Unit-9

People Development & Environment

UGC NET STUDY MATERIALS

STUDY OF EDUCATION

Human and Environment

Human Beings are a beautiful creation by God. Science says that human beings have appeared through biological evolution. Whatever the reason for Human appearance on the Earth, humans have been interacting with their environment since people first walked the Earth. And obviously, they interacted with the environment for the first and foremost need of food.

For example, humans have been cutting down forests to clear land to grow crops for centuries, and by doing so, we have altered the environment. Conversely, the environment affects us in many different ways as well. A simple example is a way we change our clothes in response to cold or hot weather. We will discuss some of how humans interact with their environment and how the environment influences us, both positively and negatively.

Before going for further details on Human and Environment. Integration, we must know about the term

Environment means our physical surroundings and the characteristics of the place in which we live. It also refers to the wider natural world of land, sea, and atmosphere.

The environment is the sum total of living and non-living components surrounding an organism.

Different organisms live in different types of surroundings, such as air, water, and soil. Different kinds of living organisms share these surroundings. The surroundings are the "environment" of an organism.

The environment has two components:

(i) **Physical or abiotic (non-living) components and**
(ii) **living or biotic components.**

i. **Physical or abiotic (non-living) components:** **Abiotic components** of the environment are air, water, soil, energy radiation, etc.

ii. **living or biotic components.**

Biotic components of the environment are microbes (such as bacteria, algae, and fungi), plants, animals, etc.

The environment consists of four segments, such as:

(i) Biosphere
(ii) Atmosphere
(iii) Hydrosphere, and
(iv) Lithosphere

i. ***Biosphere:*** All the parts of the Earth are not suitable for the survival of organisms. Some parts are too hot or very cold to support life. The part of Earth on which organisms can survive and reproduce is called the biosphere. The survival of organisms depends upon a delicate balance between themselves and with the various components of the environment. Any disturbance, damage or adverse change in the quality of the environment poses a threat to the survival and well-being of organisms. Therefore, any threat of degradation or damage to environment should be a cause of concern to all of us.

ii. ***Atmosphere:*** Atmosphere is the only place where free oxygen and water vapor exist. The atmosphere is a thin layer of air (a mixture of gases) around the Earth, which is a great source for all living organisms.

iii. ***Hydrosphere:*** Water plays a vital role in the biosphere; without it, life is impossible. The hydrosphere is the part of Earth on which all types of water resources exists, viz., **oceans, seas, rivers, lakes, glaciers,**

ice caps, groundwater, etc.

iv. ***Lithosphere:*** Soil is a part of the lithosphere which supports life. The lithosphere is the part of the Earth where all types of minerals, metals, organic matters, rocks, soils, etc. exist.

An **ecosystem** includes all the living organisms (humans, plants, animals, micro- organisms) and their physical environment (soil, water, air, land) and the interactions between them.

Ecology is the study of the relationships between living organisms, including humans, and their physical environment; it seeks to understand the vital connections between plants and animals and the world around them. Ecology also provides information about the benefits of ecosystems and how we can use Earth's resources in ways that leave the environment healthy for future generations.

The environment can be summarized collectively as:

1. Biosphere	Plants, Animals, and Bio organism
2. Atmosphere	Air (oxygen, CO2, Nitrogen, Hydrogen etc.)
3. Hydrosphere	Water including oceans, seas, rivers, lakes, glaciers, ice caps, ground water, etc.
4. Lithosphere	Soil, Minerals, Rocks

Human and Environmental Interaction

Human and Environmental Interaction can be described as the connections between human beings and the entire ecological system.Human and environment interaction is the way people depend, adapt and modify the environment.

The interaction between human and environment can be categorised in three ways:

1. Dependency on the environment for food, water, timber, natural gas, etc.
2. Adaptability for the environment to fulfill their own needs.
3. Modification of the environment positively or negatively like drilling holes, building dams etc.

Anthropogenic activities and their impact on environment

of or relating to the study of the origins and development of human beings. Most of the disctionaries defined the term **"Anthropogenic"** as **"created or caused by human activity or "resulting from the influence of human beings on nature"**

The population of India has crossed the figure of 1.3 billion and the world population is estimated to have crossed the 7.5 billion mark. To meet the demand of food, housing and energy, environmental resources are being exploited at a fast pace.

Anthropogenic Activities (Human Activities)

Anthropogenic activities do not only mean that human activity to meet the demand for food, housing, clothing, and energy. It also includes all those development activities which directly or indirectly affect nature.

The anthropogenic activities are the followings:

- **Agriculture**

- Energy production
- Industrialisation
- Transportation
- Personal and Domestic Activities
- Wars

Impact of Anthropogenic Activities on Environment

Overpopulation is a stage in which the demand for natural resources does not meet for the population. In other words, overpopulation is the condition in which the available natural resources are limited or not sufficient for the human population. The effects of overpopulation are quite severe, with one of the most severe being the degradation of the environment. The environment has the potential to restore most of its resources in a certain period of time. However, over-exploitation of resources and anthropogenic activities have altered it, leading to many environmental problems, such as:

1. Deforestation
2. Pollutions
3. Global Warming
4. Depletion of Ozone Layer
5. Diminishing of Fossil Fuels
6. Acid Rain
7. Climate Change

1. Deforestation

Cutting of the natural forest cover is called **deforestation**. we are aware of the importance of forests as a major natural resource. They provide wood for multiple use, shelter to wild life, soil conservation and rainfall. Plants take up carbon dioxide for photosynthesis. Less forests mean more carbon dioxide in the atmosphere.

Cutting down of forests may lead to the following:

1. Destruction of habitat or living place for wild plants and animals leading to disappearance and extinction of many species,
2. Reduced rainfall in that area,
3. Lowering of water table or depth of ground water,
4. Soil erosion, loss of fertility of soil and lack of vegetation leading to desertification, and
5. Increased CO2 levels in the atmosphere and global warming.

2. Pollution

Human life includes a number of daily activities. Bathing and washing of clothes with soaps and detergents add some chemical residue to water and change its quality. Cooking of food by using firewood may give out smoke in the air. Agricultural activities may dump fertilizers and pesticides in the environment.

Each activity, human or industrial, discharges some unwanted substances in the environment. The addition of unwanted substances in wrong concentration that has an adverse effect on organisms and environment, is called pollution. Technological growth has given new devices for human comfort but has also added substances that may have an adverse effect on life and environment.

An undesirable change in the physical, chemical and biological characteristics of the environment especially air, water and land that may adversely affect human population and the wildlife, industrial processes, cultural assets (buildings and monuments), is called **pollution.** The agents that pollute the resources or cause of pollution are called **pollutants.**

3. Global Warming (Greenhouse Effect)

Greenhouse is referred to as a glass chamber where plants are grown in a closed warm environment as compared to the outside temperature. This is normally practiced in cold regions on the hills. The solar radiations bringing heat (in the form of infra-red rays from the sun) are trapped inside the chamber.

4. Causes of Global Warming

Industrialization and urbanization has lead to deforestation and release of gases, such as Carbon dioxide (CO2), Chlorofluorocarbons (CFCs), Methane (CH4) and Nitrous oxides (N2O) into atmosphere These gases are the main greenhouse gases that cause **global warming**. An increase in the concentration of these greenhouse gases leads to an increased trapping of long wave radiations resulting in an increase in Earth's temperature causing **global warming.**

Greenhouse Gases: Their sources and Causes

Gas	**Sources and Causes**
Carbon dioxide (CO2)	Burning of fossil fuels, deforestation
Chlorofluorocarbons(CFCs)	Refrigeration, solvents, insulation foams, aero propellants, industrial and commercial uses
Nitrogen oxides (N2O)	Burning of fossil fuels, fertilizers; burning of wood and crop residue.
Methane (CH4)	Growing paddy, excreta of cattle and other livestock, termites,

Effects of global warming

Although the increase in global temperature in the last hundred years has been estimated to rise by only 1 degree, it has resulted in serious consequences, such as:

- melting of snow caps/ glaciers and rising of sea level,
- unpredictable weather patterns,
- submerging of coastal areas of the Maldives islands in the Indian Ocean,
- early maturation of crops leading to reduced grain size and low yields, and
- interference with the hatching of eggs in certain fish.

5. Depletion of Ozone Layer

The ozone hole: depletion of the ozone layer

The ozone layer present in the Earth's atmosphere prevents the entry of sun's harmful ultraviolet (UV) radiations reaching the Earth's surface. Industrial use of chemicals called chlorofluorocarbons (CFCs) in refrigeration, air conditioning, cleaning solvents, fire extinguishers and aerosols (spray cans of perfumes, insecticides, medicines, etc.) damage the ozone layer. Chlorine contained in the CFCs on reaching the ozone (O3) layer splits the ozone molecule to form oxygen (O2). Amount of ozone, thus, gets reduced and cannot prevent the entry of UV radiations. There has been a reduction by 30-40% in the thickness of the ozone umbrella or shield over the Arctic and Antarctic regions.

Depletion of ozone layer may lead to the following hazards:

- Sunburn, fast ageing of skin, cancer of skin, cataract (opaqueness of eye lens leading to loss of vision),
- cancer of the retina (sensitive layer of the eye on which image is formed)?
- Genetic disorders

Reduced productivity at sea and forests

Important Ozone Depleting Chemicals and their uses

Name of the compound	Used in

CFCs	Refrigeration, aerosol, foam, food freezing, warming devices, cosmetics, heat detectors solvents, cosmetics, refrigerants, firefighting
Halon	Firefighting
HCFC-22	Refrigeration, aerosol, foam, fire fighting
Methyl chloroform	Solvent
Carbon tetrachloride	Solvent

6. Acid Rain

Acid rain occurs when Sulphur dioxide (SO2) and oxides of Nitrogen (NOx) are emitted into the atmosphere, undergo chemical transformations and are absorbed by water droplets in clouds. This causes the **formation of sulphuric and nitric acids in rain clouds**. The droplets then fall to Earth as rain, snow or mist. If rain falls through polluted air it picks up more of these gases and increases its acidity. This is called **acid rain**. This can increase the acidity of the soil and affect the chemical balance of lakes and streams. Thus, acid rain is defined as any type of precipitation with a **pH that is unusually low**. A **pH** of less than **about 5** is used as a definition of acid rain. Acid rain is a serious environmental problem that affects large parts of the world.

Sources of Acid Rain

Sulphur dioxide (SO2) is generally a byproduct of industrial processes and burning of fossil fuels. Ore smelting, coal-fired power generators and natural gas processing are the main contributors to Sulphur dioxide in the atmosphere.

The main source of **oxides of nitrogen (NOx)** emissions is the combustion of fuels in motor vehicles, residential and commercial furnaces, industrial and electrical- utility boilers and engines, and other equipment's.

Effects of Acid Rain

It causes acidification of lakes and streams and contributes to the damage of trees and many sensitive forest soils. Also, acid rain accelerates the decay of building materials and paints, including heritage buildings, statues, and sculptures that are part of our nation's cultural heritage. Before falling to the Earth, Sulphur dioxide (SO2) and nitrogen oxide (NOx) gases and their particulate matter derivatives; sulphates and nitrates, contribute to visibility degradation and harm public health.

Depletion of Fossil Fuels

Fossil fuel is a term used to describe a group of energy sources that were formed from ancient plants and organisms during the Carboniferous Period, approximately 360 to 286 million years ago, before the age of dinosaurs. Fossil fuels are also called **non-renewable energy.**

There are three types of fossil Fuels;

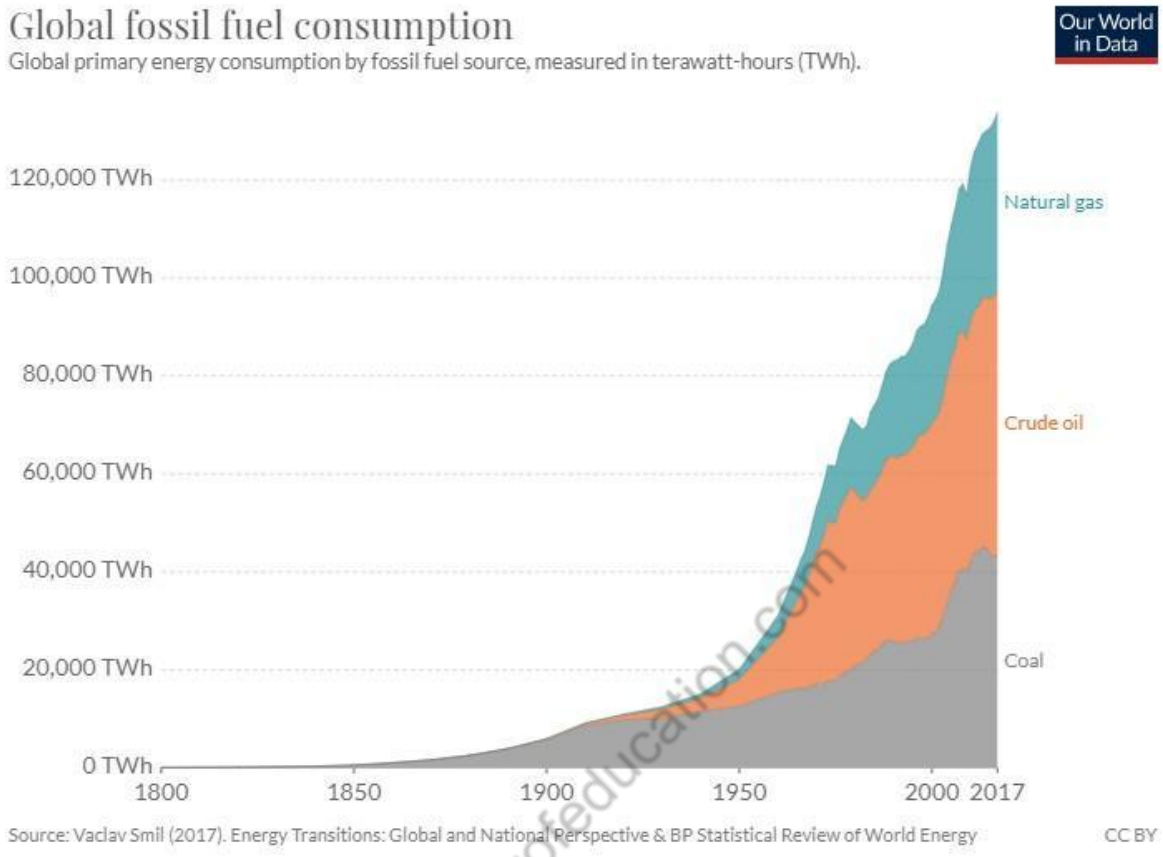
1. **Coal,**
2. **Oil and**
3. **Natural Gases.**

The reserves of fossil fuels are limited.

Fossil fuels (coal, oil, gas) have, and continue to, play a dominant role in global energy systems. Fossil energy was a fundamental driver of the Industrial Revolution, and the technological, social, economic and development progress which has followed. Energy has played a strongly positive role in global change.

However, fossil fuels also have negative impacts, being the dominant source of local air pollution and emitter of carbon dioxide (CO2) and other greenhouse gases.

Fossil Fuel Consumption



We are oblivious of the fact that there will be a time, measured in decades, when these fuels will run out. Because of global population rise, there is a growing demand for energy. This growth is endangering our future.

All deposits of fossil fuels are limited either physically or economically, thus making them finite and non-renewable natural resources. Because of the global population rise, there is a growing demand for energy. Countries, which have fossil fuel reserves, are extracting at a high rate either for the use or to sell to the other countries. As we know that fossil fuels can not replenish through human efforts and technology. Hence, the extraction of finite non-renewable resources is at a faster rate, then it will eventually be depleted within 100-150 years (approximately).

7. Climate Change

Rising fossil fuel burning are increasing quantities of greenhouse gases into the Earth's atmosphere. These greenhouse gases include carbon dioxide (CO2), methane (CH4) and nitrogen dioxide (N2O), and a rise in these gases has caused a rise in the amount of heat from the sun withheld in the Earth's atmosphere, the heat that would normally be radiated back into space. This increase in heat has led to the greenhouse effect, resulting in climate change.

The main characteristics of climate change are:

- increases in average global temperature (global warming);
- changes in cloud cover and precipitation particularly over land;
- melting of ice caps and glaciers and reduced snow cover; and
- increases in ocean temperatures and ocean acidity (due to seawater absorbing heat and carbon dioxide from the atmosphere).

Literally '**Climate Change'** denotes the long-term change in the statistical distribution of weather patterns (e.g. temperature, precipitation etc.) over decades to millions years of time. The climate on Earth has changed on all time scales even since long before human activity could have played a role in its transformation.

UNFCCC defined Climate Change as "**a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods**".

And the adverse human activities for example burning fossil fuel, deforestation etc. are considered likely to bring change in some climatic aspects which are briefly presented in the following table

Table: **Aspects of Climate Change and perceived implications**

Climatic Features		Implications of Change
	GHG concentration	Emission of Green House Gases thorough industrialization, travelling etc. is increasing the GHG concentration in the atmosphere. At this moment CO2 concentration is at its highest concentration in 650 000 years – 393 ppm
	Change in world temperature	GHG concentration along with some other issues leads to warming the world. Earth has warmed since 1880. Most of this warming has occurred since the 1970s, with the 20 warmest years having occurred since 1981. Being central to the issue predominantly, Global warming brings about change in following different features of the human environment
Ozone layer depletion		A slow, steady decline of about 4 % per decade in the total volume of ozone in Earth's stratosphere (the ozone layer) since the late 1970s is estimated which is likely to bring health implications (different cancerous diseases), augmenting extreme weather events (desertification, drought) through opening the curtain that was protecting Earth from hazardous sun rays.
Shrinking ice sheets		Greenland lost 150 km^3 to 250 km^3 (36 mi^3 to 60 mi^3) of ice per year between 2002 and 2006 and Antarctica lost about 152 km^3 (36 mi^3) of ice between 2002 and

	2005. This on the other hand contributing to the next problem sea level rise.
Rise in Sea Level	Global sea level rose about 17 cm in the last century. Continual increase is very likely to inundate many island states, low-lying delta regions leaving their population having no land to inhabit.
Ocean Acidification	Since 1750 the CO2 content of the Earth's oceans has been increasing and it is currently increasing about 2 billion tons per year which has increased ocean acidity by about 30 %.
Warming Oceans	With the top 700 m (about 2300 ft) of ocean showing warming of 0.16 degree Celcius since 1969 due to absorbed increased heat of the Earth.

Ocean Acidification and Warming Oceans, these two changes are likely to bring massive change/destruction in ocean habitations.

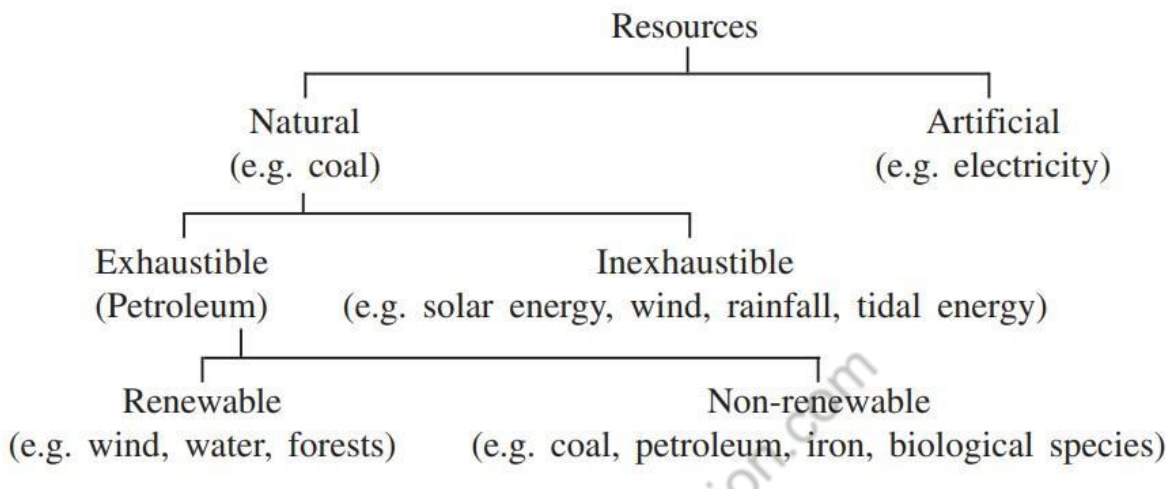
Natural and Energy Resources

A **resource** can be defined as 'any natural or artificial substance, energy or organism, which is used by human being for its welfare.

Natural Resources: All things that nature has provided such as soil, air, water, minerals, coal, sunshine (sunlight), animals and plants, etc., are known as natural resources.

Artificial Resources: The resources, which have been developed by human beings during the growth of civilization, are called artificial resources. **For**

example, biogas, thermal electricity, plastics. These man- made resources are generally derived from some other natural resources. For example, plastics from the natural resource, petroleum.



Types of Natural Resources

The natural resources can be classified in the following ways:

Inexhaustible Resources

The resources which cannot be exhausted by human consumption are called **inexhaustible resources.** These include energy sources like solar radiation, wind power, waterpower (flowing streams) and tidal power, and substances like sand, clay, air, water in oceans, etc.

Exhaustible Resources

On the other hand, there are some resources, which are available in limited quantities and are going to be exhausted as a result of continuous use. These are called **exhaustible resources**. For example, the stock of coal,

petroleum, and natural gases in the earth is limited and one day there will be no more coal available for our use.

Renewable Resources

Some of the exhaustible resources are naturally regenerated after consumption and are known as **renewable resources.** e.g. **Forest trees and plants** that make a forest may be destroyed but new ones grow in their place. But if forest is totally cut down to get land for construction of buildings, it is lost forever. Some other examples are fresh water, fertile soil, forest (yielding wood and other products), vegetation, wildlife, etc.

Non-renewable Resources

The resources, which cannot be replaced after the use, are known as **non-renewable Resources.** These include minerals (copper, iron etc.) fossil fuels (coal, oil etc.). Even wildlife species (rare plants and animals) belong to this category.

We have always been using different forms of energy obtained from various sources for our daily activities like cooking, heating, ploughing, transportation, lighting, etc.

For example, heat energy required for cooking purpose is obtained from firewood, kerosene oil, coal, electricity or cooking gas. LPG (liquefied petroleum gas) We use animal power (horse, bullock, etc.) for transportation and for running minor mechanical devices like the Persian wheel for irrigation or for running a **"kolhu"** for extracting oil from oilseeds. Different forms of these energies are obtained from various sources. We will discuss about them in detail.

Types of Energy Sources

There are two main categories of energy sources:

1. **Conventional Sources of Energy,** which are easily available and have been in usage for a long time.
2. **Non-Conventional Sources of Energy,** that are other than the usual, or that are different from those in common practice.

The table below summarises the list of both the above categories of energy resources.

Types of Energy Sources

Conventional Energy		Non-Conventional Energy
Conventional Non-renewable Energy (Mostly fossil fuels found under the Ground)	Conventional Renewable Energy (Mostly non-fossil fuels seen above the Ground)	Solar Energy Hydel Energy Wind Energy Nuclear Energy Hydrogen Energy Geothermal Energy Biogas Tidal Energy Biofuel
Examples: Coal, Oil, Natural gas etc.	Examples: Firewood, Cattle Dung, Farm, Vegetable Wastes, Wood charcoal, etc.	

1. Biosphere	Plants, Animals, and Bio organism
2. Atmosphere	Air (oxygen, CO2, Nitrogen, Hydrogen etc.)
3. Hydrosphere	Water including oceans, seas, rivers, lakes, glaciers, ice caps, ground water, etc.

. Lithosphere	Soil, Minerals, Rocks

Conventional Sources of Energy

Conventional sources of energy have been in used since ancient times. Most important among them are the fossil fuels.

Fossil Fuels

Fossil fuels are the fossilised remains of plants and animals, which over millions of years have been transformed into coal, petroleum products and natural gas.

Coal is the most abundant fossil fuel. It is widely used for combustion in cooking and industrial activities. There are different types of coal products such as coal gas, coal tar, benzene, toluene, etc., which are used for various purposes.

Oil and Natural gases are formed from plants and animals which once lived in the tropical seas. Oil (or petroleum) is a source of countless products. Apart from petrol, diesel and other fuels, petroleum products include lubricants, waxes, solvents, dyes, etc. Petroleum reserves are supposed to last for another 100 years or so.

Natural gas is often found with petroleum. The gas mainly contains methane. Apart from serving as fuel in several industries, it is being increasingly used as domestic fuel in many countries including India. United States of America is the largest producer as well as consumer of natural gas.

Now-a-days in big cities and towns it is being supplied through pipelines which is called **Piped Natural Gas (PNG)**. The natural gas is also used as a fuel to run vehicles. It is known as **Compressed Natural Gas (CNG)**. It is accepted as an economical and less polluting fuel for transport.

The **Liquefied Petroleum Gas (LPG)** is the common cooking gas used in Indian homes. It is a mixture of propane and butane gases kept under pressure in liquid form, but they burn in gaseous form. This gas is made available in a specific container for domestic as well as industrial uses. It is a byproduct of petroleum refineries

Non-Conventional Sources of Energy

We have already learnt known about conventional sources of energy, whether renewable or non- renewable (coal, oil, etc.), which are fast depleting and will not last long. Therefore, greater utilisation of non-conventional sources of energy (solar, wind, hydro, geothermal, etc) will have to be used.

1. Solar Energy

Solar energy is the ultimate source of all energy on earth. Firewood, coal, oil or natural gas are the products of plants and other organisms, which had used solar energy for the synthesis of organic molecules during photosynthesis. Even today it will turn out to be the most important answer to problems of energy except nuclear energy.

The solar energy has the following advantages:

(i) It is abundant
(ii) It is everlasting
(iii) It is available almost everywhere.
(iv) It is free from political barriers.

2. Hydel /Hydro Energy

The generation of electricity by using the force of falling water is called hydro- electricity or hydel power. It is cheaper than thermal or nuclear power. For its generation dams are built to store water, which is made to fall to rotate turbines that generate electricity.

3. Wind Energy

Wind as an energy can be utilised in our daily life by converting it into mechanical energy. This mechanical energy is used to generate electricity, raise water from wells and rivers for irrigation and other purposes. **Windmills** have been in use since early times to provide power for grinding grains. It is also used for grain cutting and shelling. In India a large number of windmills are being constructed on the sea beach and hilly areas.

Minimum wind speed required for operating the windmill is 7 km/hour. A windmill can draw water upto a maximum depth of 55 feet and the output is 4000-9000 litres (of water) per hour.

4. Tidal Energy

Tidal energy is one that is produced by making the use of water movement from a high tide to a low tide. Ocean waves and tides can be made to turn a turbine and generate electricity. Areas where rivers flow into the sea experience waves and tides and electricity can be generated there. It has much potential. As you know we have a large coastline and major river systems in our country, electricity can be generated on a large scale from waves and tides.

5. Nuclear Energy

Radioactive elements like uranium and thorium disintegrate spontaneously releasing large quantities of energy. This energy can be trapped to produce electricity. 25% of world's thorium reserve is found in our country, which can be utilised to generate electricity. Most advanced countries have nuclear power stations. We too have some in India, for example, **Tarapur (Maharashtra), Kalpakkam (Tamil Nadu), Narora (Uttar Pradesh), Kota (Rajasthan)**. Approximately 3% of India's electricity comes from nuclear power and about 25% is expected to come by 2050.

Installation costs of nuclear power stations are very high, but maintenance costs are relatively low. If not carefully maintained, these also have an inherent risk of causing radioactive pollution.

6. Hydrogen Energy

Hydrogen is the primary fuel for the hydrogen-based fuel cells and power plants. Power can be generated for industrial, residential and transport purposes by using hydrogen.

7. Geothermal Energy

This is the energy derived from the heat in the interior of the earth. In volcanic regions, springs and fountains of hot water called "geysers" are commonly found. These eruptions of hot steaming water can be used to turn turbines and produce electricity in geothermal power plants. In this method cold water is allowed to seep through the fissures in the rocks till it reaches the hot rocks in the lower layers. Water gets heated and gets converted into steam which forces out to the surface to be used in power generation. Besides the superheated steam of hot springs can also generate electricity. There are 46 hydrothermal areas in India where the water temperature normally exceeds 150 degree centigrade. Electricity can be generated from these hot springs.

8. Biogas (Biomass)

Another form of non-conventional energy is **biogas**. It is produced by the microbial activity on cattle dung in a specially designed tank called digester. A mixture of water and cattle dung is poured in this digester where anaerobic decomposition takes place and biogas is generated. This gas contains 55 –70 percent methane, which is inflammable, and it is generally used as cooking gas and for generation of electricity. The "waste" left in the tank after the generation of biogas is used as manures. Thus, biogas plant provides us both the fuel and the manure. Biogas plants are becoming very popular in rural India.

9. Biofuel

The hydrocarbons present in such plants can be converted into petroleum hydrocarbons. This liquid hydrocarbon is the biofuel and the plants producing it are called petro-plants. The plant species, ***Jatropha curcus*** is the most suitable one, which yields biodiesel. The Indian Oil Corporation is carrying out experiments for preparation of biodiesel from various vegetable oils extracted from **rice bran, palm, karanjia, sunflower** etc.

Environmental Issues: Local, Regional and Global

Environment have been supplying us the different types of resources to live a life since our appearance on the earth. In return, we have damaged the environment severely. The human activities have polluted the ecology and have modified the environmental structure.

Due to changes in the originality of the nature, we are facing different types of environmental issues at local, regional and global levels.

Environmental Issues at Local level:

- Drinking water
- Poor Air Quality
- Infertility of soil
- Health issues due to Hazardous waste

Environmental Issues at Regional Level:

- Deforestation
- Desertification
- Pollutions
- Diminishing of Fossil Fuels

Environmental Issues at Global Level:

- Global warming
- Depletion of Ozone layer
- Acid Rain
- Climate Change

POLLUTION

The addition of unwanted substances in a concentration that has an adverse effect on organisms and environment is called pollution.

Types of Pollution

- Air pollution
- Water pollution
- Soil pollution

- Noise pollution
- Waste (Solid, Liquid, Biomedical, Hazardous, Electronic)

Air Pollution

According to NASA, the composition of air (gases) in Earth's atmosphere include:

Nitrogen — 78 percent

Oxygen — 21 percent

Argon — 0.93 percent

Carbon dioxide — 0.04 percent

Trace amounts of neon, helium, methane, krypton and hydrogen, as well as water vapor.

If there is some disturbance in proportion of gases or addition of some unwanted substances (like, smoke, dust particles etc.) in atmospheric air, then it is called **Air Pollution.**

Sources of Air Pollution

The sources of air pollution can he divided into two categories (i) Natural, and (ii) Human-made

(i) Natural sources

(i) Ash from burning volcanoes, dust from storm, forest fires

(ii) Pollen grains from flowers in air are natural sources of pollution

(ii) Anthropogenic (human-made) sources

(i) Power stations using coal or crude oil release CO2 in air

(ii) Also, furnaces using coal, cattle dung cakes, firewood, kerosene, etc.

(iii) Steam engines used in railways, steamers, motor vehicles, etc. give out CO2.

(iv) So do Motor and internal combustion engines which run on petrol, diesel, kerosene. etc.
Vegetable oils, kerosene, and coal as household fuels

(v) Sewers and domestic drains emanating foul gases

(vi) Pesticide residues in air

Major Air Pollutants

- ### Carbon Dioxide

Carbon dioxide is one of the major gases which contributes towards air pollution. It is mainly produced during the combustion of fuel in factories, power stations, household etc. The increasing CO2 in the atmosphere is likely to have the following effects:

i. **A rise in atmospheric temperature or global warming due to greenhouse effect. Also causes climate change.**

ii. **Reduced productivity of the marine ecosystem**. This is due to the fact that water in the oceans would be more acidic due to increased concentration of CO2 in the air, which dissolves in the water.

iii. **Due to Global warming,** the increased surface temperature would cause **melting of continental and mountain glaciers** and thus would cause **flooding of**

coastal areas of some countries.

- ## Sulphur Dioxide

It is produced by the burning of coal in powerhouses and automobiles (car, trucks etc.). It causes **chlorosis** and **necrosis** of plants, irritation in eyes and injury to the respiratory tract (asthma, bronchitis) in humans responsible fordiscoloration and deterioration of buildings. High concentration of sulphur dioxide in the atmosphere dissolves in rain drops to form sulphuric acid which causes **acid rain**.

- ## Carbon Monoxide

Carbon monoxide is produced as a result of incomplete combustion of fossil fuels like coal, petroleum and wood charcoal. Automobiles using diesel and petroleum are the major sources of carbon monoxide which gets added to the atmosphere. Carbon monoxide is more dangerous than carbon dioxide. It is a poisonous gas which causes respiratory problems. When it reaches the blood stream, it replaces oxygen due to its high affinity for haemoglobin. It also causes giddiness, headache and interferes with normal function of the heart.

- ## Fluorides

Upon heating, rocks, soils and minerals that contain fluorides, give out hydrogen fluoride gas. This is an extremely toxic gas, which causes serious injury to livestock and cattle.

- ## Oxides of Nitrogen

A few oxides of nitrogen, such as nitric oxide (NO), nitrous oxide (N2O) and nitrogen dioxide (NO2) are produced by

natural processes as well as from thermal power stations, factories, automobiles and aircrafts (due to burning of coal and petroleum). They reduce the oxygen carrying capacity of blood, may cause eye irritation and skin cancer in human beings.

- ### Smog

Smog is a mixture of smoke, dust particles and small drops of fog. Smog may cause necrosis and develop a white coating on the leaves (silvering) of plants. In human beings and animals, it may cause asthma and allergies.

- ### Aerosol Spray Propellants

Suspended fine particles in the air are known as aerosols. Aerosols contain chlorofluorocarbons (CFCs) and fluorocarbons used in refrigerants and aerosol cans. They cause depletion of the ozone layer.

- ### Domestic Air Pollutants

Smoke from cigarettes, *biri*, cigar and other such objects using burning tobacco, burning of coal, firewood, cow dung cakes, kerosene oil and liquefied gases are major domestic pollutants. The common pollutant gases emitted during the domestic burning of coal, kerosene oil, firewood, cow dung cakes, etc. are carbon monoxide (CO), carbon dioxide (CO2), Sulphur dioxide (SO2), etc. The pollution due to these pollutants causes suffocation, eye and lung diseases and low visibility.

Impact of Air Pollutants

Major effects of air pollutants on human health, plants and other animals is given below:

Some major air pollutants, their sources and effects

Pollutant	Source	Harmful effect
Carbon compounds (CO and CO2)	Automobile exhausts, burning of Wood and coal	- Respiratory problems - Greenhouse effect global warning and climate change
Sulphur Compounds (SO2 and H2S)	Power plants and refineries, Volcanic eruptions	• Respiratory problems in humans • loss of chlorophyll in plants (chlorosis) • Acid rain
Nitrogen Compound (NO and N2O)	Motor vehicle exhaust, atmospheric reaction	• Irritation in eyes and lungs • Low productivity in plants • Acid rain damages material (metals and
Hydrocarbons (benzene, ethylene)	Automobiles and petroleum industries	• Respiratory problem • Cancer causing properties
SPM (Suspended Particulate matter) (Any Solid or liquid particles suspended in the air, (fly ash, dust, lead)	Thermal power plants, construction activities, metallurgical processes and automobiles	- Poor visibility, breathing problems - Lead interferes with the development of red blood cells and causes lung diseases and cancer - Smog (smoke+fog) formation leads to poor visibility and aggravates asthma in patients
Fibres (Cotton, wool)	Textile and carpet weaving industries	- Lung disorders

Water Pollution

Any physical, biological or chemical change in water quality that adversely affects living organisms or makes water unsuitable for desired use is called water pollution.

Sources of Water Pollution

There are two sources of water pollution on the basis of origin of pollutants:

(i) Point sources and (ii) Non-point sources

(i) **Point sources:** Those sources which discharge water pollutants directly into the water are known as point sources of water pollution. Oil wells situated near water bodies, factories. power plants, underground coal mines, etc. are point sources of water pollution.

(ii) **Non-point sources:** Those sources which do not have any specific location for discharging pollutants in the water, are known as non-point sources of water pollution. Run-offs from agricultural fields, lawns, gardens, construction sites, roads and streets are some non-point sources of water pollution.

Water Pollutants

River, lake and sea water may be polluted in many ways.

- **Domestic sewage** discharged into rivers from areas located on its banks
- **Industrial wastes** effluents from urban areas containing high concentration of oil, heavy metals and detergents
- **Minerals, organic wastes and crop dusting** from agricultural fields with phosphate and nitrogen fertilizers that reach lakes, rivers and sea (water becomes deoxygenated and poisonous, thus, cannot support aquatic life)

- **Chemical fertilizers, pesticides, insecticides, herbicides and plant remains**
- Industrial wastewater containing several **chemical pollutants,** such as calcium, magnesium, chlorides, sulphide, carbonates, nitrates, nitrites, heavy metals and radioactive waste from nuclear reactor.
- **Excretory wastes of humans and animals in water bodies**
- **Disposal of urban and industrial waste matter into water bodies**

Fertilizers and pesticides are widely used in agriculture. Their excessive use for increasing agricultural yield has led to the phenomenon of **eutrophication** and **biomagnification.**

Some major disturbances in the ecosystem due to water pollution

Pollutant	Sources	Cause	Effect
Nitrates, phosphates, ammonium salts	Agricultural fertilizers, sewage, manure	Plant nutrients	Eutrophication
Animal manure and plant residues	Sewage, paper mills, food processing wastes	Oxygen deficiency	Death of aquatic animals
Heat	Power plants and industrial cooling	Thermal discharge	Death of fish

Oil slick	Leakage from oil ships	Petroleum	Death of marine life due to non-availability of oxygen dissolved in water

Some water pollutants, their sources and effect on human health

Pollutant	Source	Diseases in humans
Lead	Industrial waste	Nervous disorders, Kidney failure, blood poisoning
Tin	Industrial dust	Affects central nervous system (CNS) Affects, vision
Mercury	Industrial discharge	Affects central nervous system and peripheral nervous system, kidney failure, Numbness of lips, muscles and limbs, Blurred vision
Arsenic	Industrial discharge	Respiratory and skin cancer, Nervous disorder
Nickel, Cadmium	Aerosols, Industrial dust, Industrial discharge	Pulmonary disorders, Dermatitis, Kidney disorders, Pulmonary and skeletal diseases
Uranium, Thorium, Cesium	Radioactive waste	Leucoderma, Skin cancer

Soil Pollution

Addition of substances that change the quality of soil by making it less fertile and unable to support life is called **soil pollution.**

Sources of soil pollution

Soil pollution is caused due to:

- Domestic sources: plastic bags, kitchen waste, glass bottles, and paper
- Industrial sources: chemical residue, fly ash, metallic waste,

and

- Agricultural residues: fertilizers and pesticides.

Harmful effects of soil pollution

- Decrease in irrigated land thereby reduction in agricultural production.
- Decrease in soil productivity.
- Carry over of pollutants into the food chain.
- Damage to landscape

Control of Soil Pollution

Judicious use of chemical fertilizers and pesticides. Proper and appropriate irrigation practices

- Conversion of farm wastes into compost and much use of bio fertilizers and manure in farming.
- Ensure use of pollution free or treated wastewater only for irrigation.
- Recycling of waste material for example plastic, metal and glass are recyclable and incineration of non-recyclable, wastes.

Soil Erosion

The process of detaching and removal of loosened soil particles by water (running water, ground water, rain, sea waves) and wind is known as soil erosion.

Soil may be eroded by water and wind, each contributing towards a significant amount of soil loss every year in our country.

Types of soil erosion

Wind erosion

Erosion of large quantity of fine soil particles and sand from deserts by wind is known as wind erosion.

It is spread over the cultivated land and thus, destroys fertility of that land.

Sheet erosion

When water moves over the land surface as a sheet, it takes away the topmost thin layer of soil. This phenomenon occurs uniformly on the slopes of hilly areas, riverbeds and areas affected by floods. This type of erosion is known as **sheet erosion**.

Gully erosion

When water moves down the slope as a channel, it scoops out the soil and forms gullies which gradually multiply and spread over a large area. This type of soil erosion is known as **gully erosion.**

NOISE POLLUTION

Any unwanted sound is defined as noise. You know that the noises come from traffic, vehicles, especially at peak hour every day, loudspeakers and building construction work. Industries expose their workers to a high level of noises for long period of work every day.

Prolonged exposure to high level of noise is harmful. Noise is measured in terms of 'decibel' (db) - a scale expressing intensity of the sound.

Noise has harmful effects on human body. Noise of **70-80 dB** causes annoyance and irritation. Above this level, breathing rate may be affected, blood vessels may constrict, movement of digestive canal is disturbed, glandular secretions may be affected. Long exposure to high noise levels can impair hearing.

Pollution control Legislations in India

Acts	Year
Indian Forest Act	1927
Wildlife Protection Act	1972
The water (Prevention and control of Pollution) Act	1974
The air (Prevention and control of Pollution) Act	1981
The Environmental (Protection) Act	1986
The National Environmental Tribunal Act	1995

The pollution related laws like the Water Act (1974), Air Act (1981), and the Environmental Protection Act (1995) do not give the right to an individual to move the court under the environment laws for damages caused to them by pollution. The right has been vested only in the agencies of the State Government.

Radiation: An Environmental Pollutant

Radiation is one of the chief forms of energy consisting of high energy particles. Radiation could be natural (solar and cosmic) or and human (nuclear). Radiation has also become a major factor causing environmental pollution.

Radiation may have both short term and long-term effects. They can further be divided functionally into:

- Ionising and
- Non Ionising radiations

Ionizing and Non-Ionising Radiations

Type	Ionising	Non-ionising
Examples	Alpha, Beta, Gamma	Ultraviolet radiation

	and X-	
	Ray	
Properties	Short wave lengths, high energy.	Higher wave lengths, low energy
Effects	Causes ionisation in cells photo products	Damage through toxic
Harmful Effects	- Deep penetrating power effects both external & internal organs - Brea kage of chromoso mes - Gene mutation and genetic variations - Cancer of bone marrow (Leukaemia) - Loss hair, - Male sterility	- Only superficial tissues are damaged - Kills micro-organism and egg of fish & amphibians - Prevents synthesis of DNA and RNA, Cell division Skin cancer in humans

Inhabitants of Hiroshima (Japan) exposed to nuclear fallout had no children for a long time or had deformed infertile offspring.

Nuclear Radiation and its harmful effect

Radiations emitted by **nuclear** substances or wastes (fallout) or from atomic power plant or an atomic explosion cause **nuclear radiation**. Nuclear wastes continue to emit radiation for a very long period. **Radioactive Iodine (^{131}I) and Strontium (^{90}Sr)** are two **nuclear wastes** from an atomic explosion and may cause cancer of thyroid and cancer of bone narrow/ respectively. By entering food chain they also get accumulated in high concentration in the body of the top consumer causing harmful effect on the health of both humans and animals.

Waste

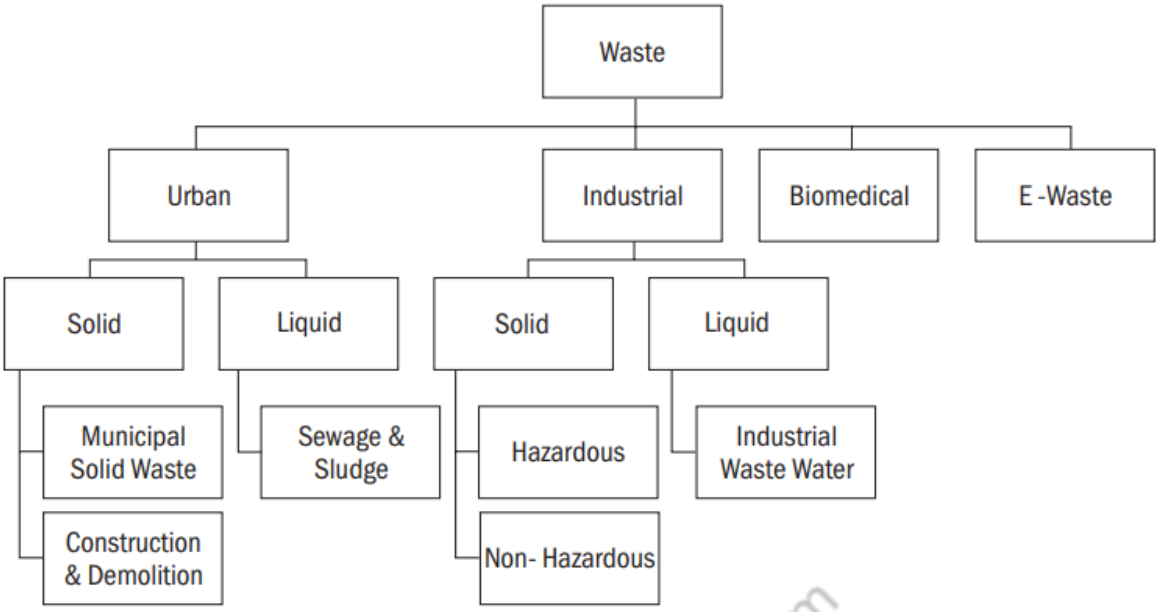
As per the oxford dictionary, wastes are the materials that are no longer needed and are thrown away. Waste is the unwanted and unusable materials and is regarded as a substance which is of no use.

Basel Convention by UNEP define wastes **"as substances or objects, which are disposed of or are intended to be disposed of or are required to be disposed of by the provisions of national law".**

Types of Waste

1. **Solid Waste**
2. **Liquid Waste**
3. **Biomedical Waste**
4. **Hazardous Waste**
5. **Electronic Waste**

Classification based on the Sources:



1. Solid Waste

Solid waste is the unwanted or useless solid materials generated from human activities in residential, industrial or commercial areas.

It may be categorised in three ways. According to its:

- origin (domestic, industrial, commercial, construction or institutional)
- contents (organic material, glass, metal, plastic paper etc)
- hazard potential (toxic, non-toxin, flammable, radioactive, infectious etc).

It can be classified into different types depending on their source:

1. **Municipal Solid Waste (MSW):** It consists of household waste, construction and demolition debris (CnD), sanitation residue, and waste from streets, generated mainly from residential and commercial complexes. As per the MoEF it

includes commercial and residential waste generated in municipal or notified areas in either solid or semi-solid form excluding industrial hazardous wastes but including treated bio-medical wastes;

2. **Industrial Solid Waste (ISW):** In a majority of cases it is termed as hazardous waste as they may contain toxic substances, are corrosive, highly inflammable, or react when exposed to certain things e.g. gases.
3. **Biomedical waste or hospital waste:** It is usually infectious waste that may include waste like sharps, soiled waste, disposables, anatomical waste, cultures, discarded medicines, chemical wastes, etc., usually in the form of disposable syringes, swabs, bandages, body fluids, human excreta, etc. These can be a serious threat to human health if not managed in a scientific and discriminate manner.

Rules and regulations associated with SWM

Under the 74th Constitutional Amendment, Disposal and management of Municipal Solid Waste is one of the 18 functional domains of the Municipal Corporations and Nagar Panchayats. The various rules and regulations for solid waste management are

1. The Bio-Medical Waste (Management and Handling) Rules, 1998
2. Municipal Solid Waste (Management and Handling) Rules 2000

3. The Plastic Waste (Management and Handling) Rules, 2011
4. E-Waste (Management and Handling) Rules, 2011

Liquid Waste

When water is used once and is no longer fit for human consumption or any other use, it is considered to be liquid waste. Liquid waste is not only wastewater but also **include fats, oils or grease (FOG), used oil, solids, gases, or sludges and hazardous household liquids. Liquid waste is commonly found both in households as well as in industries.**

Wastewater can be sub categorized as industrial and domestic.Industrial waste water is generated by manufacturing processes and is difficult to treat. Domestic wastewater includes water discharged from homes, commercial complexes, hotels, and educational institutions.

Biomedical Waste

Biomedical waste (BMW) comprises waste generated from hospitals, healthcare facilities and health research laboratories.

Biomedical waste is defined as any waste, which is generated during the diagnosis, treatment or immunisation of human beings or animals, or in research activities pertaining thereto, or in the production or testing of biologicals.

Examples: syringes, needles, disposable scalpels and blades, etc.

BMW is estimated to be only a small fraction of the MSW generation. About 80 per cent of this waste – called “general waste” – is non-infectious and if segregated can be managed as Muncipal Solid Waste. However, the

remaining 20 per cent is infectious and hazardous and hence is required to be treated in dedicated facilities.

Categories of Biomedical Waste

There are ten defined categories as follows:

1. Human Anatomical Waste: (tissues, organs, body parts)
2. Animal waste: (including animals used in research and waste originating from veterinary hospitals and animal houses).
3. Microbiological and biotechnology waste: (including waste from lab cultures, stocks or specimens of microorganisms, live or attenuated vaccines, wastes from production of biologicals, etc.)
4. Waste sharps: (used/unused needles, syringes, lancets, scalpels, blades, glass etc.)
5. Discarded medicines and cytotoxic drugs.
6. Soiled wastes: (items contaminated with blood and body fluids, including cotton dressings, linen, plaster casts, bedding etc.)
7. Solid wastes: (wastes generated from disposable items other than waste sharps such as tubing, catheters, i.v. sets, etc.)
8. Liquid waste: (waste generated from washing, cleaning, housekeeping and disinfection activities including these activities in labs).
9. Incineration ash: (from incineration of any biomedical waste)
10. Chemical waste: (chemicals used in production of biologicals and disinfection).

The major sources of biomedical waste are:

- Human anatomical waste like tissues, organs and body parts
- Animal wastes generated during research from veterinary hospitals
- Microbiology and biotechnology wastes
- Waste sharps like hypodermic needles, syringes, scalpels and broken glass
- Discarded medicines and cytotoxic drugs
- Soiled waste such as dressing, bandages, plaster casts, material contaminated with blood, tubes and catheters
- Liquid waste from any of the infected areas
- Incineration ash and other chemical wastes

Hazardous Waste

Hazardous wastes can be defined as **"wastes or combinations of wastes that pose a substantial present or potential hazard to humans or other living organisms or natural resources because they are nondegradable or persistent in nature, can be biologically magnified, can be toxic, or may otherwise cause detrimental cumulative effects."**

Hazardous wastes contain organic or inorganic elements that, due to their toxicological, physical, chemical, carcinogenic or persistency properties, may cause:

- Explosion or fire;
- Infection, including infection by parasites or their vectors;
- Chemical instability, reactions or corrosion;
- Acute or chronic toxic effects;
- Cancer, mutations or birth defects; or
- Damage to ecosystems or natural resources

Sources of Hazardous Waste

The term hazardous waste often includes by-products of industrial, domestic, commercial, and health care activities. Rapid development and

improvement of various industrial technologies, products and practices may increase hazardous waste generation.

Hazardous waste sources include industry, institutional establishments, research laboratories, mining sites, mineral processing sites, agricultural facilities and the natural environment.

Major hazardous waste sources and their pollution routes in the environment are listed below.

Agricultural land and Agro-industry: Hazardous wastes from agricultural land and agro-industry can expose people to pesticides, fertilizers and hazardous veterinary product wastes.

Domestic: Households stock various hazardous substances such as batteries and dry cells, furniture polishes, wood preservatives, stain removers, paint thinners, rat poisons, herbicides and pesticides, mosquito repellents, paints, disinfectants, and fuels (i.e. kerosene) and other automotive products. These can present a variety of dangers during storage, use and disposal.

Mines and mineral processing sites: Mining and mineral processing sites handle hazardous products that are present in the additives, the products and the wastes.

Health care facilities: Health care facilities are sources of pathological waste, human blood and contaminated needles. Specific sources of these wastes include dentists, morticians, veterinary clinics, home health care, blood banks, hospitals, clinics and medical laboratories.

Commercial wastes: Commercial waste sources include gasoline stations, dry cleaners and automobile repair shops (workshops). The types of hazardous wastes generated by these sources depend on the services provided.

Institutional hazardous waste sources: Institutional hazardous waste sources are mainly research laboratories, research centres and military installations.

Industrial hazardous waste sources: Hazardous wastes are created by many industrial activities. For example, the hazardous wastes from the petroleum fuel industry include the refinery products (fuels and tar), impurities like phenol and cyanides in the waste stream, and sludge flushed from the storage tanks.

Solid waste disposal sites: These are mainly disposal sites for municipal solid waste, but hazardous wastes that have not been properly separated from other wastes are also at these sites. In developing countries, solid waste disposal sites are a major source of pollutant-laden leachate to surrounding areas, as well as recyclable materials for scavengers, who can collect and resell waste materials that have been exposed to or that contain hazardous substances.

Contaminated sites: These are sites that are contaminated with hazardous wastes due to activities that use or produce hazardous substances or due to accidental spills. Former sites of industries that used or produced hazardous materials belong to this group.

Building materials: Roofs and pipes made of materials incorporating asbestos, copper, or other materials may present a source of hazardous waste.

e-Waste

Rapid growth of technology, upgradation of technical innovations, and a high rate of obsolescence in the electronics industry have led to one of the fastest growing waste streams in the world which consist of end of life electrical and electronic equipment product such as : Refrigerator, Washing machines, Computers and Printers, Televisions, Mobiles, Ipods etc. Many of which contain toxic materials.

E-waste or electronic waste broadly describes loosely discarded, surplus, obsolete, broken, electrical or electronic devices.

Pollutant Occurrence Liquid crystal, Lithium, Mercury Nickel Alloys, PCBs (poly chlorinated biphenyls) Selenium, Silver Zinc, etc.

The laws concerning Waste Management in India

Year	Law
1974	The Water (Prevention and Control of Pollution) Act
1975	The Water (Prevention and Control of Pollution) Rules
1977	The Water (Prevention and Control of Pollution) Cess Act
1978	Water (Prevention and Control of Pollution) Cess Rules
1981	The Air (Prevention and Control of Pollution) Act
1986	The Environment (Protection) Act
1989	The Manufacture, Storage and Import of Hazardous Chemical Rules
1991	The Public Liability Insurance Act
1995	The National Environment Tribunal Act
1997	The National Environment Appellate Authority Act
1998	The Bio-Medical Waste (Management and Handling) Rules
2001	Batteries (Management and Handling) Rules
2008	Hazardous Waste (Management, Handling & Transboundary Movement) Notified 2008
2010	National Green Tribunal Act
2011	The Plastic Waste (Management and Handling) Rules
2011	E-Waste (Management and Handling) Rules

Natural Hazards and Disasters

Natural hazards are severe and extreme weather and climate events that occur naturally in all parts of the world, although some regions are more vulnerable to certain hazards than others. **Natural hazards become natural disasters when people's lives and livelihoods are destroyed.**

Natural hazard events can be grouped into two broad categories:

Geophysical hazards encompass **geological and meteorological** phenomena such as earthquakes, coastal erosion, volcanic eruption, cyclonic storms, and drought.

Biological hazards can refer to a diverse array of disease and infestation. Other natural hazards such as floods and wildfires can result from a combination of geological, hydrological, and climatic factors.

Geological Hazards

Avalanche

An avalanche occurs when a large snow (or rock) mass slides down a mountainside. An avalanche is an example of a gravity current consisting of granular material. In an avalanche, lots of material or mixtures of different types of material fall or slide rapidly under the force of gravity. Avalanches are often classified by the size or severity of consequences resulting from the event.

Earthquake

An earthquake is a phenomenon that results from a sudden release of stored energy that radiates seismic waves. At the Earth's surface, earthquakes may manifest with a shaking or displacement of the ground; when the earthquake occurs on the seafloor, the resulting displacement of water can sometimes result in a ***tsunami***. Most of the world's earthquakes (90%, and 81% of the largest) take place in the 40,000-km- long, horseshoe-shaped zone called the circum-Pacific seismic belt, also known as the Pacific Ring of Fire, which for the most part bounds the Pacific Plate. Many earthquakes happen each day, few of which are large enough to cause significant damage.

Tsunami

A tsunami also known as a seismic sea wave or as a tidal wave, is a series of waves in a water body caused by the displacement of a large volume of water, generally in an ocean or a large lake. Tsunamis can be caused by undersea earthquakes such as the 2004 Boxing Day tsunami, or by landslides such as the one in 1958 at Lituya Bay, Alaska, or by volcanic eruptions such as the ancient eruption of Santorini. On March 11, 2011, a tsunami occurred near Fukushima, Japan and spread through the Pacific.

Coastal erosion

Coastal erosion is a physical process by which shorelines in coastal areas around the world shift and change, primarily in response to waves and currents that can be influenced by tides and storm surge. Coastal erosion can result from long-term processes as well as from episodic events such as tropical cyclones or other severe storm events.

Lahar

A lahar is a type of natural event closely related to a volcanic eruption, and involves a large amount of material originating from an eruption of a glaciated volcano, including mud from the melted ice, rock,

and ash sliding down the side of the volcano at a rapid pace. These flows can destroy entire towns in seconds and kill thousands of people, and form flood basalt. This is based on natural events.

Landslide

A landslide is a mass displacement of sediment, usually down a slope.

Sinkholes

A sinkhole is a localized depression in the surface topography, usually caused by the collapse of a subterranean structure such as a cave. Although rare, large sinkholes that develop suddenly in populated areas can lead to the collapse of buildings and other structures.

Volcanic Eruption

A volcanic eruption is the point in which a volcano is active and releases its power, and the eruptions come in many forms. They range from daily small eruptions which occur in places like Kilauea in Hawaii, to mega colossal eruptions (where the volcano expels at least 1,000 cubic kilometers of material) from super volcanoes like Lake Taupo (26,500 years ago) and Yellowstone Caldera. According to the Toba catastrophe theory, 70 to 75 thousand years ago, a super volcanic event at Lake Toba reduced the human population to 10,000 or even 1,000 breeding pairs, creating a bottleneck in human evolution. Some eruptions form pyroclastic flows, which are high-temperature clouds of ash and steam that can travel down mountainsides at speed exceeding an airliner.

Metrological Hazards

Blizzard

A blizzard is a severe winter storm icy and windy conditions characterized by low temperature, strong wind and heavy snow.

Drought

Scientists warn that global warming and climate change may result in more extensive droughts in coming years. These extensive droughts are likely to occur within the African continent due to its very low precipitation levels and high climate.

Hailstorm

A hailstorm is a natural hazard where a thunderstorm produces numerous hailstones which damage the location in which they fall. Hailstorms can be especially devastating to farm fields, ruining crops and damaging equipment.

Heat wave

A heat wave is a hazard characterized by heat which is considered extreme and unusual in the area in which it occurs. Heat waves are rare and require specific combinations of weather events to take place, and may include temperature inversions, katabatic winds, or other phenomena. There is potential for longer-term events causing global warming, including stadial events (the opposite to glacial "ice age" events), or through human-induced climatic warming.

Maelstrom

A maelstrom is a very powerful whirlpool. It is a large, swirling body of water with considerable downdraft. There are virtually no documented accounts of large ships being sucked into a maelstrom, although smaller craft and swimmers are in danger. Tsunami-generated maelstroms may even threaten larger crafts.

Cyclonic storm

Hurricane, tropical cyclone, and typhoon are different names for the same phenomenon: a cyclonic storm system that forms over the oceans. It is caused by evaporated water that comes off the ocean and becomes a storm. The **Coriolis effect** causes the storms to spin, and a hurricane is declared when this spinning mass of storms attains a wind speed greater than 74 mph (119 km/h). *Hurricane* is used for these phenomena in the Atlantic and

eastern Pacific Oceans, *tropical cyclone* in the Indian, and *typhoon* in the western Pacific.

Ice storm

An ice storm is a particular weather event in which precipitation falls as ice, due to atmosphere conditions. It causes damage.

Tornado

A tornado is a natural disaster resulting from a thunderstorm. Tornadoes are violent, rotating columns of air which can blow at speeds between 50 mph (80 km/h) and 300 mph (480 km/h), and possibly higher. Tornadoes can occur one at a time or can occur in large tornado outbreaks associated with super cells or in other large areas of thunderstorm development. Waterspouts are tornadoes occurring over tropical waters in light rain conditions.

Climate change

Climate change is a long-term hazard which can increase or decrease the risk of other weather hazards, and also directly endangers property due to sea level rise and biological organisms due to habitat destruction.

Geomagnetic storm

Geomagnetic storms can disrupt or damage technological infrastructure and disorient species with magnetoception.

Waterspout

A **waterspout** is an intense columnar vortex (usually appearing as a funnel-shaped cloud) that occurs

over a body of water. They are connected to a towering cumuliform cloud or a cumulonimbus cloud. In the common form, it is a non-supercell tornado over water

Flood

A flood results from an overflow of water beyond its normal confines of a body of water such as a lake, or the accumulation of water over land areas.

Wildfire

Wildfire is a fire that burnt in an uncontrolled and unplanned manner. Wildfires can result from natural occurrences such as lightning strikes or from human activity.

Classification of Disasters by High Powered Committee (HPC) in India

High Powered Committee (HPC) was constituted in August 1999 under the chairmanship of J.C. Pant. The mandate of the HPC was to prepare comprehensive model plans for disaster management at the national, state and district levels. This was the first attempt in India towards a systematic comprehensive and holistic look at all disasters. Thirty odd disasters have been identified by the HPC, which were grouped into the following five categories, based on generic considerations:

1. Water and Climate	**3. Biological**

• Floods • Cyclones • Tornadoes and hurricanes (cyclones) • Hailstorms • Cloudburst • Heat wave and cold wave • Snow avalanches • Droughts • Sea erosion • Thunder/ lightning	• Epidemics • Pest attacks • Cattle epidemics • Food poisoning **4. Chemical, industrial and nuclear** • Chemical and Industrial disasters • Nuclear **5. Accidental** • Forest fires • Urban fires • Mine flooding
2. Geological	
• **Landslides and mudflows** • **Earthquakes** • **Large fires** • **Dam failures and dam bursts** • **Mine fires**	

1) Water and Climate

- Floods
- Cyclones
- Tornadoes and hurricanes (cyclones)
- Hailstorms
- Cloudburst
- Heat wave and cold wave
- Snow avalanches
- Droughts
- Sea erosion
- Thunder/ lightning

2) Geological

- Landslides and mudflows
- Earthquakes
- Large fires
- Dam failures and dam bursts
- Mine fires

3) Biological

- Epidemics
- Pest attacks
- Cattle epidemics
- Food poisoning

4) Chemical, industrial and nuclear

- Chemical and Industrial disasters
- Nuclear

5) Accidental

- Forest fires
- Urban fires
- Mine flooding
- Oil spill
- Major building collapse
- Serial bomb blasts
- Festival related disasters
- Electrical disasters and fires
- Air, road, and rail accidents
- Boat capsizing
- Village fire

Mitigation Strategies

Mitigation refers to long-term risk reduction measures, which are intended to minimise the effects of a hazard; for example, dam construction is considered an activity that mitigates the effects of droughts. Hence,

"Mitigation involves not only saving lives and injury and reducing property losses, but also reducing the adverse consequences of natural hazards to economic activities and social institutions." According to Coburn Sspence, Pomonis (1994 in the DMTP, UNDP), Mitigation is defined as **"a collective term used to encompass all activities undertaken in anticipation of the occurrence of a potentially disastrous event, including long term preparedness and risk reduction measures…. It has occasionally been defined to include post-disaster response, which makes it equivalent to disaster management."**

The mitigation strategy is made up of three main required components: mitigation goals, mitigation actions, and an action plan for implementation. These provide the framework to identify, prioritize and implement actions to reduce risk to hazards.

Mitigation mainly focuses on minimising the destruction and disruption by a hazard and offers long term cost-effective methods of dealing with or managing natural disasters.

According to **Carter (1991),** there are two approaches to mitigation:

1. Structural Approach
2. On-structural Approach

In fact, non-structural measures complemented by structural measures are the effective means towards disaster mitigation.

Structural Approach Structural approach for mitigation may refer to both:

a) **Engineered Structures:** Engineered structures involve architects and engineers during the planning, designing and construction of structures, including buildings, dams, roads, bridges etc.

b) **Non-engineered Structures:** Non-engineered structures are generally constructed by people with the help of local artisans like masons, carpenters etc., using locally available raw material. These structures can be made safer, if people are trained and given improved designs.

These structures are normally of low-cost but have less strength/resistance for a disaster.

Non-structural Approach

Non-structural approach encompasses those measures that attempt to bring about coordination of efforts between all organizations and persons during all phases of disaster management, training and public awareness, legislation, policy making, preparing of action plans etc., Such approach to mitigation consists of positive actions through legislation, incentives, educating people, creating community awareness etc. Some of the non-structural mitigation measures are:

Legal Framework

In some of the disasters like flood, cyclone, earthquake etc., more casualties occur because people either live in low flood plains or not follow building codes made for the highly seismic zones or vulnerable cyclone areas. In case people are made to follow safe principles, byelaws and construction on unsafe areas is restricted, the disasters can be mitigated. The Disaster Management Act 2005 includes provisions for institutional and coordination mechanisms for undertaking the preparedness and mitigation measures and strategies for ensuring preparedness and capacity building.

Incentives: By suitable incentives people could be encouraged to adopt safe measures.

Insurance: Insurance of crops, buildings and other infrastructure in disaster-prone area is another measure.

Training, Education and Public Awareness: Training of the public officials at different levels is an essential part of disaster management. The general public should be made aware and kept informed about the nature of hazards to which they are exposed, their vulnerability and available protection

measures. Training and education need to target various categories of personnel including school children, crafts persons, technical personnel etc.

Institution Building: To increase the disaster mitigation capacity of a country, institution building is of great importance. Government bodies, departments, NGOs and people should be careful to avoid actions that will further increase a society's vulnerability. By increasing self -sufficiency, agencies may improve the ability of individuals, families and communities to cope with disaster.

Warning System: A reliable and timely warning of disasters can save a lot of human lives.

Mitigation Strategies: Government of India Initiatives

The Government of India has also issued guidelines indicating that priority will be given to projects addressing mitigation. We shall now discuss in brief the initiatives of Government of India in the area of disaster mitigation. These shall be categorised into structural and non-structural strategies.

Structural Strategies

a) **Flood Mitigation:** Flood mitigation measures have been in place since 1950s, in the form of embankments, dams and barrages etc. In order to respond effectively to floods, the Ministry of Home Affairs has initiated measures such as drawing up mitigation plans at the state, district, block, village levels, training of elected representatives and officials in flood management. etc. I

b) **Earthquake Risk Mitigation:** A comprehensive programme for earthquake risk mitigation is being taken up. This includes incorporation of Bureau of Indian Standard (BIS) Codes in building regulations, - town and country planning Acts etc. Especially states in earthquake- prone zones have been requested to incorporate BIS Seismic Codes for construction in the concerned zones. An Expert Committee appointed by the National Core

Group for Earthquake Risk Mitigation, has submitted its report covering appropriate amendments to the existing Town and Country Planning Acts, Land-use Zoning Regulation, Development Control Regulations and Building Byelaws. The Model Building Byelaws also cover the aspect of ensuring technical implementation of the safety aspects in all new constructions and upgrading the strength of existing structurally vulnerable constructions.

c). Constitution of Hazard Safety Cells in States: The states have been advised to constitute Hazard Safety Cells (HSC) headed by Chief Engineer, State Public Works Department with necessary engineering staff so as to establish mechanism for proper implementation of the building codes in all future government constructions and to ensure safety of buildings and structures from various hazards.

d) **Retrofitting of Lifeline Buildings:** The Ministries of Civil Aviation, Railways, Telecommunications, Power, Health and Family
Welfare have been advised to take appropriate action for detailed evaluation of retrofitting of lifeline buildings located in seismically vulnerable zones to comply with BIS norms.

e) **Mainstreaming Mitigation in Rural Development Schemes:** Rural housing and community assets for vulnerable sections of the population are created on a fairly large scale by the Ministry of Rural Development under the Indira Awaas Yojna (IAY) (Now, Pradhan Mantri Awaas Yojna), Sampooran Grameen Rojgar Yojna (SGRY). This includes construction of compact housing units, community assets such as community centres, recreation centres, anganwadi centres etc. Efforts are being made to ensure that buildings constructed under this scheme are disaster resistant.

f) **National Cyclone Mitigation Project:** This project drawn up in consultation with the cyclone-prone states envisages construction of cyclone shelters, coastal shelter belt plantation, strengthening of warning systems etc.

g) **Landslide Hazard Mitigation:** A National Group has been constituted under the Chairmanship of Secretary, Border Management, with the

collaboration of Department of Science and Technology, Road Transport and Highways, Geological Survey of India, National Remote Sensing Agency, to examine several aspects of landslide mitigation, including landslide hazard zonation, early warning system etc.

Non-structural Strategies

a) **Human Resource Development:** Human resource development at all levels is critical for institutionalizing disaster mitigation strategy. **The National Centre for Disaster Management (NCDM)** at the national level has been upgraded and designated as the National Institute of Disaster Management (NIDM).

This is entrusted with the task of developing training modules at different levels, undertaking training of trainers, organizing training programs, developing national level information base on disaster management policies, prevention mechanism, mitigation measures etc. Disaster management has been incorporated in the training curricula of All India Services with effect from 2004-2005. There is a separate faculty in the area of Disaster management in 29 State level training institutes.

b) **Capacity Building of Engineers and Architects in Earthquake Risk Mitigation:** This activity is being initiated under two national programmes for Capacity Building for Earthquake Risk Mitigation. Around 10,000 engineers and 10,000 architects in the states will be imparted training in seismically safe building designs and related techno-legal requirements. Seven National Resource Institutions have been designated as National Resource Institutions for imparting training to faculty of select State Engineering and Architecture colleges, and also put in place a framework for mandatory registration and compulsory competency assessment of the practicing architects.

Development and Environment (New Topic)

There is close link between environment and sustainable development which is used in the broad perspective and the overall development of human beings without any distinction. The World Conservative Strategy initiated by the United Nations Environment Programme (UNEP), the worldwide Fund for Nature (WWF) and international Union for Conservation of Nature (IUCN), provided the platform for international debate on sustainability. The most noteworthy step towards sustainable development is the publication of an international report titled "Our Common Future" by World Commission on Environment (WCED) in 1987. This is commonly known as "**The Brundtland Report"**. The report defined sustainable development as "Development that meets the needs of the present, without compromising the ability of future generations to meet their own needs".

According to this report, the major objective of development should be to ensure the satisfaction of human needs and aspirations of a material kind. It emphasized the fact that over exploitation of resources may compel human societies to compromise their ability to meet the essential needs of their people in future. Settled agriculture, the diversion of watercourses, the extraction of minerals, the emission of heat and noxious gases into the atmosphere, commercial forests, and genetic manipulation, were all mentioned in the report as examples of human intervention in natural system during the course of development. It called upon all countries to adopt the objective of sustainable development as the overriding goal and test of national policy and international cooperation.

Three Earth Summits were held under the auspicious of United Nations Conference on Environment and Development (UNCED) in 1992, 1997 and 200. Over 170 countries participated in these Summits renewed their commitment to sustainable development aiming at "giving special attention to the worldwide conditions that pose severe threats to the sustainable development of the people, which include: chronic hunger; malnutrition; foreign occupation; armed conflict; illicit drug problems; corruption; natural

disasters, communicable diseases, in particular HIV/AIDs, malaria and tuberculosis".

After these Summits, the sustainable development has become a universal theme to describe the amalgamation of environmental opportunities and human wisdom.

Different Dimensions of Sustainable Development

Sustainable development has many dimensions. Some of them are briefly described in the followings:

Social Dimension

- Workers" health and safety.
- Impact on local communities, quality of life.
- Benefits to disadvantaged groups, for example, the disabled.

Economic Dimension

- Creation of new markets and opportunities for sales growth.
- Cost reduction through efficiency improvements and reduced energy and raw material inputs.
- Creation of additional value.

Environmental Dimension

- Reduced waste, effluent generation, emissions into environment.
- Reduced impact on human health.
- Use of renewable raw materials.
- Elimination of toxic substances.

Millennium Development Goals

In September 2000, at the UN Millennium Summit, the UN General Assembly adopted the United Nations Millennium Declaration. The Declaration, which called for a global partnership to reduce extreme poverty, was the first ever global strategy with quantifiable targets to be agreed upon by all UN member states and the world's leading development institutions. To support the Declaration, former UN Secretary General Kofi Annan established eight

accompanying objectives to combat poverty, hunger, disease, illiteracy, environmental degradation, and discrimination against women. These objectives (listed below) were set with a deadline of 2015 and became known as the Millennium Development Goals (MDGs).

The Eight Millennium Development Goals are:

1. **Eradicate extreme poverty and hunger**
2. **Achieve universal primary education**
3. **Promote gender equality and empower women**
4. **Reduce child mortality**
5. **Improve maternal health**
6. **Combat HIV/AIDS, malaria and other diseases**
7. **Ensure environmental sustainability**
8. **Develop a global partnership for development**

9.

Key MDGs achievements

- More than 1 billion people have been lifted out of extreme poverty (since 1990)

- Child mortality dropped by more than half (since 1990)
- The number of out of school children has dropped by more than half (since 1990)
- HIV/AIDS infections fell by almost 40 percent (since 2000)

From MDGs to Sustainable Development Goals

The MDGs were concrete, specific and measurable, and therefore helped establish some priority areas of focus in international development. But that was also one of their biggest criticisms: by being so targeted, they had left out other, equally important, areas.

Despite the criticism, significant progress has been made over the past 15 years, especially when it comes to the goals of eradicating poverty and improving access to education. That progress, however, has been very uneven, with improvements often concentrated in specific regions and among certain social groups. A 2015 UN assessment of the MDGs found they fell short for many people: "The assessment of progress towards the MDGs has repeatedly shown that the poorest and those disadvantaged because of gender, age, disability or ethnicity are often bypassed."

The Sustainable Development Goals

At the historic UN General Assembly Summit in September 2015, the 2030 Agenda for Sustainable Development was adopted by the UN's 193 member states. The 17 Sustainable. Development Goals (SDGs) and their 169 targets are part of this agenda. The Sustainable Development Goals are a bold, universal agreement to end poverty and all its dimensions and craft an equal, just and secure world – for people, planet and prosperity. The SDGs have been developed through an unpresented consultative process that brought national governments and millions of citizens from the globe together to negotiate and adopt this ambitious agenda.

The Goals and targets will stimulate action for the next 15 years up to 2030 in areas of critical importance for humanity and the planet.

5 Ps of Sustainable Development

Planet: Protect our Planets natural resources and climate for future generations.

People: End poverty and hunger in all forms and ensure dignity and equality.

Prosperity: Ensure prosperous and fulfilling lives in harmony with nature.

Peace: Foster peaceful, just and inclusive societies.

Partnership: Implement the agenda through a solid global partnership.

The 17 Sustainable Development Goals:

There are 17 sustainable Development Goals to achieve by 2030 to all its member countries.

1. **No Poverty:** End poverty in all its forms everywhere.

2. **Zero Hunger:** End hunger, achieve food security and improved nutrition, and promote sustainable agriculture.
3. **Good Health and Well-being:** Ensure healthy lives and promote wellbeing for all at all ages.
4. **Quality Education:** Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.
5. **Gender Equality:** Achieve gender equality and empower all women and girls.
6. **Clean Water and Sanitation:** Ensure availability and sustainable management of water and sanitation for all.
7. **Affordable and Clean Energy:** Ensure access to affordable, reliable, sustainable and modern energy for all.
8. **Decent Work and Economic Growth:** Promote sustained, inclusive and sustainable economic growth, full and productive employment, and decent work for all.
9. **Industry, Innovation, and Infrastructure:** Build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation.
10. **Reducing Inequality:** Reduce inequality within and among countries.
11. **Sustainable Cities and Communities:** Make cities and human settlements inclusive, safe, resilient and sustainable.
12. **Responsible Consumption and Production:** Ensure sustainable consumption and production patterns.
13. **Climate Action:** Take urgent action to combat climate change and its impacts (noting agreements made by the UNFCCC forum).
14. **Life Below Water:** Conserve and sustainably use the oceans, seas and marine resources for sustainable development.
15. **Life on Land:** Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification and halt and reverse land degradation, and

halt biodiversity loss.

16. **Peace, Justice, and Strong Institutions:** Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels.
17. **Partnerships for the Goals:** Strengthen the means of implementation and revitalize the global partnership for sustainable development.

Sustainable Development Goals (SDGs) and India

The Sustainable Development Goals (SDGs) were adopted in September 2015 as a part of the resolution, 'Transforming our world: the 2030 Agenda for Sustainable Development'. India is committed to achieve the 17 SDGs and the 169 associated targets, which comprehensively cover social, economic and environmental dimensions of development and focus on ending poverty in all its forms and dimensions. At the Central Government level, NITI Aayog has been assigned the role of overseeing the implementation of SDGs in the country.

To spread awareness about the Goals, bring together stakeholders and build capacities for the realization of SDGs, NITI Aayog has organized several national and regional level consultations

Achievements in The Year 2018-19

National level consultations

In February 2018, a National Workshop on capacity development for localising the SDGs was held. Union Territories (UTs) and 23 states, as well as other relevant stakeholders participated in the workshop.

Another National Consultation on SDG 1 and associated targets was held in March 2018, which saw Central Ministries, States/UTs and other stakeholders discuss policies, implementation strategies and best practices.

The private sector is an important stakeholder in the implementation of SDGs. Recognising this, a government and business partnership conclave was held in August 2018 to sensitise businesses and industries in the private sector and analyse their programme strategies on various SDGs.

The Task Force on Implementation of SDGs held two meetings to take stock of SDGs at the national level. Progress on implementation of SDGs at the state level was reviewed through a series of meetings with States and UTs.

Regional level forums on SDG

The central platform for international follow-up and review of the 2030 Agenda is the High-Level Political Forum (HLPF), which meets annually under the auspices of the UN Economic and Social Council (ECOSOC).

As a regional preparatory for the HLPF, the Asia-Pacific Forum on Sustainable Development (APFSD) was held for the fifth time at Bangkok in Mar 2018, under the chairmanship of Dr. Rajiv Kumar, Vice Chairman, NITI Aayog. Around 600 participants joined the event, where States, United Nations bodies, international organizations and other stakeholders engaged in deliberations on the theme, "Transformation towards sustainable and resilient societies".

The Forum reviewed progress on the identified SDGs to be discussed at the next HLPF as well as the interlinkages across all Goals. The Forum facilitated experience sharing between countries who have already presented their Voluntary National Reviews at the HLPF and those who were to present theirs at the HLPF 2018 to be held in the month of July at New York.

The Forum also took stock of the regional progress made in respect implementing the 2030 Agenda for Sustainable Development in Asia and the Pacific.

South Asia Forum on Sustainable Development

The South Asia Forum on the Sustainable Development Goals, 2018 was co-organized by NITI Aayog, United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) and RIS in October 2018, to enhance awareness on challenges and opportunities for the implementation of the 2030 Agenda; generate reflections on sub-regional perspectives and good practices on the Goals under review at the HLPF in 2019; and identify ways to strengthen partnerships and implementation efforts.

Representatives from South Asian countries, prominent think tanks and academia as well as regional and sub-regional organizations supporting implementation of SDGs participated in the Forum. Key focal areas of the deliberations were the scope and options for improving the regional/sub-regional policy environment for implementation of SDGs and capacity development of key stakeholders.

Revised Mapping of Ministries, Centrally Sponsored and Central Sector Schemes

A mapping exercise was of Central Ministries and Centrally Sponsored /Central Sector Schemes was revised to include more schemes and reflect more comprehensively the interconnectedness of SDGs.

Monitoring Progress on SDGs

NITI Aayog finalised and released the SDG India Index – Baseline Report 2018 in December 2018, to track the progress of all the States and Union Territories (UTs) on the priority indicators, measuring their achievements and failures on the outcomes of the interventions and schemes of the central Government.

The SDG India Index has been developed to provide a holistic view on the social, economic and environmental status of the country and its States and

UTs. It will also go a long way in helping analyse and identify best practices and priority areas, giving direction to developmental policies.

Environment Protection Act, 1986

It was the Bhopal Gas Tragedy which necessitated the Government of India to enact a comprehensive environmental legislation, including rules relating to storing, handling and use of hazardous waste. On the basis of these rules, the Indian Parliament enacted the Environment Protection Act, 1986. This is an umbrella legislation that consolidated the provisions of the Water (Prevention and Control of Pollution) Act of 1974 and the Air (Prevention and Control of Pollution) Act of 1981. Within this framework of the legislations, the government established Pollution Control Boards (PCBs) in order to prevent, control, and abate environmental pollution.

The Act is special for many reasons.

- It has the sole aim of ensuring the protection of the environment, the prevention and reduction of environmental pollution and provides the authority to take strict action against perpetrators.
- It is an Act that takes precedence over other Acts. This means that if an offence is committed that is liable to be booked under multiple legislation including this Act, the EPA 1986 will be given the highest priority.
- This Act forced the country to take note of environmental pollution in a serious way.

Some of the special features of this Act include:

- EP Act covers all forms of pollution; air, water, soil and noise.
- Provides the safe standards for the presence of various

pollutants in the environment.

- Prohibits the use of hazardous material unless prior permission is taken from the Central Government.
- Allows the central government to assign authorities in various jurisdictions to carry out the laws of this Act.

Provisions of Penalties:

- The penalty for the contravention under this Act is imprisonment of 5 years, or fine of Rs. 1 lakh or both.
- Failure to comply with this punishment will result in a further penalty of 5000/- per day, followed by an extended imprisonment of 7 years.
- If the offence is committed by a company, the company as well as the director, officer in charge and any other relevant personnel is liable to be held guilty under this Act.
- If the offence is conducted by a government department, the HOD and any other relevant officer shall be held guilty. The HOD can be exempted if he/she can prove that the offence took place without their knowledge, or if they can prove that they did their utmost to prevent the offence.
- The section also states that a case/prosecution cannot be filed if the government entity or an officer of the government did actions under good faith.

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 Hazardous Waste Management Regulations, etc.

Other Laws Relating to Environment

In addition, there are many other laws relating to environment, namely –

Indian Forest Act, 1927
The Wildlife Protection Act, 1972 (Wildlife (Protection) Amendment Act, 2002)

The Forest Conservation Act, 1980 Public Liability Insurance Act, 1991 Protection of Plant Varieties and Farmers' Rights Act of 2001 The Biological Diversity Act, 2002

The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006

National Action Plan on Climate Change

The National Action Plan on Climate change was formally launched on June 30th, 2008. The NAPCC identifies measures that promote development objectives while also yielding co-benefits for addressing climate change effectively. There are eight "National Missions" which form the core of the National action plan. They focus on promoting understanding of climate change, adaptation and mitigation, energy efficiency and natural resource conservation."

The guiding principles of the plan are:

- Inclusive and sustainable development strategy to protect the poor
- Qualitative change in the method through which the national growth objectives will be achieved
  i.e. by enhancing ecological sustainability leading to further mitigation
- Cost effective strategies for end use demand side management
- Deployment of appropriate technologies for extensive and accelerated adaptation, and mitigation of greenhouse gases

- Innovative market, regulatory and voluntary mechanisms to promote Sustainable Development
- Implementation through linkages with civil society, local governments and public-private partnerships
- International cooperation, transfer of technology and funding

The eight missions are:

1. National Solar Mission
2. National Mission for Enhanced Energy Efficiency
3. National Mission on Sustainable Habitat
4. National Water Mission
5. National Mission for Sustaining the Himalayan Ecosystem
6. National Mission for a Green India
7. National Mission for Sustainable Agriculture
8. National Mission on Strategic Knowledge for Climate Change

National Solar Mission: The NAPCC aims to promote the development and use of solar energy for power generation and other uses with the ultimate objective of making solar competitive with fossil-based energy options. The plan includes: Specific goals for increasing use of solar thermal technologies in urban areas,

industry, and commercial establishments; a goal of increasing production of photo-voltaic to 1000 MW/year; and a goal of deploying at least 1000 MW of solar thermal power generation. Other objectives include the establishment of a solar research centre, increased international collaboration on technology development, strengthening of domestic manufacturing capacity, and increased government funding and international support.

National Mission for Enhanced Energy Efficiency: Current initiatives are expected to yield savings of 10,000 MW by 2012. Building on the Energy Conservation Act 2001, the plan recommends: Mandating specific energy consumption decreases in large energy-consuming industries, with a system

for companies to trade energy-savings certificates; Energy incentives, including reduced taxes on energy-efficient appliances; and Financing for public-private partnerships to reduce energy consumption through demand-side management programs in the municipal, buildings and agricultural sectors.

National Mission on Sustainable Habitat: To promote energy efficiency as a core component of urban planning, the plan calls for: Extending the existing Energy Conservation Building Code; A greater emphasis on urban waste management and recycling, including power production from waste; Strengthening the enforcement of automotive fuel economy standards and using pricing measures to encourage the purchase of efficient vehicles; and Incentives for the use of public transportation.

National Water Mission: With water scarcity projected to worsen as a result of climate change, the plan sets a goal of a 20% improvement in water use efficiency through pricing and other measures.

National Mission for Sustaining the Himalayan Ecosystem: The plan aims to conserve biodiversity, forest cover, and other ecological values in the Himalayan region, where glaciers that are a major source of India's water supply are projected to recede as a result of global warming.

National Mission for a "Green India": Goals include the afforestation of 6 million hectares of degraded forest lands and expanding forest cover from 23% to 33% of India's territory.

National Mission for Sustainable Agriculture: The plan aims to support climate adaptation in agriculture through the development of climate-resilient crops, expansion of weather insurance mechanisms, and agricultural practices.

National Mission on Strategic Knowledge for Climate Change: To gain a better understanding of climate science, impacts and challenges, the plan envisions a new Climate Science Research Fund, improved climate modelling, and increased international collaboration. It also encourages private sector initiatives to develop adaptation and mitigation technologies through venture capital funds.

The NAPCC also describes other ongoing initiatives, including:

Power Generation: The government is mandating the retirement of inefficient coal-fired power plants and supporting the research and development of IGCC and supercritical technologies.

Renewable Energy: Under the Electricity Act 2003 and the National Tariff Policy 2006, the central and the state electricity regulatory commissions must purchase a certain percentage of grid-based power from renewable sources.

Energy Efficiency: Under the Energy Conservation Act 2001, large energy consuming industries are required to undertake energy audits and an energy labeling program for appliances has been introduced.

International Agreements/ efforts - Climate Change accords

Various climate change accords that were and are in existence are covered here.

Montreal Protocol, 1987

The Montreal Protocol is widely considered as the most successful environment protection agreement. The Protocol sets out a mandatory timetable for the phase out of ozone depleting substances. This timetable has been reviewed regularly, with phase out dates accelerated in accordance with scientific understanding and technological advances.

The Montreal Protocol sets binding progressive phase out obligations for developed and developing countries for all the major ozone depleting substances, including Chlorofluorocarbons (CFCs), halons and less damaging transitional chemicals such as and Hydrochlorofluorocarbons (HCFCs).

Kigali Amendment

The agreement refers to the Hydroflurocarbon (HFC) Amendment to the Montreal Protocol, agreed to at the 28th Meeting of Parties at Kigali, Rwanda on 15 October 2016. Nearly 200 countries struck this landmark deal to reduce the emissions of powerful greenhouse gases, hydrofluorocarbons (HFCs), in a move that could prevent up to 0.5 degrees Celsius of global warming by the end of this century. The Kigali Amendment to the Montreal Protocol is legally binding and will come into force from January 1, 2019

1. Kyoto Protocol

The Kyoto Protocol is an international and legally binding agreement to reduce greenhouse gas emissions worldwide. It came into force on 16th February 2005. The major feature of the Kyoto Protocol is that it sets binding targets for industrialized countries for reducing greenhouse gas (GHG) emissions. The greenhouse gases include carbon dioxide (CO2), methane (CH4), nitrous oxide (NO), sulphur hexafluoride (SF6), hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs).

2.Convention on Biological Diversity

The Convention on Biological Diversity (CBD), known informally as the Biodiversity Convention, is a multilateral treaty. The Convention has three main goals including: the conservation of biological diversity (or biodiversity); the sustainable use of its components; and the fair and equitable sharing of benefits arising from genetic resources.

In other words, its objective is to develop national strategies for the conservation and sustainable use of biological diversity. It is often seen as the key document regarding sustainable development. The Convention was opened for signature at the Earth Summit in Rio de Janeiro on 5 June 1992 and entered into force on 29 December 1993. CBD has two supplementary agreements - **Cartagena Protocol** and **Nagoya Protocol**.

Cartagena Protocol

The Cartagena Protocol on Biosafety to the Convention on Biological Diversity is an international treaty governing the movements of living modified organisms (LMOs) resulting from modern biotechnology from one country to another. It was adopted on 29 January 2000 as a supplementary agreement to the Convention on Biological Diversity and entered into force on 11 September 2003.[1]

Nagoya Protocol

The Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization (ABS) to the Convention on Biological Diversity is a supplementary agreement to the Convention on Biological Diversity. The Nagoya Protocol on ABS was adopted on 29 October 2010 in Nagoya, Japan. Its objective is the fair and equitable sharing of benefits arising from the utilization of genetic resources, thereby contributing to the conservation and sustainable use of biodiversity. By helping to ensure benefit-sharing, the Nagoya Protocol creates incentives to conserve and sustainably use genetic resources, and

therefore enhances the contribution of biodiversity to development and human well-being. India signed this protocol in 2010.

Cancun Agreements - 2010

The Cancun Agreements are a set of significant decisions by the international community to address the long-term challenge of climate change collectively and comprehensively over time and to take concrete action now to speed up the global response. The agreements, reached on December 11 in Cancun, Mexico, at the 2010 United Nations Climate Change Conference represent key steps forward in capturing plans to reduce greenhouse gas emissions and to help developing nations protect themselves from climate impacts and build their own sustainable futures. (UNFCC).

Durban Climate Change Conference - November/December 2011

The United Nations Climate Change Conference, Durban 2011, delivered a breakthrough on the international community's response to climate change. In the second largest meeting of its kind, the negotiations advanced, in a balanced fashion, the implementation of the Convention and the Kyoto Protocol, the Bali Action Plan, and the Cancun Agreements. (United Nations framework for Climate Change)

Rio Submit (Earth Summit)

The United Nations Conference on Environment and Development (UNCED), also known as the Rio de Janeiro Earth Summit, the Rio Summit, the Rio Conference, and the Earth Summit, was a major United Nations conference held in Rio de Janeiro from 3 to 14 June in 1992.

Earth Summit was created as a response for Member States to cooperate together internationally on development issues after the Cold War. Due to issues relating to sustainability being too big for individual member states to

handle, Earth Summit was held as a platform for other Member States to collaborate. Since the creation, many others in the field of sustainability show a similar development to the issues discussed in these conferences, including non-governmental organizations (NGOs).

In 2012, the United Nations Conference on Sustainable Development was also held in Rio and is also commonly called Rio+20 or Rio Earth Summit 2012. It was held from 13 to 22 June.

Paris Agreement

At the Paris climate conference (COP21) in December 2015, 195 countries adopted the first-ever universal, legally binding global climate deal. The agreement sets out a global action plan to put the world on track to avoid dangerous climate change by limiting global warming to well below 2°C. The agreement is due to enter into force in 2020.

The Paris Agreement's central aim is to strengthen the global response to the threat of climate change by keeping a global temperature rise this century well below 2 degrees Celsius above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius. Additionally, the agreement aims to strengthen the ability of countries to deal with the impacts of climate change. To reach these ambitious goals, appropriate financial flows, a new technology framework and an enhanced capacity building framework will be put in place, thus supporting action by developing countries and the most vulnerable countries, in line with their own national objectives. The Agreement also provides for enhanced transparency of action and support through a more robust transparency framework.

International Solar Alliance (ISA)

International Solar Alliance (ISA) is a coalition of solar resource rich countries lying fully or partially between the Tropic of Cancer and the Tropic of Capricorn to specifically address energy needs by harnessing solar energy. The Alliance aims to provide a platform for prospective member

countries to collaborate and address the identified gaps through a common agreed approach. ISA has been envisioned as a dedicated platform that aims to contribute towards the common goal of increasing utilization and

promote solar energy and solar applications in the prospective member countries to help the world transform to a low-carbon and greener society.

ISA was launched at the United Nations Climate Change Conference in Paris on 30th November 2015 by Mr. Narendra Modi, Hon'ble Prime Minister of India and Mr. François Hollande former President of France, in the presence of H.E. Mr. Ban Ki Moon, the then Secretary General of the United Nations.

For details: International Solar Alliance (ISA)

India's contribution to ISA

The Government of India will contribute US $ 27 million to the ISA for creating corpus, building infrastructure and towards recurring expenditure over a 5 year duration from 2016-17 to 2020-21. An

initial donation of US $ 16 million has already been made. In addition, public sector undertakings of the Government of India namely Solar Energy Corporation of India (SECI) and Indian Renewable Energy Development Agency (IREDA) have made contributions of US $ 1 million each for creating the ISA corpus fund. In addition, the Government of India has offered training support for prospective ISA member countries at the National Institute of Solar Energy. They have also offered to support the prospective ISA member countries by organising demonstration on projects like solar home lighting, solar pumps for farmers and for other solar applications. The Government of India has dedicated 5 acres (over 20,000 Sq. meters) of land in the National Institute of Solar Energy campus for the construction ISA Headquarters. Proposal for allocating additional 5 acres of land is also under consideration.