, lakes, rivers and wildlife, and to have compassion for living creatures. Further, the Constitution of India under Part IV (Art 48A-Directive Principles of State Policies) stipulates that the State shall endeavour to protect and improve the environment and to safeguard the forests and wildlife of the country.

Several environment protection legislations existed even before Independence of India. However, the true thrust for putting in force a well-developed framework came only after the UN Conference on the Human Environment (Stockholm, 1972). After the Stockholm Conference, the National Council for Environmental Policy and Planning was set up in 1972 within the Department of Science and Technology to establish a regulatory body to look after the environment-related issues. This Council later evolved into a full-fledged Ministry of Environment and Forests (MoEF).

MoEF was established in 1985, which today is the apex administrative body in the country for regulating and ensuring environmental protection and lays down the legal and regulatory framework for the same. Since the 1970s, a number of environment legislations have been put in place. The MoEF and the pollution control boards ("CPCB", ie, Central Pollution Control Board and "SPCBs", ie, State Pollution Control Boards) together form the regulatory and administrative core of the sector. Some of the important legislations for environment protection are as follows :

- The National Green Tribunal Act, 2010
- The Air (Prevention and Control of Pollution) Act, 1981
- The Water (Prevention and Control of Pollution) Act, 1974
- The Environment Protection Act, 1986
- The Hazardous Waste Management Regulations, etc.

Multiple Choice Questions

Q.1 What is called for a discrete group of organisms of the same kind ?

[a] Genes [b] Community
[c] Species [d] Column

Q.2 Approximately, how many species are assigned with scientific names ?

[a] Around 1 million [b] Around 1.5 million
[c] Around 2 million [d] Around 2.5 million

Q.3 What is the significance of spices diversity ?

[a] Species interacts with its environment and thus perform certain functions
[b] Species minimize interaction with its environment and thus perform certain functions
[c] Species never interacts with environment
[d] Though species interacts with environment it do no perform any functions

Q.4 How do human activities affect species diversity ?

a Due to over-exploitation of humans

b Due to conserving the forests

c Due to decline in population growth in humans

d Due to decrease in the pollution causing by industries

Q.5 State true or false. We cannot calculate species diversity.

a True b False

Q.6 How will increasing species diversity affect ecosystem ?

a It increase the efficiency and productivity of an ecosystem

b It increase only the efficiency and not productivity of an ecosystem

c It does not increase the efficiency and productivity of an ecosystem

d It only increase the productivity of an ecosystem

Q.7 Which is the largest scale of biodiversity ?

a Species diversity b Genetic diversity

c Cell diversity d Ecological diversity

Q.8 Which one of the following diversity boosts the availability of oxygen ?

a Species diversity b Ecosystem diversity

c Genetic diversity d Cell diversity

Q.9 Which of the following is an example of ecosystem diversity ?

a Earth b Sun

c River d Glass

Q.10 State true or false. Forests are the only example for ecosystem diversity.

a True b False

Q.11 Ecosystem is smallest unit of _____.

a ionosphere b lithosphere

c biosphere d mesosphere

Q.12 Energy _____ in an ecosystem.

a is released b is absorbed

c flows d none of the above

Q.13 The set of ecosystems is called a _____.

a biome b climate

c subsystem d structure

Q.14 The following is an example of Terrestrial Biome

a Tropical rain forest b Rivers

c Streams d All of the above

Q.15 Ecosystems rely on the following major sources of energy _____.

a sun

b chemical or nuclear fuels

c both (A) and (B)

d none of the above

Q.16 The following type of ecosystems have a low productivity or capacity to do work.

a Unsubsidized natural solar powered ecosystems

b Naturally subsidized solar powered ecosystems

c Man subsidized Solar powered ecosystems

d Fuel powered ecosystems

Q.17 Industrial parks are examples of _____.

a unsubsidized natural solar powered ecosystems

b naturally subsidized solar powered ecosystems

c man subsidized solar powered ecosystems

d fuel powered ecosystems

Q.18 Every Ecosystem has ___ major component(s).

a one b two

c three d four

Q.19 The following is (are) Abiotic components of the ecosystem _____.

[a] soil [b] carbon
[c] protein [d] all of the above

Q.20 Human is _____ factor of an Ecosystem.
[a] physical [b] chemical [c] both (A) and (B)

Q.21 The following is (are) producer(s) _____.
[a] algae [b] green plants
[c] photosynthetic bacteria
[d] all of the above

Q.22 The autotropsv _____.
[a] are self nourishing organisms
[b] derive energy from sunlight
[c] make organic compounds from inorganic compounds
[d] All of the above

Q.23 Autotropic components are _____.
[a] producers [b] donsumers
[c] decomposers [d] none of the above

Q.24 _____ are primary consumers.
[a] Herbivores [b] Carnivores
[c] Omnivores [d] All of the above

Q.25 The following are dependent on others for food
[a] autotrops [b] heterotrops
[c] both (A) and (B) [d] none of the above

Q.26 _____ are secondary consumers.
[a] Herbivores [b] Carnivores
[c] Omnivores [d] All of the above

Q.27 The following have vegetarian as well as non-vegetarian diet
[a] Herbivores [b] Carnivores
[c] Omnivores [d] All of the above

Q.28 Snake is a _____.
[a] primary consumer [b] secondary consumers
[c] tertiary consumers

Q.29 The following is a secondary consumer _____.
[a] goat [b] lizard
[c] wolf [d] lion

Q.30 In the process of photosynthesis, plants use chlorophyll to transform sunlight into _____ energy.
[a] heat [b] chemical
[c] light [d] none of the above

Q.31 The following is the correct grazing food chain _____.
[a] Grass - Grasshopper - Frog - Snake - Hawk
[b] Grass - Frog - Grasshopper- Snake - Hawk
[c] Grass - Grasshopper - Frog - Hawk - Snake
[d] Grass - Grasshopper - Snake - Frog – Hawk

Q.32 The following is not a type of ecosystem _____.
[a] grassland ecosystem [b] aquatic ecosystem
[c] desert ecosystem [d] mountain ecosystem

Q.33 Which one of the following is not a functional unit of an ecosystem ?
[a] Productivity [b] Stratification
[c] Energy flow [d] Decomposition

Q.34 What is true of ecosystem ?
[a] Primary consumers are least dependent upon producers
[b] Primary consumers out-number producers
[c] Producers are more than primary consumers
[d] Secondary consumers are the largest and most powerful

Q.35 Transfer of energy from source of plants through a series of organism is known as _____
[a] food web [b] energy cycle
[c] food chain [d] biological system

Q.36 What flows through ecosystem while matter cycles within them ?
[a] Energy [b] Force
[c] Pressure [d] Wind

Q.37 Total primary production in an ecosystem is known as _____
[a] gross final production

b gross primary production
c gross middle production
d net primary production

Q.38 The three functional components interact with each other to form _____
a environmental succession
b environmental depression
c environmental system
d ecology

Q.39 Green plants are the most important organisms for an ecosystem.
a True b False

Q.40 Which among the following is product of photosynthesis ?
a Glucose b Carbon
c Monoxide d Nitrogen

Q.41 Why energy flow is linear in an ecosystem ?
a Because it flows in air medium
b Because it is very particular
c Because ecosystem is linear
d Because energy flows from one tropic level to the next higher one

Q.42 Energy flow is cyclic
a True b False

Q.43 Flow of nutrients is _____
a unidirectional b rectangular
c cyclic d triangular

Q.44 Why plants in forests do not make use of all the light energy available to them ?
a Because plants do not require energy
b Because plants are grown only in winter season
c Because of the absence of chlorophyll
d Because sunlight doesn't fall on the leaves fully

Q.45 Which form of Sun's energy is trapped by the producers in the energy flow ?
a Light energy b Chemical energy
c Wind energy d Pressure energy

Q.46 There is always a loss of some energy as heat during energy flows through an ecosystem.
a True b False

Q.47 Which state in India has the maximum percentage of its area covered by forests ?
a Arunachal Pradesh b Madhya Pradesh
c Mizoram d Nagaland

Q.48 Forest plays an important role in ecosystem.
a True b False

Q.49 The term "ecosystem" was first proposed by _____.
a A.G. Tansely b H.T. Odum
c Karl Mobius d None of these

Q.50 _____break down complex organic matter into inorganic substances like carbon dioxide, water and nutrients
a Decomposers b Producers
c Both a and b d None of the above

Q.51 _____ is a example of detritivores
a Man b Trees
c Rabbit d Earthworm

Q.52 _____ and mineralisation occur during decomposition in the soil.
a Photosynthesis b Decomposition
c Humidification d None of these

Q.53 Decomposers break down complex organic matter into inorganic substances like carbon dioxide, water and nutrients and the process is called decomposition
a Fermentation b Decomposition
c Humidification d None of the above

Q.54 The incident solar radiation less than 50 per cent of it is photo synthetically active radiation (PAR)
a 30 b 20
c 10 d 50

Q.55 Those animals that depend on the primary carnivores for food are labelled _____

[a] primary consumer [b] secondary consumer
[c] secondary carnivores [d] primary carnivores

Q.56 The movement of nutrient elements through the various components of an ecosystem is called _____ cycling

[a] cabon [b] sulpher
[c] nutrient [d] none of these

Q.57 Nutrient cycles are of two types _____

[a] gaseous and sedimentary.
[b] organic and sedimentary.
[c] organic and inorganic.
[d] Gaseous and liquid.

Q.58 The non-living factors or the physical environment prevailing in an ecosystem form the _____ components.

[a] biotic [b] abiotic
[c] both a and b [d] none of the above

Q.59 The living organisms including plants, animals and micro-organisms that are present in an ecosystem form the _____ components

[a] biotic [b] abiotic
[c] both a and b [d] none of the above

Q.60 _____ make their own food.

[a] Consumer [b] Decomposer
[c] Producer [d] None of these

Q.61 What are called for the value of nature's products that are consumed directly ?

[a] Productive value [b] Indirect value
[c] Non-consumptive value [d] Consumptive value

Q.62 "Flowers offered to the god" is an example of _____.

[a] non-consumptive values of biodiversity
[b] consumptive values of biodiversity
[c] social value of biodiversity
[d] ethical values of biodiversity

Q.63 Which one of the following values of diversity we can classified for 'The beauty of waterfall in the Western Ghats' ?

[a] Ethical values [b] Social values
[c] Option values [d] Aesthetic values

Q.64 Why biodiversity is of great scientific value ?

[a] Because many species of plants and animals are the subjects of our research
[b] Because biodiversity can be use only in space
[c] Because biodiversity can only be useful for scientist
[d] Because biodiversity provides only few products that helps for humans

Q.65 State true or false. Biodiversity provides Option values.

[a] True [b] False

Q.66 Which one of the following is the backbone of viable ecosystems on which we depend on for basic necessities ?

[a] Pollution [b] Atmosphere
[c] Biodiversity [d] Pollination

Q.67 What is called for the illegal collection of indigenous plants by corporations who patent them for there own use ?

[a] Biopiracy [b] Biomagnifications
[c] Biodegradation [d] Biodiversity

Q.68 Why we should not encourage biopiracy ?

[a] Because it kills the whole biodiversity
[b] Because it don't provide any useful for humans
[c] Because it takes years of time
[d] Because it creates inequality between nations

Q.69 Why India has been traditionally one of the targets of biopiracy ?

[a] Because India has more population
[b] Because India has large amount of biodiversity

c Because India's don't use biodiversity
d Because India do not impose any punishment for biopiracy

Q.70 When did Convention on Biological Diversity established ?
a 1990 b 1991
c 1992 d 1993

Q.71 Which event provided conditions for high levels of biological diversity in India ?
a Biological events in the atmosphere
b Geological events in the rivers
c Biological events in the rivers
d Geological events in the landmass

Q.72 How can we say India as one of the bio-rich nations ?
a Because of its great variety of plants and animals
b Because of its low variety of planets and animals
c Because of the more population of humans
d Because of more pollution

Q.73 Who introduced the term hotspot of diversity ?
a Darwin b McLean
c Mike Housie d Myers

Q.74 Which of the following region has maximum diversity ?
a Mangrooves b Temperature rainforest
c Taiga d Coral reefs

Q.75 Hotspot are region of high _____.
a rarerity b endemism
c diversity
d critically endangered population

Q.76 Endemic species are _____.
a Rare species
b Species localized at specific region
c Cosmopolitan in distribution
d Critically endangered species

Q.77 Biodiversity can be broadly classified into how many types ?
a 2 b 5
c 3 d 4

Q.78 Biodiversity is of importance as it offers _____.
a Stability of ecosystems
b Stability of atmosphere
c Stability of species
d Stability of research

Q.79 The loss in biodiversity is not attributed to ____.
a Explosion in human population
b Transforming earth's surface
c Destruction of natural habitats
d Use of sustainable products

Q.80 Biodiversity has an aesthetic value to it.
a True b False

Q.81 In how many ways does the conservation of biodiversity work ?
a 5 b 2
c 3 d 4

Q.82 The area of National Parks range between :
a 0.61 to 7818 kms b 0.04 to 3162 kms
c 0.14 to 3612 kms d 0.16 to 8718 kms

Q.83 The activities of cultivation of land, timber harvesting is permitted in :
a sanctuaries b national parks
c biosphere reserves d protected areas

Q.84 Hot spot areas have :
a low density of biodiversity
b only endangered plants
c high density of hot springs
d high density of biodiversity

Q.85 The law which ensure environmental stability and maintenance of ecological balance is ____.
a Forest Act 1927
b National forest policy 1988
c Wild life Act 1992

d Wild life protection act 1991

Q.86 Term used for species which is in danger of being extinct in near future is _____.

a degradability b extinct
c endangered d global biodiversity

Q.87 International organization IUCN is abbreviation of _____.

a Internal Union Council for Natural gas
b International Union Council for Nature
c International Union for Conservation of Nature
d Internal United Council of Nations

Q.88 Major causes of extinction of different species includes _____.

a habitat loss and over-hunting
b climate change and pollution
c deforestation d all of above

Q.89 Which of the following is a function of ecosystem _____.

a biological control b water retention
c soil retention d all of above

Q.90 The function of the ecosystem is related to _____ and material cycling through and within the system

a energy flow b energy transfer
c Both a and b d none of these

Q.91 MoEF was established in _____

a 1990 b 1975
c 1985 d 1966

Q.92 MoEF is stand for _____

a Ministry of environment and forests
b Ministry of ecology and forests
c Ministry of environment and fermentation
d Ministry of energy and forests

Q.93 Which of the following is the threat of biodiversity _____.

a climate change b deforestation
c both a and b d none of these

Q.94 An "unnatural separation of expansive tracts of habitats into spatially segregated fragments" that is too limited to maintain their different species for the future, is known as _____ fragmentation

a habitat b species
c diversity d none of these

Q.95 Which one of the following is the cause for man-wildlife conflicts ?

a Reduction in the availability of natural food resources
b Increase in the forest area
c Adequate rainfall
d Curiosity of wildlife animals that leads for the invasion to outside the forest area

Q.96 Which one of the following is not the outcome of man-wildlife conflict ?

a Damage to human property
b Increase in the forest area
c Injury and loss of life of humans and wildlife
d Destruction of habitat

Q.97 The Jim Corbett National Park is famous for notable man-eaters _____.

a Leopard b Tiger
c Bear d Lion

Q.98 Which one of the following is a way to reduce human-wildlife conflict ?

a Killing all the wild animals
b Shifting all the wild animals from natural forests to zoo
c Use of strobe lights
d Kill the animals when they invade outside the forests

Q.99 Which one of the following is the major threat for biodiversity ?

a Reduction in the cutting of trees
b Increase in the number of trees
c Climate change

d Balance in the predator and prey in forests

Q.100 Habitat destruction which results in the threat to biodiversity is resulted due to _____

a agricultural industries

b decrease in the human population

c adequate rainfall

d decrease in the human-wildlife conflicts

Q.101 What is called for the natural habitats under in-situ conservation ?

a Unprotected areas b Depleted areas

c Exploited areas d Protected areas

Q.102 Which one of the following is the way for conservation of biodiversity ?

a Increase in the pollution level in the ecosystem

b Converting forest land into agricultural land in rapid way

c Removal of exotic species

d Overexploitation

Q.103 Who among the following defined the term biodiversity hot spots ?

a Norman Myers b Aziz Ab'Saber

c Charles Christopher Adams d Warder Clyde Allee

Q.104 Consider the following statement (s) related to the biodiversity hotspot.

I. It is an area with unusual concentration of species, many of which are endemic.

II. It is marked by serious threat to its biodiversity by humans.

Code :

a Only I b Only II

c Both I & II d Neither I nor II

Q.105 Consider the following statement (s) related to the biodiversity hotspots in India.

I. The North-eastern India is included in a separate CEPF funding region (Eastern Himalayas Biodiversity Hotspot), while Bangladesh and Malaysia only extend marginally into the Indo-Burma hotspot.

II. India shares its territories into three biodiversity hotspots viz. Eastern Himalaya, Western Ghats and Indo-Burma.

Code :

a Only I b Only II

c Both I & II d Neither I nor II

Q.106 Which of the following is not the biodiversity hotspot region ?

a California Floristic Province

b Madrean pine-oak woodlands

c Mesoamerica

d Antarctica

Q.107 Which of the following statement correctly defined the term biodiversity hotspot ?

a It is a biogeographic region that is both a significant reservoir of biodiversity and is threatened with destruction.

b The term biodiversity hotspot specifically refers to biologically rich areas around the world that have lost at least 70 % of their original habitat.

c Only B d Both B & C

Q.108 The concept of Mega-diverse countries was first developed by _____ in 1988.

a Norman Myers

b Russell Mittermeier

c Aziz Ab'Saber

d Charles Christopher Adams

Q.109 Why biodiversity hotspots are important ?

a It important due to the high vulnerability of habitats and high irreplaceability of species found within large geographic regions.

b The identification of an area as a biodiversity hotspot increases the likelihood of conservation investment. In addition, other designations for biodiversity conservation are likely to be present within these broad areas which may have more formal management structures.

c It is because it provides grants to organizations around the world that are working to help protect biodiversity hotspots.

d All of the above

Q.110 Which of the following is not the criterion to qualify as a hotspot ?

a It must contain at least 1,500 species of vascular plants (> 0.5 % of the world's total) as endemics;

b It has to have lost ? 70 % of its original native habitat.

c It must be the part of underdeveloped country.

d None of the above

Q.111 Consider the following statement (s) related to the hotspot conservation.

I. Hot spots have the highest concentrations of unique biodiversity on the planet

II. They are the places at the greatest risk of destruction

III. The need for conservation in the hot spots regions is urgent to present a wave of species extinctions.

Code :

a Only I b Only II

c Only III d I, II & III

Q.112 Which of the following two regions from India included as hot spot ?

a Eastern Himalayas and Western Ghats

b Western Himalayas and Western Ghats

c Northern Himalayas and Western Ghats

d Southern Himalayas and Western Ghats

Answer Keys for Multiple Choice Questions

Q.1	c	**Q.2**	b	**Q.3**	a
Q.4	a	**Q.5**	b	**Q.6**	a
Q.7	d	**Q.8**	b	**Q.9**	c
Q.10	b	**Q.11**	d	**Q.12**	c
Q.13	a	**Q.14**	a	**Q.15**	c
Q.16	a	**Q.17**	d	**Q.18**	b
Q.19	d	**Q.20**	b	**Q.21**	d
Q.22	d	**Q.23**	a	**Q.24**	a
Q.25	b	**Q.26**	b	**Q.27**	c
Q.28	c	**Q.29**	b	**Q.30**	b
Q.31	a	**Q.32**	d	**Q.33**	b
Q.34	c	**Q.35**	c	**Q.36**	a
Q.37	b	**Q.38**	c	**Q.39**	a
Q.40	a	**Q.41**	d	**Q.42**	b
Q.43	c	**Q.44**	d	**Q.45**	a
Q.46	a	**Q.47**	b	**Q.48**	a
Q.49	a	**Q.50**	a	**Q.51**	d
Q.52	c	**Q.53**	b	**Q.54**	d
Q.55	c	**Q.56**	c	**Q.57**	a
Q.58	b	**Q.59**	a	**Q.60**	c
Q.61	d	**Q.62**	c	**Q.63**	d
Q.64	a	**Q.65**	a	**Q.66**	c
Q.67	a	**Q.68**	d	**Q.69**	b
Q.70	d	**Q.71**	d	**Q.72**	a
Q.73	d	**Q.74**	d	**Q.75**	b
Q.76	b	**Q.77**	c	**Q.78**	a
Q.79	d	**Q.80**	a	**Q.81**	b
Q.82	b	**Q.83**	a	**Q.84**	d
Q.85	b	**Q.86**	c	**Q.87**	c
Q.88	d	**Q.89**	d	**Q.90**	a
Q.91	c	**Q.92**	a	**Q.93**	c
Q.94	a	**Q.95**	a	**Q.96**	b
Q.97	a	**Q.98**	c	**Q.99**	c
Q.100	a	**Q.101**	d	**Q.102**	c
Q.103	a	**Q.104**	c	**Q.105**	c
Q.106	d	**Q.107**	d	**Q.108**	b
Q.109	a	**Q.110**	c	**Q.111**	d
Q.112	a				

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