CHAPTER - 02

ENVIRONMENTAL DEGRADATION AND ECOLOGICAL IMBALANCE

INTRODUCTION

Since the advent of industrial revolution, the explosive growth and need of the world's expanding population accompanied by new technological advances have modified our mother Earth's landscape. Exponential growth in population and resource use has drastically changed the face of the planet. Man has exploited the natural resources in such a way that it led to over-exploitation and losing the balance in natural eco-system. Indiscriminate dumping of toxic, nuclear and bio medical wastes and environmental distaste of numerous scale have begun to cut deep scars into the earth's eco-system and its delicate ecological balance. Mankind's injudicious utilization of physical and biological resources for their effective living and functioning in society is resulting into environmental degradation.

We know that environment is made up of biotic and aboitic components. A living organism cannot live by itself. Organisms interact among themselves and their surrounding physical environment. Hence, all organisms, such as plant, animal, and human beings, as well as the physical surrounding with which we interact, are dependent upon each other. They maintain a balance in nature.[1]

This natural environment or ecosystem is regulated and controlled by various biological and physical processes and interaction among its components. These processes are functioned in such a way that if any improper change occurs in any part of the environment or component of environment, other activities or processes compensate it. It is clear, that there exists an inbuilt self regulatory mechanism in the whole environment system, in which if any disturbance occurs, it is auto-compensated by other processes and activities. Consequently, balance is self-achieved. Such an automatic regulation is called 'homeostatic mechanism'.[2] Homeostasis is the maintenance of equilibrium, or constant conditions in a biological system by means of automatic mechanism that counteract influences tending toward disequilibrium.[3]

Man is one of the species that inhabits the earth and constitutes a major component in a number of natural eco-systems. However, he is the only one who has interfered with various natural processes for use of both biological and physical resources to meet his multiple demands. After industrialization, mankind became

more capable of altering natural environment. Exponential growth in population and exploitation of natural resources affected the natural environment a lot. There has been a steady encroachment on natural resources, resulting in lasting changes in the land use and landscape. This has been done to fulfill the growing aspirations of mankind for having a better and satisfying life style. As a result of this intervention many natural processes have been interrupted, some have been accelerated and a few slowed down. These changes in the natural environment changed many of environmental components to such an extent that they couldn't be compensated even by environment's inbuilt homeostatic mechanism. Consequently, such changed environmental conditions put negative impact on the habitats of biosphere. Such man-made change in the natural environment is called environmental degradation.[4]

"Degradation" as a concept invokes the ecological concept of 'carrying capacity'. Carrying capacity is the ability of an environment to sustain the resource demands of a species or a community without losing its ability to regenerate the resources.[5] Degradation usually means that carrying capacity is reduced by some natural or human phenomenon. Defining environmental degradation it is said, "Environmental degradation refers to the deterioration in its physical components brought in by biological processes mainly by human activities to such an extent that it cannot be set right by the self regulatory mechanism or homeostatic mechanism of the environment."[6] Environmental degradation is the deterioration of the environment through depletion of resources, such as air, water and soil, the destruction of ecosystems and the extinction of wildlife. When natural habitats are destroyed or natural resources are depleted the environment is degraded. **Glossary of Environment statistics**[7] states, "Environmental degradation is the deterioration in environmental quality from ambient concentrations of pollutants and other activities and processes such as improper land use and natural disasters." According to the **Dictionary of Ecology and Environment**, "(i) reduction in the quality of something, making worse, becoming worse; (ii) decomposition of a chemical compound into its elements, reduction in the quality of the environment is environmental degradation."[8]

Thus, it can be said in totality that when the environment becomes less valuable and damaged in terms of its quality and inbuilt self-mechanism, environmental degradation is said to occur. Environmental degradation is a process through

which the natural environment is compromised in some way, reducing biological diversity and the general health of the environment. This process can be entirely natural in origin or it can be accelerated or caused by human activities. Many international organizations recognize environmental degradation as one of the major threats facing the planet, since humans have only been given one earth to work with, and if the environment becomes irreparably compromised, it could mean the end of human existence.

FACTORS OF ENVIRONMENTAL DEGRADATION

Environmental degradation is caused broadly by two factors: (a) Natural factors, (b) Man made factors. Natural factors of environmental degradation are also called as natural hazards. Man made factors includes economic growth, population growth, urbanization, intensification of agriculture, increasing energy consumption etc.

(i) Natural Hazards

Within nature nothing is constant. Indeed, nature is typified by continual changes, in some cases by predictable evolution or the normal sequence of cyclical events as in seasonal weather. Much of nature is, though, unpredictable, when unpredictable natural events becomes extreme in their occurrence, they may constitute a danger to humans and to other members of environment. Such an event, then, define a natural hazard. Earth's internal and external processes cause natural hazards events that destroy or damage wildlife habitats and kill or harm humans and damage property.[9]

According to **Encyclopedia of Disaster Management** "A hazard is a rare or extreme event in the natural or human made environment that adversely affects human life, property or activity to the extent of causing a disaster."[10]

Another way of conceptualizing natural hazard is as the co-existence of people in a natural environment that may disrupt or threaten their safety, property or livelihood at an unpredictable time. There are many natural events that, when experienced in an extreme degree, may become a risk to the inhabitants of all environment. These include earth-quake, volcano, cyclones, drought, flood etc. Occurrence of such hazards leads to environmental degradation. Some forms of environmental degradation may also contribute to the creation of hazard or be an

extension of them such as deforestation and desertification. Growing industrialization and unjustified exploitation of natural resources have brought our ecosystem to a verge of non-reversibility and imbalance. This has led to a threat from a set of natural hazards.[11]

Natural disaster is the consequence of natural hazards which affects human activities. Disaster is unlike anything else in human experience. It strikes quickly– it changes the lives of all that touches and its effects are felt long after the event. The Oxford English dictionary states that the word 'disaster' derives from the 16th century French word "disaster". The definition given by **Encyclopedia of Disaster Management** is, "Anything that befalls of ruinous or distressing nature; a sudden or great misfortune, mishap, or misadventure, a calamity is disaster.[12]

A disaster can be more precisely defined as an occurrence of widespread severe damage, injury, or loss of life or property with which a community cannot cope and during which the property undergoes severe disruption.

Hazards and disasters they cause are classified as rapid on set or cataclysmic, and long term or continuing. In a cataclysmic disaster, one larger scale event causes most of the damages and destruction. Following this event, there may be a tremendous amount of suffering and chaos, but things soon begin to improve. In a long term, continuing disaster, the situation after the event remains constant or may even deteriorate as the time passes. Cataclysmic disaster includes earthquake, volcanic eruption, cyclonic storms and floods. Continuing natural disasters include drought, crop failures, and environmental degradation such as deforestation and desertification. The destructive potential of any natural hazards is estimated basically by its spatial extent and severity. Almost all the hazards more or less create destructive effects on natural environment, man habitats and manmade environment.[13]

As per the below mention chart various disasters are categorized, and some of the major are discussed further :

Table-1

Disaster Classification and Predominant Agent[14]

Disaster Type	*Natural*	*Man-Made*
Avalanche/Rockfall	Yes	No
Landslide/Mudslide	Yes	Yes
Air	No	Yes
Road	No	Yes
Marine	No	Yes
Rail	No	Yes
Climatic	Yes	No
Drought	Yes	Yes
Famine	Yes	Yes
Epidemic	Yes	No
Plague	Yes	Yes
Earthquake	Yes	No
Fire	Yes	Yes
Explosion	No	Yes
Flooding	Yes	No
Mining	No	Yes
Volcanic Activity	Yes	No
Miscellaneous	No	Yes

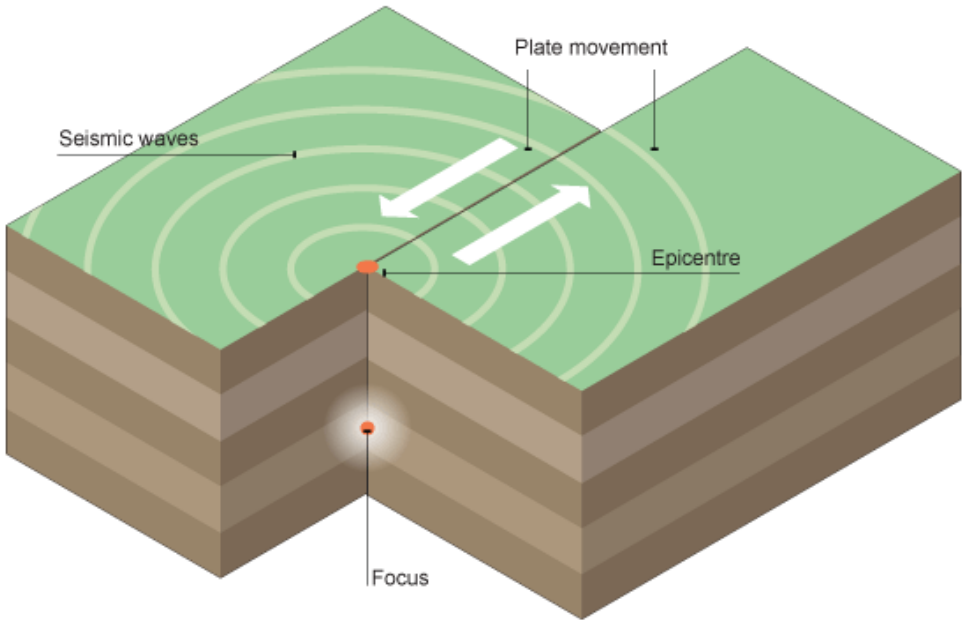
(a) Earthquake

Earthquakes are one of the most dangerous and destructive forms of natural hazards. They strike with sudden impact and little warning. An earthquake begins deep inside the earth as an expression of its internal energy, shifting masses of rocks and mineral inside that set up the waves we feel as tremors.

The focus of an earthquake is inside the earth and the area on the earth's surface above the focus is its epic center. The deeper the focus the less the damage are on the surface, and the more shallow the earthquake is the more destruction it causes. The most severe quakes release a total energy approximately equal to a hundred large atom bombs. They can make the earth vibrate enough for it to be felt across the globe.

Earthquakes waves are generally either surface waves that move over the crust or bodily waves that move through the interior on the earth. They are studied by an instrument, seismograph, which is a ray of light drawing the depth of the tremors on sensitized paper.

Earthquakes are caused by stresses within the earth. These stresses are due to certain unstable subterranean conditions in the geological formations brought about by the presence of fault planes and other stressful environments like the internal heat of the earth. Such instability can lead to the shifting of rock bodies within the earth, thereby creating shock waves, which under suitable conditions, can result in an earthquake. Minor slippages of rock bodies may result in mild tremors that occur even so frequently in many parts of the world.



(Picture – 1: Formation of Earthquake)

Under the hard earth crust, there are large, thick, rocky plates floating on molten rock. As these rock plates, nearly 140 miles thick, are not on solid ground they constantly move on rub against each other causing earth tremors. In a day there are about 2000 such movements, but most of them are so mild that we hardly notice them and they pass without causing any harm. Most earthquakes occur along the sides of the plates, especially where they interact-spreading, parts sliding or under thrusting each other.[15]

In other words the earth's crust is broken into a series of blocks or plates that are separated by deep fractures called faults. Faults form lines of weakness in the masses of rock at the earth's surface. Pressures that build up below the surface eventually force a sudden, shift between two of these blocks. This sudden shift is called the earthquake.[16]

Effects of Earthquakes

The primary effects of earthquakes include shaking and sometimes permanent vertical or horizontal displacement of the ground. These may have serious effects on people and structure, such as buildings, bridges, freeway overpasses, dams, and pipelines.[17]

Another primary effect is known as liquefaction. Loose sandy soils with a high moisture content separate when shaken by an earthquake. The water moves upward, giving the surface a consistency much like that of quicksand. Heavy structures resting on this soil slowly sink into the ground.

Secondary effects of earthquakes include various types of mass wasting (such as rock falls and rock slides), landslides, fires, tsunamis and floods due to subsidence of land. Landslides are especially damaging and often account for the majority of liver lost.

One of the recent major examples of earthquake is sea earthquake in Japan in March, 2011, which was 8.11 reactor scales powerful. It caused the devastation in Japan Coastal areas including loss of humans and animals, and human habitats in large numbers. [18]

(b) Tsunami

The Tsunami is a sea wave that may become one or more massive waves of water as it makes landfall. These sea waves are often called "tidal waves", but this is a misnomer. They are not caused by tidal action of the moon and sun like the regular ocean tides.[19] The term ‘Tsunami’ has been derived from Japanese term ‘Tsu’ meaning 'harbor' and nami meaning 'waves'. These waves which often affect distant shores, originate by rapid displacement of water from the lake or the sea either by seismic activity, landslides, volcanic eruption or large meteoroid impacts. Whatever the cause may be, sea water is displaced with a violent motion and swells up, ultimately surging over land with great destructive power.[20] The

crest of these waves can exceed heights of 25 meters on reaching shallow water. The unique characteristics of tsunamis (wave length commonly exceeding 100 km, deep-ocean velocities of up to 700 km/hour, and small crest heights in deep water) make their detection and monitoring difficult.[21]

In short, a tsunami is a natural hazard generated or created by other natural hazards, which is a secondary effect of other natural hazards that can potentially have greater impact on population than the original hazard event.

The geological movements that cause tsunami produced in there major ways. The most common these are fault movement on the sea floor, accompanied by an earthquake. They release huge amount of energy and the capacity to cross ocean. The degree of movement depends on how fast the earthquake occurs and how much water is displaced.

The other most common causes of the tsunami are landslide alters occurring under water or originating above the sea and then plunging into the water, extosine volcanic actions e.g. Santorin, Krakatau, and impact events when they contact water. These phenomena rapidly displace large volumes of water, as energy from falling debris or expansion is transferred to the water into which the debris falls at a rate faster than the ocean water can absorb. The spectacular under water volcanic explosion that obliterated Krakatau Island on August 26-27, 1883, created waves as high as 35 m (115 ft) in many East Indies localities, killing more than 36,000 people.[22]

Tsunamis have occurred in all the oceans and in the Mediterranean Sea, but the great majority of them are observed in the pacific ocean, which is ringed, from New Zealand through, Asia, and the western coasts of the America as far as the South Shetland Islands by zone of high seismic and volcanic activity. About 180 Tsunamis were recorded in the pacific between year 1900 and 1970. Of these, 35 caused casualties and damage near the source only, whereas nine spread destruction throughout the pacific.

Effects of Tsunami

The effects of these waves on the coastal sea of the pacific are characterized by maximum destructive force at the water's edge. Damage further inland is potentially high, even though the force of the wave has diminished, because of the

floating debris, which batters the inland installations. Ships moored in harbors are often swamped and sunk or are left battered and stranded high on the shore. Breakwaters and piers collapse, sometimes because of scouring actions that sweep away their foundation material and sometimes because of the sheer impact of the waves.[23]

Environmental effects of tsunamis include flooding and damage from giant waves. The force of water can raze everything in its path. It is normally the flooding affect of tsunami that causes major destruction to the human settlements, road, and infrastructure thereby disrupting the normal functioning of the society. These destructive waves destroy or damage buildings, bridges, irrigation systems, localized destruction of corps, scours land, satinates wells and standings water, destroys tree along shorelines. Apart from the physical damage, there is a huge impact on the public health system. Health mainly occurs because of drowning as water inundates home. Many people get washed away or crushed by the giant waves and some are cursed by the debris.

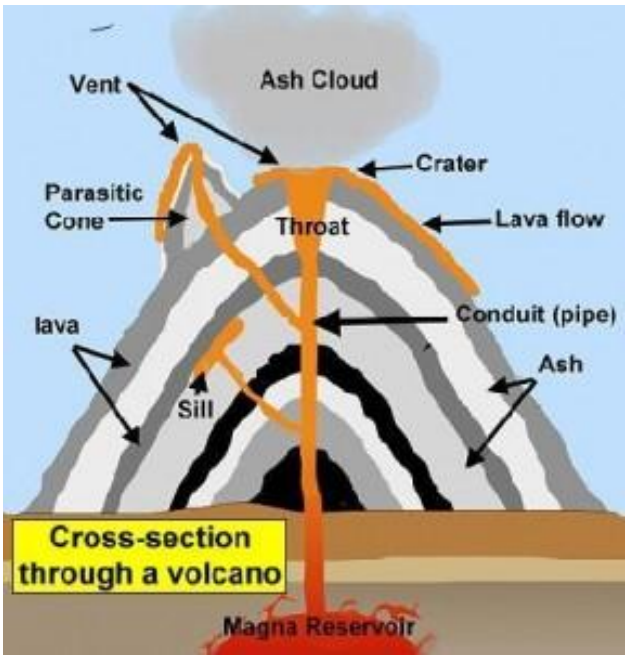
Devastating impact of earthquake is also visible on the built environment and its inhabitants. Approximately 90% of the loss of life in all earthquakes is the result of structural collapse.[24] Widespread destructive earthquakes can also have a significant impact on economic development. Because they damage human-produced structures, reconstruction costs can be substantial.

One of the major and recent examples of disastrous tsunami is Japan Tsunami, which came on 12 March 2011 in Japan. [25]

(c) Volcano

Volcano has played a key role in forming and modifying the planet upon which we live. More than 80% of the earth's surface–above and below sea level–is of volcanic origin. Volcano is an opening or rapture in a planet's surface, which allows hot magma, ash and gases to escape from below the surface.[26] In other words, 'a volcano is a vent or chimney to the earth's surface from a reservoir of molten matter, known as magma, in the depths of the crust of the earth'. The material ejected through the vent frequently accumulates around the opening building up a cone, called the volcanic edifice. Such volcanic activities release ejecta (debris ranging from large chunks of lava rock to ash that may be glowing-

hot, liquid lava, and gases (water vapor, carbon-dioxide, sulfur dioxide, nitrogen and others) into environment.[27]



(Picture – 2 : Formation of Volcano)

The term 'volcano' is thought to derive from Volcano, a volcanic island in the Aeolian islands of Italy whose name in turn originates from *vulcan*, the name of god of fire in Roman Mythology. The term volcano includes both the vent and the accumulation (core) around it.[28]

Volcanic eruptions vary between two extremes. In one, the lava rises more or less quietly to the sun face and overflows the tip of the crater. The gases bubble through the lava and escape ungrammatically, or in same instances rush out with force top form lava fountains hundreds of meters in height. Nevertheless the lava is not disrupted, but flows away as a river of lava with little resulting damage except to objects in the path of its flow. On the other extreme, tremendous explosions occur in the chimney, and as the lava rises into zones of less pressure it forths and is ejected in the form of ash and pumice. Thus, in these volcanoes the molten rock never reaches the surface as a liquid (lava) but is disrupted and ejected as ash.[29]

Effects of Volcano

There are different type of volcanic eruptions and associated activities. Large explosive volcanic eruptions inject water vapor, carbon dioxide, sulfur dioxide, hydrogen chloride, hydrogen fluoride and ash into stratosphere to heights of 16-32 km. above earth's surface. The most significant impacts from these injections come from the conversion of sulfur dioxide to sulfuric acid (H_2SO_4), which condenses rapidly in the stratosphere to form five sulfate aerosols. The aerosols increases the Earth's albedo–its reflection of radiation from sun back into space– and thus cool the earth's lower atmosphere; however, they also absorb heat radiated up from the earth, thereby warming stratosphere. Several eruptions during the past century have caused a decline in the average temperature at the Earth's surface of up to half a degree for periods of one to three years – sulfur dioxide from the eruption of Huaynaputina probably caused the Russian famine of 1601-1603. Sulfur aerosols also modify the earth's radiation balance. In short, finally explosive volcanic eruption releases the greenhouse gas, carbon dioxide and thus provides a deep source of carbon for biochemical cycles. Gas emissions from volcanoes are a natural contribution to acid rain. Volcano actively releases 130-230 teragrams CO_2 every year. Large injection may cause visual effects such as unusually colorful sunset and affect global climate mainly by cooling it. Volcanic eruption also provides the benefit of adding nutrient to soil through weathering process of volcanic rocks. [30]

(d) Drought

A drought is an extended period of months or years when a region notes a deficiency in its water supply. Generally this occurs when a region receives constituently below average precipitation. It is a climate anomaly, characterized by deficient supply of moisture resulting either from sub-normal rain fall distribution, higher water need or a combination of all these factors. In other words, droughts may be defined most simply as any usual dry period which results in a shortage of water. Drought is usually called a creeping hazard. This is because it develops slowly-often over a period of months and also has a prolonged existence often over a period of years for major events. Unlike many other hazards, droughts are not constraint to a particular topographic setting and their impact extends over many thousand of square kilometers.[31]

Before the rise of modern water consuming cities, drought was an agricultural disaster. Now, with cities having expanded faster than water supplies can be made available, the specter of drought faces both the farmer and the urban dweller.[32]

Shortage of rainfall coupled with its distribution during rainy season causes severe water deficit conditions resulting in various intensities of droughts. Generally, rainfall is related to the water vapor in the atmosphere, combined with the upward forcing of the air mass containing that water vapor. If either of these is reduced, the result is a drought. This can be triggered by an above average prevalence of high pressure system, winds carrying continental, rather than oceanic air masses (i.e. reduced water content) and ridges of high pressure areas form with behaviors which prevent or restrict the developing of thunderstorm activity or rainfall over one certain region. Oceanic and atmosphere weather cycles such as El Nino-Southern Oscillation (CNSO) make drought a regular recurring feature of the Americans along the Pacific Coast and Australia.[33]

Other causes of drought include (i) widespread and persistent atmospheric calm areas called subsidence which does not cause precipitation, (ii) absence of rain making disturbances causes dry weather even in areas of moist air and (iii) absence of humid airstreams. (iv) almost continuously dry climates (v) semiarid or sub humid climates with a short wet season.[34]

Human activities also contribute to the development of drought conditions. Overgrazing, poor cropping methods and improper soil conservation techniques often contribute to creating the drought.

There are generally three types of droughts are considered:

(a) Meteorological Drought: This type of drought all about the weather and occurs when there is a prolonged period of below average precipitation, which creates a natural shortage of available water.

(b) Agricultural Drought: This type of drought occurs when there is not enough moisture to support average crop production on farms or average grass production on land.

(c) Hydrological Drought: This type of drought occurs when water reserves in aquifers, lakes and reservoirs fall below an established statistical average.[35]

Drought occurs in the world's entire continent. In recent decades the most severe and demonstrating to human population have been in Africa. In fact devastating droughts have occurred in virtually all of the major semiarid regions of the world as well as in many zones that are normally temperate with significant annual rainfalls. In addition to droughts in the African Sahel, there have recently been major droughts in northeast Brazil, Chili, Ethiopia, the Philippines, the Bolivian altiplano, and India.

Effects of Drought

Periods of drought can have significant environmental, agricultural, health, economic and social consequences. Primary or immediate effects of drought result from lack of water. As the dry period progress and water supplies dwindle, existing water supplies are overtaxed and finally dry up. The primary losses are loss of crops, loss of livestock and other animals, and loss of water for hygienic use and drinking.

Secondary effects of drought also include major ecological changes. Such as increased scrub growth, increased flooding, increased wind erosion of soil, desertification, the most serious impact of drought can be that of famine, which further trigger disastrous impact.

During the last 100 years, major droughts have occurred on the Great Plains every 20 years, the worst being that of the 1930s-the Dust Bowl year. During the droughts of the 1990s, widespread reports of starvation and deaths due to malnutrition were reported with little done by the authorities to relive distress. The semi-arid area of northeastern Brazil suffers from frequent drought and an estimated 2 million people died from starvation in the 1877 disaster.[36]

(e) Flood

A flood is too much water in the wrong place, whether it is inundated city or a single street or a field flooded due to a blocked drain. Flooding is generally defined as any abnormally high stream flow that overtops the natural or artificial banks of a stream. Flooding is a natural characteristic of rivers. The flood plains are normally dry land areas. They are an integral part of a river system that acts as

a natural reservoir and temporary channels for floodwaters. If more run off is generated than the banks of a stream channel can accommodate, the water will overtop the stream banks and spread over the flood plain. The ultimate factor of damage, however, is not the quality of water being discharged, but how high the water gives above normal restraints or embankments.

Among the trigger mechanism of flood are dam failures; more rain than the landscape can dispose of; the torrential rains of hurricanes; tsunamis; ocean storm surges; rapid snow melts; ice flows blocking arriver; and burst water mains.[37]

Mostly two types of flooding are distinguished (i) land-borne flood or river flooding or natural flooding (ii) sea-borne floods or coastal flooding.

Natural flooding by streams, the most common type of flooding is caused primarily by heavy rain or rapid melting of snow, which causes water in the stream to overflow the channel in which it normally flows and to cover the adjacent area. Geologically the flat valley next to a stream channel is called a floodplain. However, for equal purposes, the term is often applied to any low area with the potential for flooding, including certain coastal area.[38]

On marine coasts flooding is due most often to the wind-driven storm surges and rain-swollen stream associated with tropical cyclones (typhoons and hurricanes) Flooding can also occur on the shorelines of large inland lakes.[39]

Impact of Flood

Of all the disasters except droughts, flood disasters affect the most people. But there are many more flood disaster than droughts, and the number affects by flood is increasing much more rapidly than those suffering droughts. In fact, flooding is one natural hazard that is becoming a greater threat rather than a constant or declining one. Each year flooding kills thousand of people and causes tens of billions of dollars in property damage. In 1959, for example, floods in North China flooded by famine and disease killed an estimated 2 million people. A 25 year analysis revealed that 39% of the deaths from natural hazards were caused by floods.[40]

Devastating consequences of flood also affect the natural environment. Environmental impacts of flooding include landslides and soil erosion. Due to high stream of flood, the top fertile soil is also degraded, which result in soil

erosion, loss of bacteria in soil. Flooding also causes silting of rivers, due to which water bodies get polluted. Because of flood, lot of trees are destroyed which further consequent in loss of biodiversity.

MAN MADE HAZARDS

Under man made hazards come several factors which are someway caused by man's harmful and unmindful activities resulting in various problems which are as follows:

(I) Pollution

Under anthropogenic causes of environmental degradation, pollution stands as a major factor. Environmental degradation also occurs from the alteration of the resources due to pollution. Environmental pollution may be defined as the unfavorable alteration of our surroundings, wholly as largely as a by product of man's action, through direct or indirect effects of changes in energy patterns, radiation levels, chemical and physical constitution and abundance of organisms.[41] It occurs when a substance present in the environment prevents the functioning of natural process and produces harmful environmental and health effects.[42] In other words, pollution is an undesirable change in the physical, chemical or biological characteristic of our air, water, land and living creatures-plants and animals that may or will waste or deteriorate our raw material sources.[43] In short, pollution is the introduction of contaminants into an environment that causes instability, disorder, harm or discomfort to the ecosystem i.e. physical system or living organism.

Pollution is a relative concept. Although almost no substance exist in a pure state, it is only when the impurities rise above a certain level that it becomes dangerous and harmful. Precisely pollution may be defined as the addition to air, water and or of any material or heat that is usually not found there or that is in excess of normal amount.[44] A normal constituent of the environment becomes a pollutant if it's concentration increases beyond the acceptable limits destroying its usefulness. A pollutant is also a new substance (biotic or abiotic) or energy (heat, sound, radioactivity etc.) that is added to or formed in any component of the environment and build up to a level where usefulness of that component is damaged.[45]

It was industrial revolution that gave birth to different type of environmental pollution as we know it today. The emergence of great factors and consumption of immense quantities of coal and other fossil fuels gave rise to unprecedented air pollution and large volume of industrial chemical discharges added to the growing load untreated human waste. Chicago and Cincinnati were the first two American cities to enact laws ensuring cleaner air in 1881. Other acts followed around the country until early in the 20th century, when the short-lived office of air pollution was created under the department of the interior.[46]

Pollution results in various damages to human health, animals, crops, vegetation, property, etc. In general, any type of pollution has some effect or other on the various ecosystems, but for simplicity, it is usually classified based upon the ecosystem which gets most affected. For example, it is known as air or atmosphere pollution if its effects are mostly carried through atmosphere. Similarly, if it mainly affects the water resources, it is termed as water pollution, and so on. At present, there are many types of pollution that are in some way adversely affecting our natural environment and health of all its components whether plants or animals including human beings.

(II) Desertification

One of the major factor of environmental degradation, desertification is a land degradation problem of major importance in the arid and dry sub-humid regions of the world resulting primarily from human activities and influenced by climatic variation. Land degradation occurs all over the world, but it only referred to as desertification when it takes place in dry-lands. Desertification is a term that has been in use since at least 1949 when Aubreville, a perceptive and well informed botanist and ecologist, published a book on "Climate, Forests, et Desertification del' Afrique Tropicale". He thought of desertification "as the changing of productive land into a desert as the result of ruination of land by man induced soil erosion."[47]

World Bank report defines 'desertification' as "a process of sustained decline of the biological productivity of arid and semiarid land, the result is desert, or skeletal soil that is irrecoverable. Biological productivity refers to the naturally-occurring plant and animal life as well as to agriculture productivity of a given area. Common indicators of desertification includes a reduction in the amount and

diversity of plant and animal species, loss of water retention capacity, lessened soil fertility, and increasing wind and water erosion. Eventually, plant and animal communities become so radically simplified that species formerly common in the area can no longer survive under the drastically altered circumstances, even if they are deliberately reintroduced."[48]

Henri Le Houerou (a French scientist with considerable working experience in the arid west Africa) defined desertization to state that it is "....the irreversible growth of new desert landscapes in arid regions which, not long before, presented no such features. It is characterized by a considerable reduction in perennial vegetation and its concentration along the hydrological network, with the development of dune system and desert pavements. In general perennial plant cover is less than 5%, and often non-existent.”[49]

In 1992, U.N. Conference on Environment and Development declared "Desertification is land degradation in arid semiarid and dry sub humid areas resulting from various factors, including climatic variations and human activities.".[50]

Desert supports scanty vegetation and animals, which are especially adapted to extremely unfavorable condition. Although desertification can develop from natural causes alone, in a majority of instances human intervention causes an accentuation of arid conditions in already desert terrain. This can happen in any climatic zone or ecosystem, resulting from exploitative interaction of man with the natural eco-system.

Factors Leading to Desertification

Vulnerability to desertification and the severity of its impact are partly governed by climate, in that the lower and more uncertain the rainfall, the greater the potential for desertification. Other natural factors include the seasonal occurrence of rainfall, as between hot season, when it is quickly evaporated and cool season. Also important are non-climatic factors such as the structure and texture of the soil, topography, and types of vegetation. Above all, susceptibility to desertification is a function of pressure of land use, as reflected in density of population or livestock or in the extent of agricultural mechanization.

Another man made factors causing desertification are slash and burn technique of farming, and unwise use of the land and overgrazing necessitated by famines in lesser-developed countries.[51]

Process and Stages of Desertification

The main process and stages of desertification can be summarized as follows. In pastoral rangelands, there is an initial deterioration in the composition of pastures subject to excessive grazing in dry periods, particularly a reduction in the proportion of edible perennial plants and an increase in the proportion of annual and inedible species. The thinning and death of vegetation in dry seasons increases the extent of bare ground. This is followed in turn by a deterioration of the surface conditions that are vital to plant growth. Impoverishment of plant-water relations is especially pronounced, and ephemerals now respond poorly to rain. With consequent increase in runoff, sheet and gully erosion set in on sloping ground, and the topsoil and its store are lost. These changes result in an environment inhospitable to plant growth and less suitable as pasture. With continuing erosion, formerly productive lands may be lost through soil stripping and gully extension. These changes are even more drastic where devegetation occurs in strategic areas, as on watershed uplands, and the processes are advanced where soils are exposed and disturbed in dry land cultivation.[52]

Presently 75% of the world's dry lands are affected, and thus desertification is increasing at an estimated rate of 50,000 square kilometers (19,305 square miles) per year. Estimates suggest if this continues, 35% of the world's usable land surface will be lost by the end of the century. Presently 850 million people are directly affected. Sahara is 5,150 km. across at its widest point. Madagascar's central highland plateau, where about seven percent of the county's total land mass has become barren, sterile land. Overgrazing has made the Rio Puerco Basin of central New Mexico, one of the most eroded river basins of the western United States and has increased the high sediment content of the river.[53] Overgrazing is also an issue with some regions of South Africa such as the Waterberg Massif, although restoration of native habitat and game has been pursued vigorously since about 1980. Another example of desertification occurring is in the Sahel. The chief cause of desertification in the Sahel is slash-and-burn farming practiced by an expanding human population. The Sahara is expanding south at an average rate of

30 miles per year.[54] The Desert of Maine is a 40 acre dune of glacial silt near Freeport, Maine. Overgrazing and soil erosion exposed the cap of the dune, revealing the desert as a small patch that continued to grow, overtaking the land. The site is maintained as a tourist attraction.[55]

Ghana and Nigeria currently experience desertification; in the latter, desertification overtakes about 1,355 square miles (3,510 km^2) of land per year. The Central Asian countries, Kazakhstan, Kyrgzstan, Mongolia, Tajikistan, Turkmenistan, and Uzbekistan, are also affected. More than 80% of Afghanistan's and Pakistan's land could be subject to soil erosion and desertification. In Kazakhstan, nearly half of the cropland has been abandoned since 1980. In Iran, sand storms were said to have buried 124 villages in Sistan and Baluchestan Province in 2002, and they had to be abandoned. In Latin America, Mexico and Brazil are also affected by desertification.[56]

Thus, Desertification is accelerating with devastating consequences for both human and the environment. Desertification and the associated problems make immediate implementation of mitigation imperative. This problem will be difficult for the developing countries of Asia and very difficult for the poor countries.

(III) Deforestation

One of the major factors causing environmental degradation is deforestation. Deforestation is clearing Earth's forest on a massive scale resulting in damage to the quality of the land. In other words deforestation is the removal or damage of vegetation in a forest to the extent that it no longer supports its natural flora and fauna.[57] It is most frequently caused by humans taking care of immediate needs while not being aware of the long-term effect of their actions. Deforestation is a slow-onset disaster that may contribute to other cataclysmic disasters. It reaches catastrophic proportions after large area of vegetation in a forest are damage or removed. By changing an area's natural fauna and flora, it removes the land's protective and regenerative properties.[58]

Since agriculture began about 10,000 years ago, human activities have reduced earth's forests cover by at least one-third to about 34% of the world's land area.[59] Forests are disappearing almost everywhere. Tropical forests, which cover about 6% of the Earth's land area, grow near the equator in Latin America, Africa and

Asia. Just three countries Brazil, Indonesia and Zaire contain more than half the world's total. Latin America has 90% of the world tropical forest in the vast Amazon Basin. About 56% of the world's tropical forests have been cleared or damage and the annual rate of loss rose by 50% between 1981 and 1991. The UN Food and Agriculture Organization has reported that between 1980 and 1991 tropical forests had been destroyed on an average of 15.4 million hectares (0.8%) per year.[60] Satellite scan indicates that these forests are vanishing at a rate of 170,000 square kilometers (66,000 square miles) per year-equivalent to about 37 city block per minute or almost two football fields per second. An equal area of these forests is damaged every year.[61]

Forests serve as the lungs of our planet that use carbon dioxide and release oxygen. They give us timber for housing, biomass for fuel-wood, pulp for paper, medicine and many other product worth more than 500 billion $ per year. According to a calculation, a typical tree provides $ 290,950 worth of ecological benefits in the form of oxygen, air cleaning, soil fertility and erosion control, water recycling and humidity control and wild life habitats.[62]

Forest also serves as the home of the 80% of the world's most precious and endangered wildlife.[63] Biologist Edward O. Wilson estimates that at least 20% of tropical forest species would be gone by 2022, and as many as 50% by 2042, if current rates of tropical deforestation and degradation continue.[64]

There are many root causes of contemporary deforestation, like farming, grazing firewood collection, including corruption of governmental institution, the inequitable distribution of wealth and power and population growth.[65]

Effects of Deforestation

Deforestation has many negative impact of natural and man-built environment. As earlier said, deforestation leads to related disasters also. The greatest and most immediate danger of deforestation is that gradually diminishing forested areas contribute to worsen other disasters. For example, by removing vegetation that retains water, deforestation lead to flooding, drought, and desertification. By removing vegetation that stabilizes the soils, desertification can lead to erosion, salitation and an increase chance of landslides during earth-quakes.

Atmospheric effects of deforestation include global warming and increase in green house gas effect.[66] Tropical deforestation is responsible for 20% of world greenhouse gas emission. According of IPCC, 'deforestation, mainly in tropical areas, could account for up to one third of total anthropogenic carbon-dioxide emission.'[67] Forests are able to extract carbon-dioxide and pollutants from the air, thus contributing to biosphere stability. But both the decay and burning of woods (deforestation) release much of this stored carbon back to the atmosphere.[68]

The water cycle is also affected by deforestation. Trees extract groundwater through their roots and release it into the atmosphere. When part of a forest is removed, the trees no longer evaporate away this water, resulting in much drier climate. Deforestation reduces the content of water in the soil and groundwater as well as atmospheric moisture.[69]

Deforestation generally increase rates of soil erosion, by increasing the amount of runoff and reducing the protection from the tree litter. Forestry operation themselves also increase erosion through the development of roads and the use of mechanized equipment.

Deforestation also results in decline in biodiversity. The removal or destruction of areas of forest cover has resulted in a degraded environment with reduced bio-diversity. As forest support biodiversity providing habitat for wildlife.[70] Moreover, forests foster medicinal conservation. Since the tropical ran forest are the most diverse ecosystem on the earth and about 80% of the world's known bio-diversity could be found in tropical rain forests, removal or destruction of significant areas of forest cover has resulted in a degraded environment with reduced biodiversity.[71]

It has been estimated we are losing 137 plants, animal and insect species every single day due to rainforest deforestation, which equates to 50,000 species a year. Prediction has been made that more than 40% of the animal and plant species in Southeast Asia could be wiped out in the 21st century.[72] Thus increasing deforestation is very serious concern regarding degrading environment.

(IV) Over Population

Over Population is one of the most serious threats to mankind which is causing the environmental threat as well. Over population is a condition where an organism's number exceeds the carrying capacity of its habital. In common parlance, the term

usually refers to the relationship between the human population and its environment, the Earth. Over population does not depend only on the size or density of the population, but on the ratio of population to available sustainable resources. It also depends on the way resources are used and distributed throughtout the population.

After the agriculture revolution 10,000 year ago, human population began to increase. But, the boom came after industrial revolution which triggered the rate of population increment. It was now reached at a serious point. It took only 130, 33, 15, 13 and 12 year to add each succeding billion. This accelerating rate of increase is what is meant by term 'population explosion. The world population is curretly estimated appx. 6.8 billion.[73]

Projections to 2050

According to projections, the world population will continue to grow until at least 2050, with the population reaching 9 billion in 2040, and some predictions putting the population in 2050 as high as 11 billion.[74]

According to the United Nation's World Population Prospects report:[75]

- The world population is currently growing by approximately 74 million people per year. Current United Nations predictions estimate that the world population will reach 9.2 billion around 2050, assuming a decrease in average fertility rate from 2.5 down to 2.0.[76]
- Almost all growth will take place in the less developed regions, where today's 5.3 billion population of underdeveloped countries is expected to increase to 7.8 billion in 2050. By contrast, the population of the more developed regions will remain mostly unchanged, at 1.2 billion. An exception is the United States population, which is expected to increase 44% from 305 million in 2008 to 439 million in 2050.[77]
- During 2005-2050, nine countries are expected to account for half of the world's projected population increase: India, Pakistan, Nigeria, Democratic Republic of the Congo, Bangladesh, Uganda, United States of America, Ethiopia, and China, listed according to the size of their contribution to population growth.[78]

- By 2050 (Medium variant), India will have 1.6 billion people, China 1.4 billion, United States 400 million, Pakistan 309 million, Indonesia 280 million, Nigeria 259 million, Bangladesh 256 million, Brazil 254 million, Democratic Republic of the Congo 187 million, Ethiopia 183 million, Philippines 141 million, Mexico 132 million, Egypt 121 million, Vietnam 120 million, Russia 108 million, Japan 103 million, Iran 100 million, Turkey 99 million, Uganda 93 million, Tanzania 85 million, Kenya 85 million and United Kingdom 80 million. Some fear that the United Kingdom will suffer from severe overpopulation at this rate due to its small size and it already being one of the most densely populated countries with 61 million currently.[79]

Below is a table showing so far increamenting population starting from beginning.

Table-1: World Population Growth[80]

Year	Population
1	200 nillion
1000	275 nillion
1500	450 nillion
1804	1 billion
1900	1.6 billion
1927	2 billion
1960	3 billion
1975	4 billion
1990	5.3 billion
1999	6 billion
2006	6.5 billion
2011	7 billion
2025	8 billion
2050	9.4 billion

(www.merelnation.com /population.htm)

Causes

There are the several major factors causing population growth –

Decline in the Death Rate: The fall in death rates that is decline in mortality rate is one fundamental cause of overpopulation. Owing to the advancements in medicine, man has found cures to the previously fatal diseases. The new

inventions in medicine have brought in treatments for most of the dreadful diseases. This has resulted in an increase in the life expectancy of individuals. Mortality rate has declined leading to an increase in population. Owing to modern medications and improved treatments to various illnesses, the overall death rate has gone down. The brighter side of it is that we have been able to fight many diseases and prevent deaths. On the other hand, the medical boon has brought with it, the curse of overpopulation.

Rise in the Birth Rate: Because of the new discoveries in nutritional science, we have been able to bring in increase in the fertility rates of human beings. Medicines of today can boost the reproductive rate in human beings. There are medicines and treatments, which can help in conception. Thus, science has led to an increase in birth rate. This is certainly a reason to be proud and happy, but advances in medicine have also become a cause of overpopulation.

Migration: Immigration is a problem in some parts of the world. If the inhabitants of various countries migrate to a particular part of the world and settle over there, the area is bound to suffer from the ill effects of overpopulation. If the rates of emigration from a certain nation do not match the rates of immigration to that country, overpopulation makes its way. The country becomes overly populated. Crowding of immigrants in certain parts of the world, results in an imbalance in the density of population.

Lack of Education: Illiteracy is another important cause of overpopulation. Those lacking education fail to understand the need to prevent excessive growth of population. They are unable to understand the harmful effects that overpopulation has. They are unaware of the ways to control population. Lack of family planning is commonly seen in the illiterate lot of the world. This is one of the major factors leading to overpopulation. Due to ignorance, they do not take to family planning measures, thus contributing to a rise in population.

Viewing the issue of increasing population optimistically, one may say that overpopulation means the increase in human resources. The increase in the number of people is the increase in the number of productive hands and creative minds. But, we cannot ignore the fact that the increase in the number producers implies an increase in the number of consumers. Greater number of people requires a greater number of resources.[81]

Effects

The huge increases in size of the human population have resulted in a substantial degradation of environmental conditions. The changes have largely been characterized by deforestation, unsustainable harvesting of potentially renewable resources (such as wild animals and plants that are of economic importance), and rapid mining of non-renewable resources (such as metals and fossil fuels), pollution, and other ecological damages.

At the same time that human populations have been increasing, there has also been a great intensification of per-capita environmental impacts. This has occurred through the direct and indirect consequences of increased resource use to sustain individual human beings and their social and technological infrastructure: meat production, fuel-burning, mining, air and water pollution, destruction of wild habitat and so forth.

The major effects of overpopulation can be listed below:

Depleting Natural Resources

Technological advancements have not only transformed human life but also the face of this planet. Cars, trains, aircrafts..., all have helped us save time which has added immensely to the efficiency of human beings. However, the numerous factories and industries, that manufacture goods without which, living a day would be unthinkable, need a regular supply of energy. For years, we have fallen back on fossil fuels, but so rampant has been the growth of industries that, we have practically dug up all the known deposits of coal, oil and natural gas. The state of affairs is so grim, that we have raged ghastly wars against other nations for want of energy.[82]

Extinction of Species

To accommodate more people, we need more land. For setting up more industries and factories, we again need land. To build power plants, we require land. Our needs do not seem to end, but the land, definitely, is limited. But, so desperate is our requirement for space that we have been recklessly cutting down trees and clearing large areas of forests. With this we have been, and still are, wiping out hundreds of species, each day. These species are important for maintaining the delicate balance of nature on which existence of every life form on this planet

depends, including ours. Other than land, we witnessed how indiscriminate hunting of animals for food and business has pushed some of the magnificent animal species like, the cheetah, the blue whale and the tiger and many more, to the brink of extinction. As per the reports of 2009, there were almost 47,677 species in the IUCN Red List of threatened species, out of which, almost, 17,000 faced the threat of extinction.[83]

Habitat Destruction

A growing population requires a lot of space. As populations in cities grow, urban sprawl also grows, resulting in the destruction of critical habitat for a number of plant and animal species. The loss of habitat can result in the encroachment of animals, such as mountain lions, deer and coyotes, into suburban neighborhoods as they have nowhere else to go.

Habitat Fragmentation

Another impact of overpopulation is habitat fragmentation. Habitat fragmentation refers to natural habitats that are broken into separate pieces due the construction of buildings, roads and other man-made objects. Habitat fragmentation is especially harmful to animal migration routes as animals are often unable to access a critical portion of their migration pathway due to obstruction.[84]

Thus, the need of the hour is to Identity the solution for these overpopulation issues, and to come up with some measures to curb incessant growth of population. If we don't put in efforts today, tommorrow may not give us chance to ponder over the situation.

(V) Energy Crisis

Energy is fundamental to human progress. Modern industrial societies are characterized by intensive use of energy. There are different sources of energy available on the Earth. The ultimate main source of energy is available to man are solar and nuclear energy. All practical sources of mechanical energy found on earth derive their energy originally from sunlight. These sources of energy are hydro energy, wind energy, tidal energy, seismic energy and geothermal energy. Present world economy since the advent of industrial revolution is based mostly on fossil fuels. Fossil fuels are primarily coal, oil and gas. They are the product of geological processes acting on the remains of carbon-based life forms that were

laid down millions of year ago. The carbon from these life forms with hydrogen makes fossil fuels.[85]

Prier to 18th century most of the energy available to man was that derivable from his food, the labor of his animal and the wood used for fuel. On a world wide basis, it is doubtful if the sum of these exceeded 10,000 kilogram calories per man per day, and this was a several fold increase over the energy from the food alone. After industrial revolution there was superposed on top of these sources the energy from fossil fuels. These fossils fuels fueled the world economic growth. In 1750 European countries, where land was relatively constant, the growth of Gross national product (a measurement of economic development) has been estimated to be about 0.5% per annum very similar to the growth in population. From 1760 to 1820, as Britain started to use coal to fuel its early industrial age, the GDP growth rose to 1.5% with a population growth of 1% (population growth in the rest of Europe remained about 0.5%). Then, from 1820 to 1913, as the industrialized world adopted the steam engine fuelled by coal, the GDP growth rose to 2.5%, the population growth was 0.5 to 1.0%, and capital growth was 1.2 to 2.6%. In the period from 1950 to 1973 when the world turned to extremely cheap petroleum, GDP growth rates double to around 5%. Then after petroleum prices rose dramaticity between 1973 and 1979 and the world returned to coal and nuclear fuels in addition to petroleum.[86]

From a world average of 300 kilogram calories per capita per day in 1800, the energy from coal and petroleum increased to 9,880 by 1900, and to 22,100 by 1940. This increment was juxtaposed to increasing world population. By 1864, from which date annual world production statistics are available, the annual production of coal in the world had reached about 180 million metric tons per year, and from the date to until 1914, when it had reached a rate of 1.300 millions tones per year it continued to increase geometrically at the rate of 4% per year, or at a rate such that the annual production was doubling every 17 years.[87]

After industrialization, the growth of heavy industry leads to enormous increase in energy consumption. As development continues, the demand for financial services, communications, transportation, consumer goods grew rapidly. In other words, although economic development leads to declining growth rates of per capita energy demand in the industrial sector, there was a substantial growth in

energy demand in the transportation, residential and commercial sectors. As per capita income started rising slowly, consumers started to devote a large proportion of their income to the purchase of durable goods such as air-conditions, heaters, refrigerators and automobiles. Since these items require some energy input to produce a flow of energy services, energy demands increased and increasing.[88]

Transportation now consumes more than 20% of the world's total primary energy and produces much of the world's air pollution. In just 30 years, the number of cars in the world will soar from today's 400 million or so to more than one billion. Private transportation will then need 2-1/2 times more energy and produce 2-1/2 tones more air pollution.[89]

Global Energy use has risen nearly 70% since 1971, and is poised to continue its steady increase over the next several decades, fueled by economic expansion and development. Energy demand has risen at just over 2% per year for the past 25 years and will continue to climb at about this same rate over the next 15 years if current energy use pattern persist, according to the International Energy Agency (IEA).[90]

Below is given the table of Energy consumption of countries in 2008

Table – 2: Consumption by Fuel 2008

(Million Ton Oil Equivalent)

Country	Oil	Natural Gas	Coal	Nuclear Energy	Hydro Electric	Total	
						2007	2008
US	884.5	600.7	565.0	192.0	56.7	2299.0	2359.6
France	92.2	39.8	11.9	99.6	14.3	257.9	254.8
Germany	118.3	73.8	80.9	33.7	4.4	311.1	309.3
Russia	130.4	378.2	101.3	36.9	37.8	684.6	679.7
United Kingdom	78.7	84.5	35.4	11.9	1.1	211.6	214.7
Iran	83.3	105.8	1.3	-	1.7	192.1	188.4
Saudi Arabia	104.2	70.3	-	-	-	174.5	163.1
United Arab Emirates	22.9	52.3	-	-	-	75.2	65.0
Other Middle East	76.6	36.6	8.1	-	1.2	122.5	114.9

Total Middle East	306.9	294.4	9.4	-	2.8	613.5	577.6
China	375.7	72.6	1406.3	15.5	132.4	2002.5	1862.8
India	135.0	37.2	231.4	3.5	26.2	433.3	409.2
Total Asia Pacific	1183.4	436.8	2031.2	119.8	210.8	3981.9	3816.0
Total World	3927.9	2726.1	3303.7	619.7	717.5	11294.9	11104.4

(Source- BP Statistical Review of World Energy)

Energy consumption is loosely correlated with gross national product and climate, but there is a large difference even between the most highly developed countries, such as Japan and Germany with 6 kW per person and United States with 11.4 kW per person. In developing countries particularly those which are sub-tropical or tropical such as India the per person energy use in closer to 0.7 kW. Bangladesh has the lowest consumption with 0.3 kW per person. The US consumes 25% of the world's energy with a share of global GDP at 22% and a share of the world population at 5%. The most significant growth of energy consumption is currently taking place in China, which has been growing at 5.5% per year over the last 25 years. Its population of 1.3 billion people (20% of the world population) is consuming energy at a rate of 1.6 kW per person. Though developing countries consume proportionally less energy per person than industrialized countries do, their expansion is far more rapid.[91]

Though, increasing energy consumption is resulting in growing world economy, yet matter of concerns occurs when this increasing harness of energy resources is considered in terms of its effect on natural environment.

Effects

Over exploitation of energy resources, particularly fossil fuels, are posing different environmental problems as discussed below:

(i) Shrinking Reservoirs

The basic resources of the planet, such as land, water, energy and biota are inherently unlimited, since our economy is mostly based on fossil fuels, these resources are far more limited. Due to blind exploitation of fossils fuels, these

reservoirs are exponentially shrinking and diminishing. Oil and gas have already become too expensive, and with each passing day, they are moving towards being extinct.

Nearly 40% of the world's energy now comes from petroleum and 21% comes from natural gas.[92] Together, these finite natural resources supply about 60% of the world's energy. If oil and natural gas consumption continued to double every 15 to 20 years as it had for the 100 years preceding 1973, the earth's entire original endowment of these resources would be 80% depleted in another 30 years or so. As early as 1970 new oil and gas discoveries had dramatically declined and have remained low. In the 80s, experts estimated that U.S. reserves would last about 35 years at existing pumping rates. More recently, estimates have been revised downward. Considering known reserves and estimated undiscovered deposits, U.S. oil will be depleted in about 10-12 years at present pumping rates. And new finds will make little difference on a worldwide scale. A new Prudhoe Bay discovery would provide the world with about six months oil supply, and a new North Sea find would equate to about three year's supply.[93]

Coal is the most abundant fossil fuel. This was the fuel that launched the industrial revolution and has continued to grow in use.

Coal is the fastest growing fossil fuel and its large reserves would make it a populate candidate to meet the energy demand of the global community, short of global warming concerns and other pollutants. According to the International Energy Agency, the proven reserves of coal are around 909 billion tones, which could sustain the current production rate for 155 years,[94] although at a 5% growth per annum this would be reduced to 45 years, or until 2051. With the Fischer-Tropsch process it is possible to make liquid fuels such as diesel and jet fuel from coal. In the United States, 49% of electricity generation comes from burning coal.[95]

Thus, it can be concluded the over exploitation over of energy resources is threatening the very existence of living being and natural environment contributing to a major part of environment degradation.

(VI) Acid Rain

A form of air pollution, acid rain is a popular term for the atmosphere deposition of acidified rain, snow, sleet, hail, acidifying gases and particles as well as acidified fog and cloud water. A more accent term is 'acid deposition'. It is rain or any other form of precipitation that is unusually acidic, i.e. elevated levels of hydrogen ions (low pH). In acid rain, airborne acids produced by electric utility plants and other sources fall to earth in distant regions. The corrosive nature of acid rain causes widespread damage to the environment.[96]

The acidity of rainfall is measured in pH units, indicating the concentration of hydrogen (H) ions. Rainfall is almost more acid than pure water with variation from region to region. However, it is generally agreed that a pH less than 5.6 is abnormally acid. Basically, pH 7 is neutral and a reduction of one pH unit represents a tenfold increase in the concentration of H ions.[97]

Acid rain is mostly caused by emission of compounds of sulfur, nitrogen, and carbon, which react with the water molecules in the atmosphere to produce acids. The process that leads to acid rain begins with the burning of fossil fuels. Burning or combustion is a chemical reaction in which oxygen from the air combines with the carbon, nitrogen, sulfur and other elements in the substance being burned. The new compounds formed are gases, called oxides. When sulfur and nitrogen are present in the fuel, their reaction with oxygen yields sulfur dioxide and various nitrogen oxide compounds. These gases react with water and other chemicals in the air to form sulfuric acid, nitric acid and other pollutants. These acid pollutants reach high into the atmosphere, travel with the wind for hundred of miles, and eventually return to the ground by way of rain, snow, or fog, and as invisible 'dry' forms called acid disposition.[98]

Since the Industrial Revolution, emissions of sulfur dioxide and nitrogen oxides to the atmosphere have increased.[99] In 1852, Robert Angus Smith was the first to show the relationship between acid rain and atmospheric pollution in Manchester, England.[100] Though acidic rain was discovered in 1852; it was not until the late 1960s that scientists began widely observing and studying the phenomenon. The term "acid rain" was generated in 1972.[101] Canadian Harold Harvey was among the first to research a "dead" lake. Public awareness of acid rain in the U.S. increased in the 1970s after the New York Times promulgated reports from the

Hubbard Brook Experimental Forest in New Hampshire of the myriad deleterious environmental effects demonstrated to result from it.[102]

Effects of Acid Rain

The acids in the acid rain react chemically with any object they contact. Adverse Effects of acid rain can be categorized as follow:

Effects of acid rain on plant life: Acid rain seeps into the earth and poisons plants and trees by dissolving toxic substances such as aluminum, which get absorbed by the roots. Acid rain also dissolves the beneficial minerals and nutrients in the soil, which are then washed away before the plants and trees have a chance of using them in order to grow.

When there is frequent acid rain, it corrodes the waxy protective coating of the leaves. When this protective coating on the leaves is lost, it results in making the plant susceptible to disease. When the leaves are damaged, the plant loses its ability to produce sufficient amounts of nutrition for it to stay healthy. Once weakened, the plant becomes vulnerable to the cold weather, insects, and disease, which can lead to its death.[103]

Effects of acid rain on aquatic life: Apart from plants, acid rain also affects aquatic organisms adversely. A high amount of sulfuric acid interferes with the ability of fish to take in nutrients, salt, and oxygen. As far as freshwater fish is concerned, in order for them to stay alive they need to have the ability of maintaining a balance between the minerals and salts in their tissues. The molecules of acid result in mucus forming in their gills, which prevents them from absorbing oxygen in adequate amounts. Plus, the acidity, which reduces the pH level, causes the imbalance of salt in the tissues of fish. Moreover, this change in the pH level also impairs the some of the fish's ability to maintain their calcium levels. This impairs reproduction the ability of the fish, because the eggs become too weak or brittle. Lack of calcium also causes deformed bones and weakened spines.

Decreases in pH and elevated concentrations of aluminum have reduced the species diversity and abundance of aquatic life in many streams and lakes in acid-sensitive areas of the Northeast. Fish have received the most attention to date, but entire food webs are often adversely affected.[104]

Effect on Soils: Acid deposition depletes calcium and other base cation from soil facilitates the mobilization of dissolved organic aluminum into soil water and increases the accumulation of sulfur and nitrogen in the soil.

(i) Loss of calcium and other base cation

In the past 50-60 years, acid deposition has accelerated the loss of large amounts of available calcium from soil in the Northeast. This conclusion is based on a limited number of soil studies, but at present, calcium depletion has been documented at more than a dozen study sites throughout the Northeast, including sites in the Adirondacks, the White Mountains, the Green Mountains, and the state of Maine. Depletion occurs when base cations are displaced from the soil by acid deposition at a rate faster than they can be replenished by the slow breakdown of rocks or the deposition of base cations from the atmosphere. This depletion of base cations fundamentally alters soil processes, compromises the nutrition of some trees, and hinders the capacity for sensitive soils to recover.

(ii) Mobilization of aluminum

Aluminum is often released from soil to soil water, vegetation, lakes, and streams in forested regions with high acid deposition, low stores of available calcium, and high soil acidity. High concentrations of aluminum can be toxic to plants, fish, and other organisms.

Effect on Surface Water

Acid rain falls into and drains into streams, lakes, and marshes. Where there is snow cover in winter, local waters grow suddenly more acidic when the snow melts in the spring. Most natural waters are close to chemically neutral, neither acidic nor alkaline: their pH is between 6 and 8. In the northeastern United States and southeastern Canada, the water in some lakes now has a pH value of less than 5 as a result of acid rain. This means they are at least ten times more acidic than they should be.[105]

Effects on Animals

The effects of acid rain on wildlife can be far-reaching. If a population of one plant or animal is adversely affected by acid rain, animals that feed on that organism may also suffer. Ultimately, an entire ecosystem may become

endangered. Some Species that live in water are very sensitive to acidity, some less so. Freshwater clams and mayfly young, for instance, begin dying when the water pH reaches 6.0. Land animals dependent on aquatic organisms are also affected. Scientists have found that populations of snails living in or near water polluted by acid rain are declining in some regions. In the Netherlands songbirds are finding fewer snails to eat. The eggs these birds lay have weakened shells because the birds are receiving less calcium from snail shells.[106]

Effects on Forests

Damage to forests is complex, because various natural and contribution factors combine to harm trees. It remains difficult to sort out causes and effects. However, it can be said with confidence that acid rain and ozone do contribute to stress on forests. Acid precipitation robs some forest soils of vital nutrients and interferes with the ability of trees to absorb those that are left. This will lead to widespread stunting of some species of trees at high altitudes over the long term. Stunting of growth of trees will result from altered chemistry of mountain forest soil. The damage has two underlying causes: (1) depletion of soil of calcium and magnesium, which are necessary for formation of chlorophyll and wood, and (2) breakdown of soil and release of aluminum. Aluminum, in turn, inhibits the ability of trees to absorb remaining calcium and magnesium. Over a period of up to fifty years this not only may disrupt the physiology of the tree, but also in some cases can kill root system outright.[107]

(VII) Ozone Layer Depletion

Today, one of the major factors of environmental degradation most discussed and serious environmental issue is the ozone layer depletion, the layer of gas that forms a protective covering in the Earth's upper atmosphere. In pure form Ozone (O_3) is a bluish, explosive and highly poisonous gas. In the stratosphere, the normal concentration of ozone is about 0.1 part per million, compared with 0.02 part per million in the lower atmosphere.[108]

Protective covering in the Earth's upper atmosphere, Ozone is formed when oxygen molecules absorb ultraviolet photons and undergo a chemical reaction known as photo dissociation or proteolysis, where a single molecule of oxygen breaks down to two oxygen atoms. The free oxygen atom (O), then combines with

an oxygen molecule (O_2) and forms a molecule of ozone (O_3). The ozone molecules in turn absorb ultraviolet rays between 310 to 200 nm wavelengths and thereby prevent these harmful radiations from entering the Earth's atmosphere. In the process, ozone molecules split up into a molecule of oxygen and an oxygen atom. The oxygen atom (O) again combines with the oxygen molecule (O_2) to regenerate an ozone (O_3) molecule. Thus, this continuous process of destruction and regeneration maintains the total amount of ozone.[109]

The matter of concern is that we are thinning this layer with our recent use of chlorine and bromine containing compounds, known as ozone depletion. This phenomenon describes two distinct, but relative observations 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, and a much larger, but seasonal decrease in stratospheric ozone over Earth's polar regions during the same period. The latter is commonly referred as 'the Ozone hole'. In addition to this well known stratospheric ozone depletion, there is also troposphere ozone depletion, which occurs near the surface in Polar Regions during spring.[110]

Ozone layer depletion was first captured the attention of the whole world in the later half of 1970. In 1874, Chemist Sherwood Rowland and Mario Molina made calculation that chlorofluro carbons were lowering the average concentration of ozone in the stratosphere and creating a global time bomb. They shocked the scientific community and $28 billion for year industry making these chemicals by calling per an immediate ban of CFCs in spray cans. CFC (Chlorofluro carbon) is widely used as coolants in refrigerators and air conditioners aerosol spray propellants, agents for producing polystyrene (Styrofoam), and cleanser for electronic parts.[111]

In 1985, British atmosphere scientist discovered that 50% in some areas of the Ozone in the upper stratosphere over the Antarctic region was being destroyed during the Antarctic spring and early summer (September – December). Since then this seasonal Antarctic Ozone Hole-has expended in most years and in 1992 covered an area three times larger than the continental United States. But it seems to fluctuate in size for exempt it was large in 1987 less to the next year, and then, in 1989, back to its 1987 size. According to the **World Meteorological Organization** (WMO) "The hole spanned a record 29 million sq km (11 million

sq miles) in September 2003, exposing the southern tip of South America. The WMO said that there are where temperature is low enough for clouds to have formed an indication of the potential whole size-now covered 25million square km. This is near the 1995-2004 mean and higher than observed in 2004, but somewhat lower than in 2003.[112]

Effects of Ozone Layer Depletion

The main public concern regarding the ozone hole has been the effects of increased surface UV and microwave radiation on human health. So far ozone depletion in most locations has been typically a few percent and no direct evidence of health damage is enabling in most latitudes. But, if the high levels of depletion seen in the ozone hole ever to be common across the globe, the effects would be substantially more dramatic.

Since Ozone layer protect the earth from harmful UV rays, with less Ozone in the stratosphere, more biologically harmful UV-B radiation will reach Earth's surface giving us worse sunburns, earlier wrinkles, more cataracts (a clouding of the eye lens that reduces vision and can cause blindness if not removed) more skin cancers.

Scientist estimate that a 10% drop in the average level of ozone in the stratosphere within the next few decades and already happening part of the year in some places) would probably have severe effects like 300,000 more cases of basal-cell and squamous cell cancers, 14000 more malignant melanomas (leading to 4000 deaths), and 1.6 million more cataracts each year worldwide as long as this level of depletion continued.[113]

(VIII) Climate Change

One of the major problems concerning environment which mankind is going to face is climate change. Climate change is a change in the statestical distribution of weather over periods of time that range from decades to millions of years. It can be a change in the average weather or a change in the distribution of weather events around an average (for example, greater or fewer extreme weather events). It can be limited to a specific region or may occur across the whole earth.[114]

This term is sometimes used to refer speciafically to climate change caused by human activity; for example the Untied Nations framework Convention on

Climate Change defines 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.[115]

The Earth’s climate is influenced by many factors, such as the amount of greenhouse gases and aerosols in the atmospehre, the amount of energy coming from the sun or the properties the Earth’ surface. Changes in those factors, through human-related or natural processes, have a warming or a cooling effect on the planet because they alter how much of this solar energy is retained or reflected back to space.

The concetnrations in the atmospehre of greenhouse gases such as carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) have all increased markedly since 1750, and now exced by far their pre-industrial levels.

The effect on climate of each of the different drivers is expressed in terms of “radioactive forcing”, with positive forcing causing a warming of the surface and negative forcing a cooling of it.

The overall effect of human activities since 1750 is very likely to be one of warming, with an estimated increase of energy or radiation forcing of 1.6 watt per square meter over the whole planet. The main warming drivers are the various greenhouse gases and it is likely that the warming that they cause has been increasing during the industrial era at a higher rate than at any time over the last 10,000 years. The main cooling drivers are aerosols and the change in cloud cover that they cause.[116]

Other natural factors of climate change are as follows:

Solar variation

There are a number of variations in solar activity that have been observed through the study of sunspots and beryllium isotopes. The sun provides the earth with heat energy, an integral part of our climate. Solar variation has triggered a phenomenon called global warming.[117]

Orbital Variation

The elliptical path taken by the Earth around the sun plays a significant role in the distribution and amount of sunlight that reaches the Earth's surface. These Milankovitch cycles have a direct impact on glacial activity. The eccentricity, precession and axial tilt of the earth, along the elliptical path, create changes in seasons.[118]

Plate Tectonics

The landmass on the planet is made up of plate tectonics that shift, rub against one another and even drift apart. This results in the repositioning of continents, wear and tear of the mountains, large-scale carbon storage and increased glaciations.[119]

Volcanic Action

In the course of volcanism, material from the Earth's core and mantle is brought to the surface, as a result of the heat and pressure generated within. Phenomenon like volcanic eruptions and geysers release particulates into the Earth's atmosphere that affect climate.[120]

Human influences

There are a number of anthropogenic factors that are responsible for changes in the Earth's environment. The result of human influence on the climate is not only direct, but also unambiguous. Increase in carbon dioxide levels arising from fossil fuel combustion, release of aerosols or particulate matter, extensive land use and deforestation have resulted in severe climatic change. Since pre industrial times, increasing emission of GHG due to human activities have led to a marked increase in the concentration of GHG in the atmosphere. Between 1970-2004, global emissions have increased by 70%. Over this period emission from the energy and transport sectors have been more than doubled. In 2004, total GHG emission due to human activities reached 49 Giga tones and Co2 represented 77% the total.[121]

Impacts and Consequences of Climate Change

There are various impacts of climate change, which are marking the repercussion of climate change as well global warming.

Melting Glaciers and Ice Sheets

Glaciers are considered among the most sensitive indicator of climate change, advancing when climate cools and retreating when cliamte warms. A world glaciers inventory has been complied since the 1970's, intially based mainly on aerial photographs and maps, but now relying more on satellites. This compilation tracks more than 100,000 glaciers convey a total area of appx 240,000 km, and prelimiinary estimates indicate that the remaining ice cover is 445,000 km. The World Glacier Monitoring Service collects data annually on glacier retreat and glacier mass balance. From this data, glaciers worldwide have been found to be shrinking significantly with strong glacier stress in the 1940s, stable or growing conditions during the 1920 and 1970, and again retreating from the mid 1980, to present.[122]

Accordig to IPPC Fourth Assesment Report 2007, "The areal extent of Artic Sea ice is declining more rapidly previously expected in respose to higher and ocean temperature. The USA national snow and ice data center reported that the year's minimum sea-ice cover occurred on 12 Sept. 2008, when it extended on 4.52 million km of the Aratic Ocean. This is the second lowest figure for the area of ice thaw since satellite monitoring began in 1979.[123]

Sea Level Rise

Due to the melting glacier ice and expansion of warmer sea water, sea level is rising. The last IPCC assessment forecast that global sea level would rise by between 18 and 59 cm in the coming century. A study presented at a conference of the European Geosciences Union of Vienna in April, 2008 suggested that a rise of between 0.8 and 1.5 meters was most likely.[124] Another study on the dynamics of ice-sheet loss argued that sea level could rise by as much as two meters in the coming century as a result of outflows of ice from Greenland alone.[125]

Such a rise would be far beyond anything seen in the recent past. Sea level rose 2.0 cm in the 18th centruy, 6.0 cm in 19th century, and 19.0 cm in the 20th century and what project as an equivelent to 30 cm for the 21st century based are rates observed in its first few years.

The addition to sea level rise, warmer waters in the shallow ocean have contribution to the death of about a quarter of worlds coral reefs in the last few

decades many of the coral animals died after weakened by blending, a process tied to warmed waters.[126]

Natural Carbon Sinks Decreasing

Since 2000, anthropogenic carbon deoxide emission have been increasing four times faster than in the previous decade. Most of the emission came from burning of fossil fuels and manufacturing cements. These emissions are now 38% above those in 1992, the year governments attending the Earth summit pledged to prevent dangerous climate change.[127]

At the same time, natrual carbon sinks that absorb some of our emission are unable to perform this function with their former efficiency. The main carbon sinks are the oceans, frozen tracts in the Arctic, and forest ecoystem. All these sinks are losing their absorption capacity. Analyses of a variety of studies suggest that the uptake of carbon by the ocean fell by 10 millions tonnes in 2007. It is not yet clears whether this is part of a longer-term trend.[128]

The greatest danger was posed to those dependent on the Niger in West Africa, the Ganges in South Asia and the Yellow river in China. The Colorado River in the USA was also experiencing a drop in water levels. Other big rivers in Asia, such as the Brahmaputra in India and the Yangtze in China, remained stable or registered an increase in flow. But the scientists said they too could begin shrinking because of the gradual disappearance of the Himalayan glaciers.[129]

What Impacts are Expected in Specific Regions?

More specific information is now available across the regions of the world concerning the nature of future impacts in the coming decades if climate change is unmitigated.

Africa is particularly vulnerable to climate change because of the existing pressures on its ecosystems and its low capacity to adapt. By 2020, between 75 and 250 million people are projected to be affected by increasing water shortages. In Asia, climate change is projected to increase pressures on natural resources and the environment and thus hamper sustainable development. Glacier melt in the Himalayas is projected to increase flooding and rock avalanches, and affect water resources within the next two to three decades. It is expected that less fresh water will be available due to both climate change and population growth. Heavily

populated coastal areas will be at greatest risk due to increased flooding. Crop yields could increase in East and Southeast Asia while they could decrease in Central and South Asia by the mid-21st century.

In Australia and New Zealand a significant loss of biodiversity is projected to occur in some ecologically rich sites, such as the Great Barrier Reef. Water security problems are projected to intensify and production from agriculture and forestry is expected to decline due to increased drought and fire. In Europe, wide ranging impacts of changes in current climate have been documented: retreating glaciers, longer growing seasons, shifts in the geographic spread of species, and health impacts due to an unprecedented heat wave.

In Latin America, warming and associated drier soils are projected to lead to a gradual replacement of tropical forest by savanna, and to salinization and desertification of agricultural lands. There is a risk of significant species extinction in many tropical areas.

In North America, warming in western mountains is projected to cause more winter flooding and reduce summer flows. Moderate climate change in the coming decades is projected to increase overall yields by 5-20% on agricultural lands that rely of rainfall, although major challenges are projected for crops that are near the warm end of their suitable range. Pests, diseases, and fires are expected to have increasing impacts on forests.

In the Polar Regions, the main effect foreseen is a reduction in thickness and extent of glaciers, ice sheets, sea ice, and permafrost, and associated impacts on infrastructures, ecosystems, and traditional ways of life. Small Islands are especially vulnerable to the effects of climate change, sea level rise and extreme events. They are at risk of coastal erosion, floods, storm surges, which could harm tourism and affect the livelihood of local communities. Climate change could also cause reduce water resources and increase the risk of invasion by non-native species.[130]

Thus, Climate change has already started affecting each dimension of mankind and threatening the very basic attributes of natural environment not decreasing at Unless action is taken soon to stabilize and then decrease concentration of greenhouse gases in the atmosphere, these change will cause widespread damage

to ecosystems, natural resources, human populations and their fragile economic activities. Such damages could certainly end prosperity in developed countries and threaten basic human livelihoods in developing countries.

(IX) Global Warming

Global warming is one of the most controversial environmental issues and threat of the 21st century mankind is facing and going to face. Global warming is the increase in the average temperature of the Earth's near surface air and the ocean since the mid century and its projected continuation. Global surface temperature has increased 0.74 - 0.18^{o}C during the last 100 years ending in 2005.[131] Life on earth depends on energy from the sun. About 30% of the sunlight that beams towards earth is deflected by the outer atmosphere and scattered back into space. The rest reaches the planet surface and is reflected upward again as a type of slow-moving energy called infrared radiation.

The heat caused by infrared radiation is absorbed by greenhouse gases, such as water vapor, carbon-dioxide, ozone, methane, CFC etc. which slow down its escape from the atmosphere. Although, greenhouse gases make up only about 1% of the Earth's atmosphere, they regulate our climate by trapping heat and holding it in a kind of warm-air blanket that surround the planet[132] making its temperature by 35^{o}C. This phenomenon is called "green house gas effect". Without it, scientists estimate that the average temperature on earth would be colder by approximate 20o C, far too cold to sustain our current eco-system.[133]

The Green House Gas, effect was discovered by Joseph Fourier in 1824 and first investigated by quantitatively by Svante Arrhenius in 1896.[134] On the Earth, major GHG gases are water vapor, which causes 36-70% of the GHG effect, carbon-dioxide (CO_2) that causes 9-26%, methane (CH_4), which causes 4-9% and ozone, which causes 3-7%.

The main sources of greenhouse gases due to human activity are:

- Burning of fossil fuels and deforestation leading to higher carbon-dioxide concentrations. Land use change (mainly deforestation in the tropics) account for up to one third of total anthropogenic CO_2 emissions.
- Livestock enteric fermentation and manure management, paddy rices farming, land use and wetland changes, pipeline losses, and covered vented

landfill emissions leading to higher methane atmospheric concentrations. Many of the newer style fully vented septic systems that enhance and target the fermentation process also are sources of atmospheric methane.

- Use of chlorofluorocarbons (CFCs) in refrigeration systems, and use of CFCs and halons in fire suppression systems and manufacturing processes.
- Agricultural activities, including the use of fertilizers that lead to higher nitrous oxide (N_2O) concentrations.

The Environmental Protection Agency (EPA) ranks the major greenhouse gas contributing end-user sectors in the following order: industrial, transportation, residential, commercial and agricultural. Major sources of an individual's greenhouse gas include home heating and cooling, electricity consumption, and transportation. Corresponding conservation measures are improving home building insulation installing geothermal heat and choosing energy efficient vehicles. Ultimately, more GHG pumps means more infrared radiation trapped and held, which gradually increase the temperature of the earth's surface and the air in the lower troposphere.

Developed countries are more responsible for the emission of GHG, as they have been emitting since the start of the industrial revolution in the letter half of the 1700s. Moreover, a mature industrialized economy is energy-hungry and burns vast quantities of fossil fuels. Annual energy review on the basis of total GHG emission, according to Annual Energy Review 2008, published by U.S. Energy Information Administration in June 2009, the largest producers GHG emission in 2006 were:

- China produced 6,017 million metric tons of carbon-dioxide.
- The United States are second with 5,902 million metric tons.
- Russia is third with 1,704 million metric tons.
- India is fourth with 1,293 million metric tons.
- Japan is a close fifth with 1,246 million metric tons.
- Germany is sixth with 857 million metric tons.
- Canada is seventh with 614 million metric tons.

- The United Kingdom is eight with 585 million metric tons.
- South Korea is ninth with 514 million metric tons.
- Iran is tenth with 471 million metric tons.

In all, the world production of carbon-dioxide in 2006 was 29,195 million metric tons.

Global temperature has increased by 0.75^0 C (1.35^0 F) relative to the period 1860-1900 according to the Instrumental temperature Record. This measures temperature increase is not significantly affected by the urban heat island effect.

Since 1979, land temperatures have increased about twice as fast as ocean temperatures (0.25^0 C per decade against 0.13^0 C per decade). Temperatures in the lower troposphere have increased between 0.12 and 0.22^0 C (0.22 and 9.4^0 F) per decade since 1979, according to satellite temperature measurements. Temperature is believed to have been relatively stable over the one or two thousand years before 1850, with possibly regional fluctuations such as the Medieval Warm Period or the Little Ice Age.

Based on estimates by NASA's Goddard Institute for Space Studies, 2005 was the warmest year since reliable, widespread instrumental measurements because available in the late 1800s, exceeding the previous record set in 1998 by a few hundredths of a degree. Estimates prepared by the World Meteorological Organization and the Climatic Research Unit concluded that 2005 was the second warmest year, behind 1988. Temperatures in 1998 were unusually warm because the strongest Nino Southern Oscillation in the past century occurred during that year.[135]

The IPCC synthesis predicts that if the present rate of warming would be same, the global temperature could rise by between 1.4^0 C and 5.8 (by the year 2100).[136]

Effects of Global Warming

Since global warming is a global phenomenon, it drastic changes will be occurred both locally & globally. A warmer troposphere would have different consequences for different people and species. Some place would get driers, and some wetter. Some would get hotter.

Food Production

Food productivity could vary considerably, increasing in some areas and dropping in others, because of changes in the global distribution of heat and precipitation.

Any reduction in rainfall would obviously be disastrous for the poor farmers in the arid and semi-arid areas of sub-Saharan, Africa, Northeast Brazil, and parts of India and Pakistan. Areas that have relied on monsoon rains would be in trouble if there were any major shifts in the direction of the monsoon winds or in the quantity of rain. The semi-arid regions are already characterized by widespread malnourishment and the declining per capita food production and climate change could further aggravate these problems if it were to increase the frequency or severity of drought. If productions of food crops such as wheat, rice, maize etc. fall due to temperature rise, it would result in increased international market price of food grains, affecting poor nations, which depend on imports of grains.[137]

India, being a largely agricultural economy, global warming would have a direct effect on crops. The impact is already being felt. Scientists have recorded an increase in torrential rains in the north parts of the country in recent decades during the monsoon and a dip in the number of rainy days along the east coast. Over a half-a-billion people or half of the country's population would be adversely affected by such a deep drop in water supply. The impact on agriculture would be particularly acute. Productivity of food grain could drop by as much as 30% in the next 30 years. The report cites scientific studies showing that even a 0.5^0 C rise in winter temperature could reduce wheat yields by 0.45 tones per hectare, a 17% drop in productivity. There would be an almost identical impact on rice cultivation.[138]

Melting Glaciers & Early Ice Thaw

Rising global temperature will spread the melting of glaciers and ice caps and cause ice thaw on rivers and lakes, which may be as high as about one-third to one-half of the existing mass by the end of this century. The reduced extent of glaciers and depth of snow cover would also affect the seasonal distribution of the river flow and the water supply for hydroelectric generation and agriculture. This will also affect direction of navigation on rivers, and in coastal areas. According to

the Artic Climate Assessment Report: "Artic ice is rapidly disappearing and the region will lose 50-60% after ice distribution by 2100."[139]

Montana's glacier national park now has only 27-glacier national park, verses 150 in 1910. The United Nations panel report warns that glaciers across the Himalayas are melting at an alarming rate and may disappear altogether by 2035. Such an event will not only have severe impact on the Himalayan ecology and the people living in the region, but also cause a wide swathe of miserly down stream.[140] Grass has become established in Antarctica for the first time, showing the continent is warming to temperatures unseen for 10,000 years.

Impact on Sea level

The impact on sea level and associated damages could be many. The world's richest and most heavily populated agricultural zones are in low-lying lands, along the seacoasts. It is estimated that about half the human race lives in such areas. Among the most vulnerable low-lying areas are Guyana, Papua New Guinea, Eastern Africa, India and Indonesia. The entire land surface of the Maldives in the India Ocean is only a few meters above sea level. Much of the Netherlands is 5 meters below sea level. World's largest cities including Calcutta, Shanghai, Tokyo, London, New York etc. are also in low-level coastal areas.

Due to global warming, there is a rise in the sea level, which increases the risk of flooding of low-lying areas. It becomes more aggressive if associated with fiercer storms and hurricanes and lead to smashing of buildings, infrastructure, plantations and natural forests. According to the IPCC, a rise of sea level by 30-50 cm would significantly affect the habitability of low-lying coastal regions. A one-meter rise would impact 360,000 km of coastline, render some island countries uninhabitable, displace tens of millions of people, threaten low-lying urban areas, flood productive land and contaminate fresh water supplies. For example, increasing salinity and inundation would destroy the Sunderban's mangrove forests in India covering over 400,000 hectares. The estimates indicate that the total economic loss due to sea level rise would be equivalent to 13% of the country's GDP.[141]

Current rates of sea-level rise are expected to increase as a result both of thermal expansion of the oceans and melting of most mountain glaciers and partial melting

of the West Antarctic and Greenland ice caps. Consequences include loss of coastal wetlands and barrier islands, and a greater risk of flooding in coastal communities. Low-lying areas, such as the coastal region along the Gulf of Mexico and estuaries like the Chesapeake Bay, are especially vulnerable.

Rain and Drought

As the Earth's surface temperature rises, the additional heat increases the amount of seawater that evaporates, which in turn creates more rain clouds and triggers storms. Already there is evidence that storms are becoming more frequent, although short-term changes don't necessarily become long-term trends. As perception patterns changes and pressure system shift, some parts of the Earth will become wetter, while other may become more prone to death.

- The 1999-2002 national drought was one of the three most extensive droughts in the last 40 years.
- Warming may have led to the increased drought frequency that the West has experienced over the last years.
- The 2006 wild land fire seasons set new records in both the number of reported fires as well as acres burned. Close to 100,000 first were reported and nearly 10 million acres burned, 125 percent above the 10-years average.
- Firefighting expenditures have consistently totaled upwards of $1 billion per year.[142]

Effects on Humankind

The direct effects on mankind of global warming are:

- Homeless refugees displaced by flooding, hurricanes and drought.
- Increased hunger due to food shortages because of loss of Farmable land.
- Spread of diseases, such as malaria and lyme disease, due to the migration of disease-carrying insects with warmer, wetter weather and more standing bodies of water in the northern hemisphere.
- Economic hardships caused by catastrophic conditions, such as those in the aftermath of Hurricane Katrina.
- War and conflicts over shrinking resources.[143]

Thus, Global warming is posing a serious threat to the whole living fraternity.

It may turn out to be the largest environmental change ever triggered by human activities. The Kyoto Protocol of 1997 sought to bring carbon-dioxide emissions under control, but, even if all countries agree to ratify it, global warming will still be hard to reverse. A major switch from fossil fuels will be needed, and renewable sources - such as solar power - will have to play a much more significant role. According to the Intergovernmental Panel on Climate Change, emissions could start to drop by 2050, but, even if this happens, decades will pass before the warming trend comes to an end.[144]

(X) Loss of Biodiversity

Biodiversity is the variety and variability of plants, animals and microorganism including genes with organism and eco-systems where species live. It is defined as "the totality of genes, species and eco-systems in a region or the world."[145]

The term ‘bio-diversity’ was coined as a contraction of biological diversity. 'Biological Diversity' was coined by Thomas Lovejoy in 1980, while the word biodiversity itself was coined by the entomologist E.O. Wilson in 1986, in a report for the first American forum on biological diversity organized by the National Research Council (NRC).[146]

There are three levels of bio-diversity viz. genetic, species and eco-system diversity. In effect, these levels cannot be separated. Each is important, interacting with and influencing the others. A change in one level can cause changes at the another level. At the lowest level, the genes within species show variation through genetic coding. Due to this, distinct populations are observed under one species of genetic variation within a variety. This is called genetic diversity. The number of species in a region or world constitutes the species diversity, which is also referred to as the richness of species. Different species assemble in an area to form a group for a common function. This group, along with other attributes, forms an ecosystem. The different types of assemblage with more or less common function are termed habitat or ecosystem diversity.[147]

Thus, the world's biological diversity is a vast and undervalued resource. It comprises every form of, from the liniest microbe to the mightiest beast, and the ecosystem of which they are a part. It proves humanity with a plenty of goods and

services, from food, energy and materials to the genes, which protect our coups and cure our diseases.[148]

There are millions of species all together on the earth, most of them still unknown. Only a decade ago, the best estimate was that about 3 million species co-exist on our planet. Since then, an almost unimaginable array of living things has been uncovered. Tropical forests are now thought to be home to millions of undescribed species and the deep sea floor may host hundreds of thousands, if not millions, more. Even soil samples from around the world are revealing a previous unsuspected variety of life. Estimates of the number of species on Earth now range from 10 million to 100 million, with a mere 1.75 million described and catalogued so far. Tropical forest eco-systems are the most species rich environment. Although, they cover less than 10% of the world surface, they may contain 90% of the world's species. Coral reefs and Mediterranean Heath land are also high species rich. About 1.75 million species have been named by taxonomist to date.[149]

Estimated number of described species:[150]

Kingdom	**Described Species**
Bacteria	4,000
Protoctists (algae, protozoa etc.)	8,000
Animals-Vertebrates	52,000
Animals-Invertebrates	12,72,000
Fungi	72,000
Plants	2,70,000
Total Described Species:	**17,50,000**
Possible total including unknown species	**1,40,00,000**

Scientists estimate that the Earth's biotic wealth stood at an all-time high when the first human beings appeared. Now it is fast declining, as a result of human activities. Around the world, habitats are being rapidly destroyed. Species are now dying out as fast at any time since the mass extinction at the end of the Cretaceous period some 65 million years ago.[151]

Tropical forests are home to more than half of the Earth's species, and tropical deforestation is the crucible of today's extinction crisis. About 17 million hectares of tropic forests are cleared annually. Recent estimates of this threat to biodiversity assuming that deforestation continues at current rates conclude that at least 5 to 10 percent of tropical forest species will either die out over the next thirty years or be reduced to such small populations that extinction will become a foregone conclusion.[152]

Over the past three decades, decline and extinction of species have emerged as major environmental issue. Because biological diversity is directly linked with the human and environmental health, each species is a unique and irreplaceable product of millions of years of evolution. Each species is of scientific interest and each makes some sort of contribution to its eco-system. Overall, every species has an inherent right to exist and doesn't need to be of value to us to justify its existence.[153]

Living organism contribute to a wide variety of environmental services, such as regulation of the gaseous composition of the atmosphere, protection of coastal zones, regulation of the hydrological cycle and climate, generation and conservation of fertile soils, many corps and absorption of pollutants.[154]

Bio-diversity creates a mechanism within an eco-system contributing to the stabilization of the system. Each species in the eco-system is functionally important and is linked to other species in various ways through food chain and food web. Thus, one species is essential for the existence other species. If one species is eliminated or disappeared, other dependent species will also vanish; It may destabilize the eco-system through its complex chain of interaction.[155]

Bio-diversity also provides genetic resources for food and agriculture, and therefore constitutes the biological basis for world security and support for human livelihoods. A number of wild crop relates are of great importance to national and global economics. For e.g., Ethiopian varieties have provided protection from viral pathogens to California’s barley crop, worth US$ 160 million per year. Genetic resistance to disease obtained from wild wheat variation in Turkey has been valued at US$ 50 million per year.[156]

Extinction of species is not a modern phenomenon, infect, it is a natural process. As the planet's surface and climate have changed over the 4.6 billion years of its existence, species have disappeared and new ones have evolved to take their places.

Causes of Loss of Biodiversity

The major causes of bio-diversity extinction and reduction are as follows:

(i) Habitat loss and Fragmentation

The greatest threat to most wild species is losing their home. If an animal's habitat is destroyed or disrupted, it must adapt to the new changes, move elsewhere or die. About 50% of the world's land area is devoted directly or indirectly to agriculture, some 20% to commercial forests, and another 25% to human settlements. This leaves only about 5% for all wild terrestrial species.[157] Most of the species extinction from 1000 AD to 2000 AD is due to human activities, in particular destruction of plants and animal habitats.[158]

Most species need undisturbed habitat, unpolluted living space to find food and nutrients, water, shelter and mates. But people are altering their habitats all over the world through following activities:

- Felling of forests for land use.
- Destruction of mangrove site for agriculture.
- Mining and destruction of corals.
- Conversion of wetlands for land uses.
- Human-induced firing of habitats.
- Damaging of rivers.
- Pollution also disturbs the natural habitat.

Worldwide about 1.2 million km^2 of land have been converted to cropland in the past 30 years. In a recent global survey, habitat loss was found to be the principle factor affecting 83% of threatened mammals and 85% of threatened birds.[159]

Commercial Hunting and Poaching

Another major cause is commercial hunting and poaching. Legal and illegal commercial hunting has driven many species, such as American bison, to or over

the brink of extinction. This continues today. Bengal tigers are in trouble because a tiger fur coat sells for $100,000 in Tokyo. A mountain gorilla rhinoceros horn as much as $28,600 per kilogram. Only about 300 Siberian tigers are left, mostly because these and other tigers are killed for their furs & their bones.[160]

Predation & Pest Control

People deliberately try to exterminate species that compete with them for food and game. For e.g. U.S. fruit farmers killed off the Carolina parakeet around 1914 because it fed on fruit corps. The species was easy prey because who one member of a flock was shot, the rest of the birds hovered over it body, making themselves easy targets. As animal habitats shrink, African farmer kill large number of elephants to keep them from trampling and eating food crops. Since 1929, U.S. ranchers and government's agencies have poisoned prairie dogs because horses and cattle's sometimes step into the burrows and break their legs. This poisonings has killed 99% of North America's prairie dogs. It has also nearly wiped out the black-footed fesset, which preyed on the prairie dog. [161]

Over Exploitation

People use some plant and animal species at a greater rate than the species can replace themselves, which can lead to extinction. Nine of the world's ocean fisheries are declining because of too much fishing as well as water pollution and habitat destruction. Popular commercial species such as the Southern blue fin tuna, the Atlantic halibut and the Pacific and Atlantic salmon are now threatened.

Nitrogen Deposition

Nitrogen deposition has become a major cause of biodiversity loss. It has increased substantially in recent decades, primarily as a result of an increase in the use of fertilizer and the burning of fossil fuels. Increased nitrogen in soil and water can lead to loss of species and shifts in the species composition of plant communities.[162]

Oil Spills

Oil spills have also had major impact on bio-diversity in recent decades. In 1988 alone, a total of 108,000 tones of oil were spilled worldwide into marine and inland environments as a result of 215 incidents.[163]

Pollution and Climate Change

Toxic chemical degrade wildlife habitats, including wildlife refuges, and kill some plants and animals. Slowly degradable pesticides, especially DDT and dieldrin, have caused population of some bird species to decline. And wildlife in even the best-protected and best-managed reserves may be depleted in few decades because of climate change caused by projected global warming. The IPCC concluded that climate change could lead to severe adverse impacts on eco-system, and on the goods and services they provide.[164] For Coral reef, which are biodiversity hotspots will be lost is 20 to 40 year if global warming continues at the current trend.

Introduced Species

The widespread introduction exotic species by humans is a potent threat to biodiversity. When exotic species are introduced to eco-systems and establish self-sustaining populations, the endemic species in the eco-system that have not evolved to cope with the exotic species may not survive. The exotic organisms may be predators, parasites, or simply aggressive species that deprive indigenous species of nutrients, water and light. These invasive species often have features, due to their evolutionary background and new environment that make them highly competitive; able to become well-established and spread quickly, reducing the effective habitat of endemic species.[165]

These factors accumulatively loss of bio-diversity all over the world. This continued loss of biodiversity will greatly impact human society as well as perceptible effects of bio-diversity loss at both global and national level include their valuable services –

- The several a steady in atmospheric CO_2 level due to disruption of the carbon cycle in nature.
- Adverse effect on local climate and water flow due to loss of tropical forests.
- Decrease of overall population size of species and loss of geographic range.
- Extinction of species.
- Increase coastal erosion and loss of fishery productivity.
- Reduction of genetic diversity of crop species.

- Loss of livelihood because a large proportion of the people in the world depends on bio-resources for subsistence use of their livelihood.

Thus, biodivesity plays the significant role in the sustainablity of the whole ecosystem. And, loss of biodiversity is major problem reflecting environmental degradation.

Thus, above mentioned are the serious problems mankind and whole living freternity is facing which are need to be checked as soon as possibly we can.

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