ENVIRONMENTAL SCIENCE AND ENGINEERING

SCHX1101

Course Material

UNIT III

ENVIRONMENT POLLUTION

POLLUTION

It is defined as the excessive discharge of undesirable substances into the environment. It alters the natural quality of the environment causing damage to human plants and animals.

POLLUTANT: Toxic substances which adversely changes the environment.

TYPES OF POLLUTANTS

1. Biodegradable- Decompose rapidly by natural processes.
2. Non-degradable- Do not decompose

CLASSIFICATION OF POLLUTION

1. Air pollution
2. Water pollution
3. Soil pollution
4. Marine Pollution
5. Noise pollution
6. Thermal Pollution
7. Nuclear Hazards (Radio Active Pollution)
AIR POLLUTION

It is defined as the presence of toxic substances in the atmosphere which cause undesirable effects on man and environment.

Causes of pollution

- Rapid industrialization
- Exploitation of nature by man
- Rapid urbanization
- Increase in population
- Natural calamities like volcanic eruptions, storms, cyclones etc.,

SOURCES OF AIR POLLUTION

The two main sources of air pollution are

- **Natural sources** - volcanic eruptions, forest fires, extra terrestrial bodies, pollen grains from flowers etc.,

- **Man-made or anthropogenic sources** - thermal power plants, industrial units, vehicular emissions, fossil fuel burning, agricultural activities etc.,

Classification of air pollutants

Air pollutants are classified into three different ways

a) Based on origin

b) Based on chemical composition

c) Based on state of matter

a) **Based on origin**

The air pollution are classified into two categories

Primary pollutants
Secondary pollutants

**PRIMARY AIR POLLUTANTS**

Primary pollutants are those emitted directly from the source into the atmosphere in a potentially harmful form.

Example

- Sulphur compounds
- Oxides of nitrogen
- Carbon monoxide
- Halogen compounds
- Ammonia
- Organic compounds
- Radioactive compounds

**SECONDARY AIR POLLUTANTS**

These are formed in the atmosphere by chemical interactions between primary pollutants and atmospheric constituents by photochemical or oxidation reaction.

Example: Ozone, SO₃, Peroxy acetyl nitrate (PAN), Aldehydes, Ketones etc.,

(b) Based on chemical composition

- Pollutants are classified into
- Organic Pollutants - composed of organic compounds e.g. Hydrocarbons
- Inorganic Pollutants – composed of inorganic compounds e.g. CO, CO₂, N₂O, NO₂

(c) Based on state of matter

Gaseous air pollutants - occur in gaseous state at normal temperature and pressure.
Example:

Carbon-di-oxide CO2

Nitrogen Oxide NOx

Sulphur Oxide SOx

Hydrocarbons, Photochemical Oxidants.

**Particulate air pollutants** – finely divided solids and liquids dispersed in air. E.g. Aerosols such as dust, smoke etc…

**Common Air pollutants and their effects**

**CARBON MONOXIDE**

- It is a colorless, odorless, tasteless gas which is chemically inert under normal conditions of temperature and pressures.
- It is produced by the incomplete combustion of carbon.

**SOURCES**

- Automobile exhaust
- Forest fires
- Solid waste disposal
- Industrial sources
- Cigarette smoking

**EFFECTS**

- CO has a high affinity for haemoglobin and forms carboxyhaemoglobin.
- This affects the oxygen carrying capacity of blood causing giddiness and anaemia.
- CO reduces vision, causes cardiovascular disorders.
At high levels it causes coma, collapse, irreversible brain cell damage and death.

**CARBON DIOXIDE**

CO2 is comparatively less dangerous than CO.

**SOURCES**

- Fossil fuel combustion
- Jet planes use O2 and release CO2
- Agricultural practices (eg.) deforestation
- Forestry – Increase in CO2 concentration increases the temperature of earth’s surface.

**Effects**

- Excess CO2 causes respiratory disorders and suffocation.

**OXIDES OF NITROGEN**

In nature these include Nitrogen monoxide (NO) and nitrogen dioxide (NO2)

NO is a colorless, odorless gas which is oxidized to NO2 through secondary photochemical reactions.

NO2 is a reddish-brown irritating gas.

**SOURCES**

- Fuel combustion in automobiles
- Lightening
- Forest fires
- Power industrial plants
- Bacterial decomposition of organic matter
- Natural ionizing radiation
EFFECTS

- Being heavier than air, NO2 readily dissolves in water resulting in acid rain.
- Acid rain damages trees, soils and aquatic life in lakes.
- It corrode metals, eat away stone on buildings, statues and monuments.
- NO combines with hemoglobin to reduce the oxygen carrying capacity of blood.

OXIDES OF SULPHUR

- These include SO2 and SO3
- In nature
  - SO$_2$ is a colorless gas having a characteristics sharp, pungent and suffocating odour.
  - It is photochemically oxidized to SO$_3$
  - SO$_2$ is highly soluble in water.
  - Along with SO$_3$ it forms sulphuric or sulphurous acid and is quickly washed out of atmosphere by rain.

SOURCES

- Burning of solid and fossil fuels.
- Coal burning in power plants and industrial processes.
- Transportation.

EFFECTS

- They irritate the mucous membrane of the respiratory tracts.
- Higher concentration causes bronchitis.
- They readily attack building materials.
- SO$_2$ along with particulate matter reduces visibility.
HYDROCARBONS

- E.g.. Methane, Acetylene, Ethylene, terpenes
- Comparatively harmless hydrocarbons like ethylene undergo chemical reactions in the presence of sunlight and nitrogen oxide forming photochemical oxidants (like ozone) which are harmful.

SOURCES

- Coal field
- Natural fires
- Industrial sources
- Incomplete combustion from car engines
- Agricultural burning

Effects:

- Carcinogenic
- Affects the ozone layer
- Contributes to photochemical smog

PHOTOCHEMICAL OXIDANTS

- In nature
- The major photochemical oxidants is ozone
- Ozone is produced in the upper atmosphere by solar reaction.
- Small quantities diffuse downwards and cause air pollution
- Sunlight/air
- In the presence of sunlight oxides of nitrogen react with unburned hydrocarbons resulting in secondary pollutants like PAN(peroxy acyl nitrate), Ozone, aldehydes, ketones etc..
• Unburnt hydrocarbon + NOx
• photochemical smog

**EFFECTS**

• Photochemical oxidants cause irritation of eye, nose and throat.
• Ozone is known to damage chromosomes
• Both O3 and PAN cause damage to plants by interfering with plant cell metabolism.

**SUSPENDED PARTICULATE MATTER (SPM)**

• SPM includes solid particles and tiny droplets of liquids.
• Suspended particulate matter (SPM) is a complex mixture of small and large particles with less than 100μ varying origin and chemical composition.
• Particulate pollutants are categorized according to size, mode of formation or physical state into the following
  • a) Aerosols  b) Dust  c) Smoke  d) Fumes  e) Mist  f) Fog
  • g) Fly ash  h) Soot  i) Natural particulates.

**SOURCES**

• Burning coal in power and industrial plants.
• Agriculture
• Exhaust of automobiles

**EFFECTS**

• Nose and throat irritation
• Lung damage
• Reduces visibility
• Cause mutation and cancer

**Water Pollution**

• It is defined as any undesirable change in the quality of water which is harmful to living organisms.

• The two categories of water pollution are

• Point sources

• Non-point sources

**Point sources**

• Those sources which can be identified at a single location are point sources.

• Identification, monitoring and control of point sources discharge are easy.

**Examples**

• Factory outlets

• Power plant outlets

• Under ground mines

• Oil wells

Sewage treatment plants

**Non-point sources**

• Those sources which discharge pollutants in large and scattered area.

• Identification, monitoring and control of non-point source discharge are not that easy.

**Example**

• Urban streets, Agricultural lands, Run off from lawns, gardens.
• Soil erosion, Acid deposition from atmosphere.

**Classification of Water pollution**

• Suspended matter, Thermal discharges , Pathogens

• Natural Organic pollutant

• Synthetic organic compounds (Detergents, pesticides, fertilizers)

• Inorganic chemicals (acids, alkalis, metals)

• Oil, Sediments

**Effects of Water pollution**

• Spread of water-borne diseases like cholera, typhoid fever, hepatitis, dysentery.

• The oxygen demanding waste depletes the oxygen content of water.

• Presence of acids, alkalis, and toxic substances affect the growth of aquatic plants and fishes.

• The organic chemicals such as detergents, pesticides, plastics damages the central nervous system and causes birth defects and genetic disorders.

• Sediments increase the turbidity in water reducing photosynthesis.

• Artificial fertilizers introduce more amount of nitrate into water. This causes methemoglobinemia known as *blue baby*.

• Disposal of coolant water increases the temperature of water.

• Biological activity increases with increase in temperature.

• Increased temperature decreases the dissolved oxygen content in water.

• Dumping of solid wastes results in surface water and ground water pollution.
• Presence of radioactive materials causes genetic disorders, birth defects and cancers.

• Pollutants such as heavy metals, pesticides, and cyanides and harmful to aquatic organisms.

• The demand of oxygen (DO) increases with addition of biodegradable organic matter which is expressed as biological oxygen demand (BOD).

Control of Water Pollution

• Proper use of agro chemicals like pesticides and fertilizers which will reduce their surface run-off.

• Using more biological control pests instead of pesticides.

• Supplement use of fertilizers using nitrogen fixing plants.

• Proper treatment of industrial and municipal wastes.

• Planting more trees to prevent soil erosion.

• The radioactive substances can be removed by ion exchange method.

• Reusing treated waste water for irrigation purposes.

• Proper treatment of effluents from industries.

• Waste water should be treated properly to reduce their BOD and COD levels.

• Removal of nitrates and phosphates prevents eutrophication (the condition of excessive growth of plants in a water body).

• Proper chlorination should be done to prevent spreading of waterborne diseases.

Soil Pollution

Definition

Soil pollution is defined as the degradation of soil and land due to industrial, agricultural and by other human activities.
Sources of soil pollution

- Urban wastes
- Industrial wastes
- Agricultural practices
- Soil conditioners
- Farm house waste
- Radioactive pollutants

Biological agents

Urban wastes:

- Urban wastes are classified into domestic and commercial waste
- All solid urban wastes are commonly termed as refuse.
- It contains garbage and rubbish materials like fibers, plastics, papers, bottles, glasses, leaves, street sweepings, abandoned vehicles and discarded products.

Industrial wastes

- Industrial waste mainly consists of organic and inorganic compounds along with non biodegradable materials.
- Textile, steel, paper, chemicals, cement, oil, dyeing and other industries are responsible for soil pollution

Some of the major industries and their contaminant in the soil

<table>
<thead>
<tr>
<th>Industry</th>
<th>Contaminants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Papermill</td>
<td>chloride, sodium</td>
</tr>
<tr>
<td>Sugar</td>
<td>Nitrogen, phosphorous</td>
</tr>
<tr>
<td>Steel and coke</td>
<td>cyanide, phenols</td>
</tr>
</tbody>
</table>
• Refineries ------ phosphates, sulphur, chromium, phenol
• Fertilizers ------ chloride, nitrogen, phosphorous, potassium
• Pesticides ------ organic nitrogen, sulphate

Agricultural practices

• Most commonly used are insecticides, fungicides, herbicides
• Fertilizers discharge nitrogen, potassium, sulphate, nitrate, etc., in the soil. The nitrate causes cancer and blue baby.

Soil conditioners

• The soil conditioners are used to increase the fertility of the soil.
• These contain toxic metals such as arsenic, cadmium, lead, mercury, etc.

Farm house wastes

• Increase in population of cows, cattle, pigs, and poultries in the farm house results in the pollution of soil. Their fecal matter mainly consists of phosphate and nitrate which causes undesirable effect.

Radioactive waste

• Atomic reactor, nuclear radioactive devices releases the radioactive wastes.
• The radioactive nuclides such as isotopes of Sr90, Iodine129&131, caesium 137, barium 140, deposited on the land and continuously emit gamma radiations.

Biological agents

• Human, animals and birds excreta and pathogenic agents
• It is inhabited by bacteria, fungi, algae, protozoans, earthworms, molluscs and anthropods etc.,
• These organisms are important agents in increasing and decreasing the soil fertility and physical texture of the soil
Effects of Soil Pollution

- Organic wastes enter the soil pores and decompose pathogenic bacteria spreading infection.

- Compounds containing Arsenic, mercury, chromium, Nickel, lead, cadmium, zinc and iron are toxic to life.

- Excess use of sodium, magnesium, calcium, potassium, sulphur, zinc and iron in the form of fertilizers, and pesticides inhibit plant growths and reduce crop yield.

- The disposal of cadmium from mining, metallurgy, chemical and electroplating industries cause chronic poisoning, formation of kidney stones.

- Presence of Arsenic in the soil causes chronic poisoning which leads to loss of appetite and weight, diarrhea, gastro intestinal problems and sometimes skin cancer.

- Accumulation of methyl mercury compounds are much toxic than other form of mercury. It causes neurological problems and damages.

CONTROL OF SOIL POLLUTION

- Preserving the top soil which is the fertile soil. By planting of more trees soil erosion can be controlled.

- Disposal of properly treated industrial wastes, physically, chemically and biologically causes hazards.

- Agricultural land in the world is spoiled by soluble salts modern scientific technique can be used to reduce salts flow to soil.

- Fertilizers may be applied only after estimating soil and crop measures.

- Solid wastes should be properly collected and disposal off by appropriate method.

- Cattle dung should be used for methane generation night soil (human fasces) can also be used in the biogas plant to produce inflammable methane gas

Marine Pollution
- The contamination of sea water mostly by manmade activities thereby adversely affecting the flora and fauna of the marine habitat.

**Sources of Marine Pollution**

- According to International Maritime organization (MO), the different sources contributing marine pollution are
  - Land based sources
  - Air based sources
  - Maritime transportation
  - Dumping of wastes
  - Off shore production.

**Land based sources**

- Storm water, Pipe lines
- Rivers, Radioactive wastes

**Maritime transportation**

- Disposal of oil during the normal cleaning process
- Accidental spill of oil.
- Disposal of garbage generated by the crews of marine vessels (the navy, fishing fleets, pleasure boaters etc.,)

**Radio active material**

- Nuclear weapon testing

- **Toxic substances**
- Heavy metals, pesticides and acid rain.

**Effect of Marine pollution**
**Organic matter**

- Decomposition of organic matter present in the untreated or partially treated waste water causes
- Depletion of dissolved oxygen content of marine water.
- Death of marine plants and animals.

**Eutrophication**

- Disposal of effluent with more nitrogen and phosphorous causes Eutrophication
- Causes algal blooms which may discolor the water, deficiency of oxygen, toxic.

**Pathogenic microorganisms**

- Gastric and ENT infections, hepatitis, cholera and typhoid.

**Oil spills** –

Spilling of oil and oil products Affects respiration of plants and animals.

**Toxic chemicals** - Heavy metals, chlorinated hydrocarbons, dioxins and furans

- Damage the physiological process and functions of reproduction, feeding and respiration.

**Pesticides** - DDT and other chemicals

- Reproductive failure in marine mammals and birds.

**Radioactive wastes** - leakage or failure of radioactive wastes containers

- Causes more effects that could be devastating.

**Thermal pollution**

- Electrical generating plants along the marine coastal lines --- use of marine waters for cooling purposes.

**CONTROL OF MARINE POLLUTION**
- Careful handling of oil and petroleum products.
- Ban ocean dumping of sludge and hazardous material.
- Controlled use of pesticides and chemicals in agricultural activities in delta portions.
- Regulate coastal development
- Dispose fully treated municipal and industrial wastes.
- Protect sensitive areas from development, oil drilling and oil shipping.
- Ban on dumping of radioactive wastes.

**NOISE POLLUTION**

- Unwanted sound that produces adverse and harmful effects on living things.

**Source of Noise pollution**

- Transportation
- Industrial operations
- Air
- Construction activities
- Road
- Celebrations
- Rail-transportation
- Electric home appliances
- Incompatible land use.

**Construction noise**

- Earth moving equipments( rollers, tractors etc.,)
- Material handling equipments(Concrete mixers, pumps etc.,)
• Stationary equipment (Generators, compressors etc.)

• Impact equipment (rock drills, impact pile drives.)

**Effects of Noise pollution**

• Physiological effects

• Head ache

• Muscular strain

• Hearing loss

• Nervous breakdown

• Heart diseases

• Emotional disturbances

• Mental depression

• Sleep disruption

**Control of Noise pollution**

• Earplugs, ear-muffs, noise helmets, head phones etc., may be used as ear protection aids.

• Provide proper lubrication to the machines.

• Providing proper maintenance to machines.

• Industrial zones, aerodromes and highways would be located outside the city limits.

• Minimum use of loudspeakers

• Creating public awareness about noise pollution and its effects through newspapers, radio and televisions etc.,

**THERMAL POLLUTION**
Pollution due to heat which changes the physical and chemical properties of water, thus affecting the whole aquatic system.

**SOURCES OF THERMAL POLLUTION**

- Industrial waste water
- Nuclear power plant
- Domestic sewage
- Hydroelectric power
- Coal-fired power plants

**Industrial waste water**

- Use of water as a cooling agent in plants (natural gas, coal or nuclear) and factories causes thermal pollution.

**Nuclear power plants**

- Nuclear power plants, nuclear explosions, nuclear experiments discharge large amount of heat along with toxic radio nuclides.

**Domestic sewage**

- The domestic sewage which contains high BOD, COD and low dissolved oxygen, when discharged into water bodies raises its temperature.

**Hydroelectric power**

- Electric Power industries with cooling arrangements cause thermal pollution in receiving water bodies.

**Coal Fired Power plants**

- Many thermal power plant use coal as a fuel for producing electricity.
- Their condenser coils are cooled with water from nearby river or other water body.
This lowers the dissolved oxygen of water.

**EFFECT OF THERMAL POLLUTION**

- Reduction in Dissolved oxygen
- Change in water properties
- Increase in toxicity
- Effect on marine life
- The rate of photosynthesis
- Increased bacterial growth.

**CONTROL OF THERMAL POLLUTION**

- Temperature of water can be reduced by taking the water to wet or dry cooling towers——used to pre-cool the water.
- Discharging the heated water into shallow ponds or canals, allowing it to cool, and reusing it as cooling water.

*Artificial lakes*

- The heated effluents can be discharged into the lake at one end and the water for cooling purposes may be withdrawn from the other end.
- The heat is evaporated through dissipation in this method.

**Nuclear Hazards (Radioactive pollution)**

- Radioactive pollution is a special form of physical pollution of air, water, land with radioactive materials.

**Radioactivity**

- Is a property of certain elements (Ra, Th, U etc.,) to spontaneously emit protons (alpha particles) electrons (beta particles) and gamma rays (short wave electromagnetic waves) by disintegration of their atomic nuclides.
Sources of Radioactive pollution

- Natural sources
- Man-made sources

1. Natural sources

- The natural source of radioactivity
- Mainly of cosmic radiation - space
- Naturally occurring isotopes- environment.
- Eg. Radium-224, uranium-238, thorium-232 etc.,

2. Man-made sources

- By testing of nuclear weapons
- Establishment of nuclear power plants
- Refining of plutonium and thorium
- Preparation of radioactive isotopes.

EFFECTS OF RADIOACTIVE POLLUTION

Damages at molecular level

- Damages to macromolecules such as enzymes, DNA, RNA, etc., through ionization.

Damages at sub-cellular level

- Damages to cell membranes nuclei, chromosomes such as fragmentation, mitochondria, etc.

Damages to tissues and organs

- Central nervous system
- Loss of sight
• Inactivation of bone marrow and ulceration.

• Death or Shortening of life.

CONTROL OF RADIOACTIVE POLLUTION

• Nuclear devices should never be exploded in air. If these activities are extremely necessary, then they should be exploded underground.

• Leakage of radioactive elements from reactors and laboratories, processing or using them should be totally checked.

• In nuclear and chemical industries, the use of radioactive isotopes may be carried under a jet of soil or water instead of powder or gaseous forms.

• In nuclear mines, wet drilling may be employed along with underground drainage.

• Extreme care should be exercised in the disposal of industries wastes contaminated with radio nuclides.

Disaster Management

Introduction

Disasters have been mankind’s constant though inconvenient companion since time immemorial. Natural disasters continue to strike unabated and without notice and are perceived to be on the increase in their magnitude, complexity, frequency and economic impact globally. These disasters pose a threat to people, structures, economic assets and assume disastrous proportions when they occur in areas of dense human habitations. Since 1960, natural disasters have resulted in the loss of more than three million lives and affected many more. The economic costs are on the rise in alarming proportions, which has increased by a factor of 8 presently as compared to the 1960s. At world wide, 90% of the natural disasters and 95% of the total disaster related deaths occur only in developing countries. It is because most of the world’s worst disasters tend to occur between the area of Tropic of Cancer and the Tropic of Capricorn. This
area is inhabited by the poorer countries of the world, where the problems of disaster management are unique due to the seemingly competing needs between basic necessities for people and economic progress.

The recent disaster in Uttarakhand state (2013) is a wake up call for development planners. There is a need to look at ecological sensitivity of the place before starting any development project. There is a very significant role of foresters and ecologist in planning development in eco-sensitive regions.

**The Indian scenario**

The Indian subcontinent is highly vulnerable to cyclones, droughts, earthquakes and floods. Avalanches, forest fire and landslides occur frequently in the Himalayan region of northern India. Among the 35 total states/ Union Territories in the country, 25 are disaster prone. On an average, about 50 million people in the country are affected by one or the other disaster every year, besides loss of property worth several million (Table 1).

**Table 1: Total number of people reported killed and affected by disasters in India.**

<table>
<thead>
<tr>
<th>Year</th>
<th>Total number of People reported killed</th>
<th>Total number of People reported affected</th>
</tr>
</thead>
<tbody>
<tr>
<td>1986-1995</td>
<td>42,026</td>
<td>561,472,995</td>
</tr>
<tr>
<td>1996-2005</td>
<td>85,001</td>
<td>686,724,143</td>
</tr>
<tr>
<td>2005</td>
<td>5,405</td>
<td>28,262,805</td>
</tr>
</tbody>
</table>

*Source: World Disasters Report 2006- Disaster data*

In the 1970s and the 80s, droughts and famines were the biggest killers in India, the situation stands altered today. It is probably a combination of factors like better resources management and food security measures that has greatly
reduced the deaths caused by droughts and famines. Floods, high winds and earthquakes dominate (98%) the reported injuries, with ever increasing numbers in the last ten years. The period from 1973 to 2001 has been associated with a large number of earthquakes in Asia that have a relatively high injury-to-death ratio. Floods, droughts, cyclones, earthquakes, landslides and avalanches are some of the major natural disasters that repeatedly and increasingly affect India. Table-1 depicts an annual damage due to Natural Disasters (for the year 1985 – 1997).

The natural disasters directly impact economies, agriculture, food security, water, sanitation, the environment and health each year. Therefore it is one of the single largest concerns for most of the developing nations. Different natural hazards cause varying levels of physical damage to infrastructure and agriculture with implications for their indirect and secondary impacts. Drought causes heavy Crop and Livestock losses over wide areas of land but typically leave infrastructure and productive capacity largely unaffected. Floods and Cyclones cause extensive whereas damage to both infrastructure and agriculture, depending on their timing relative to the agricultural cycle. While Earthquakes have little impact on standing crops excluding localized losses but can cause wide spread devastation of infrastructure and other productive capacity over relatively large areas.

India is hit by one major natural disaster or the other almost every year wherein the loss of life is accompanied by losses of the magnitude that is difficult to comprehend. The decade (1990-99), which was the International Decade for Natural Disaster Reduction (1990-99), it witnessed a spate of large-scale disasters that defied all attempts to stem them. These included the Latur (Maharashtra) Earthquake of 1993 killing about 10,000 persons, the Andhra Pradesh Cyclones of 1990 and 1996, killing about 1000 persons each, the Gujarat Cyclone of 1998 killing over 3,500 persons and the Orissa Super-Cyclone of 1999 killing about 10,000 persons. Besides these major events, there
were smaller earthquakes in Uttarkashi, Chamoli and Jabalpur, and frequent floods in the north-east, Uttar Pradesh, Bihar and Kerala. Unfortunately, these disasters were not taken up as learning opportunities, and lessons were not drawn from them to the extent to be prepared in combating future disasters. What happened in Gujarat in 2001 and the way it was handled are grim reminders of the fact that we still need to learn and improve much.

The precise cost of the disaster in terms of loss of lives, property, loss of development opportunities, etc. cannot be clearly assessed, counted or scaled. The costs of disaster are clearly inequitable, falling heavily only on the few. Disasters result not only in loss of shelter but also create hardships, lack of food availability, temporary loss of livelihood and disrupt socio-economic activities. Some of the losses may be redeemable and compensated for through disaster relief and insurance. However, apart from economic dimension, such disturbances have their psychological and social dimensions as well, which need to be studied, and documented besides developing appropriate mitigation strategies.

**Types of Disasters:**

Due to the increasing frequency of natural and man-made disasters and their severe impact on the individuals, society, economy, natural resources and environment, Government of India constituted a High Powered Committee (HPC) on Disaster Management in August 1999 to prepare comprehensive plans for National, State and District levels. The HPC has rightly stressed on the need for a comprehensive and holistic approach towards dealing with all kinds of disasters. From a compartmentalized response oriented approach, a coordinated, holistic and participatory approach has been recommended. HPC identified thirty one disasters in the country. These disasters have been categorized into five sub-groups depending on generic (origin) considerations and various departments/ministries dealing with various aspects. These five sub-groups are as follows:
THE HIGH POWERED COMMITTEE ON DISASTER MANAGEMENT

In August 1999, a High Powered Committee (HPC) on Disaster Management was set up at the behest of the Prime Minister to look into the issue of Disaster Management Planning at national, state and district levels. The Committee, under the chairmanship of Mr. J. C. Pant, had examined the issue of disasters holistically, considering both natural and man-made disasters. Emphasis is on preparedness, and the role of different stakeholders in this activity. The Committee has had a number of consultations with various groups, including academicians, technocrats and voluntary agencies to arrive at a common plan. The Committee submitted its report along with a national Response Plan (HPC Report 2001). The HPC now stands converted into the Working Group of the national committee under the Prime Minister.

1. **Sub-Group I – Water and Climate Related Disasters**
   
   This sub-group includes Floods and Drainage Management, Cyclones, Tornadoes and Hurricanes, Hailstorm, Cloud Burst, Heat Wave and Cold Wave, Snow Avalanches, Droughts, Sea Erosion and Thunder and Lightning.

2. **Sub-Group II - Geologically related disasters**
   
   It includes Landslides and Mudflows, Earthquakes, Dam Failures/ Dam Bursts and Mine Fires

3. **Sub-Group III- Chemical, Industrial & Nuclear related disasters**
   
   In this category, the chemical and industrial and nuclear disasters have been included.

4. **Sub-Group IV- Accident related disasters**
   
   Forest Fires, Urban Fires, Mines Flooding Oil Spill, Major Building Collapse, Serial Bomb Blasts, Festival related disasters, Electrical disasters and Fires, Air, Road and Rail Accidents, Boat Capsizing and Village Fire have been included in this sub-group by HPC.

5. **Sub-Group V – Biologically related disasters**
This sub-group includes Biological disasters and Epidemics, Pest Attacks, Cattle epidemics and Food poisoning.

Here we will, however, discuss such natural and man-made disasters to which India severely exposes itself or herself every year, which often lead to the depletion of natural resources. These are as follows:

Natural disasters are natural phenomenon and occur without any intention while man-made disasters are events which, either intentionally or by accident cause severe threats to public health and well-being. Because their occurrence is unpredictable, man-made disasters pose an especially challenging threat that must be dealt with through vigilance, and proper preparedness and response.

**Natural disasters**

**Floods**

Floods in the Indo-Gangatic Brahmaputra plains are an annual feature. Seventy five per cent of rainfall is concentrated over four months of monsoon (June - September) and as a result almost all the rivers carry heavy discharge during this period.
The problem of sediment deposition, drainage congestion and synchronization of river floods compound the flood hazard with sea tides in the coastal plains. Brahmaputra and the Gangetic Basin are the most flood prone areas. The other flood prone areas are the north-west region of west due to over flowing rivers such as the Narmada and Tapti, Central India and the Deccan region with major eastward flowing rivers like Mahanadi, Krishna and Cavery. The average area affected by floods annually is about 8 million hectares while the total area in India liable to floods is 40 million hectares in which Uttar Pradesh has 21.9%, Bihar (12.71%), Assam (9.4%), West Bengal (7.91%), Orissa (4.18%) and other states have 43.9% flood prone area.

An analysis of data collected from different states for the period during 2004-2006 by Central Water Commission, Ministry of Water Resources, Government of India revealed that average annual damage to crops, houses and public utilities in the country was around Rs.2706.24 million
Flood vulnerability map of India
Droughts

We have a largely monsoon dependant irrigation network.

An erratic pattern, both low (less than 750 mm) and medium (750 - 1125 mm) makes 68 per cent of the total sown area vulnerable to periodic droughts. A 100 year analysis reveals that the frequency of occurrence of below normal rainfall in arid, semi-arid and sub-humid areas is 54-57%, Severe and rare droughts occur in arid and semi-arid zones once in almost every 8-9 years. Semi-arid and arid climatic zones are subject to about 50 per cent of severe droughts that cover generally 76 percent of the area. In this region, rare droughts of most severe intensity occurred on an average once in 32 years and almost every third year used to be a drought year.
Drought is a perennial feature in some states of India. 16% of the country’s total area is drought prone and approximately 50 million people are annually affected by droughts. Infact, persistent drought with less than average rainfall over a long period of time gives rise to serious environmental problems.

An adverse water balance has been added to arid and semi arid category. The episode of drought of 1987-88 was one of the worst droughts of the century. Drought situation have also affected about eleven states in the country in 1999-2000, bringing untold misery to the people and the nation. In 2002, twelve states of the country have been affected again by severe drought due to the failure of South-West monsoon. The Government of India has declared them as drought affected states.

Most of the drought prone areas identified in India lie in the arid, semi-arid and sub-humid areas. Table –2 depicts the criteria for declaration of drought scenario in India on the basis of rainfall distribution.

**Table-2: Criteria for Declaration of Drought in India.**

<table>
<thead>
<tr>
<th>Rainfall (% of normal)</th>
<th>Classification</th>
<th>Drought Scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td>+ 20 or more</td>
<td>Excess rainfall</td>
<td>-</td>
</tr>
<tr>
<td>+19 to −19</td>
<td>Normal rainfall</td>
<td>-</td>
</tr>
<tr>
<td>-20 to −59</td>
<td>Deficient rainfall</td>
<td>Early warning for drought</td>
</tr>
<tr>
<td>-60 to −99</td>
<td>Scanty rainfall</td>
<td>Drought situation</td>
</tr>
<tr>
<td>-100</td>
<td>No rainfall</td>
<td>Severe drought situation</td>
</tr>
</tbody>
</table>

*Source: Government of India, National Centre for Disaster Management(1999)*
The Moisture Index of various agro-climatic zones of India is regularly computed by the India Meteorological Department (IMD) as given in Table-3.

**Table- 3: Moisture Index in Different Climatic Zones in India**

<table>
<thead>
<tr>
<th>Moisture Index</th>
<th>Climatic Zone</th>
<th>Percent Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>-66.7</td>
<td>Arid</td>
<td>19.6</td>
</tr>
<tr>
<td>-66.7 to -33.3</td>
<td>Semi-arid</td>
<td>37</td>
</tr>
<tr>
<td>-33.2 to 0</td>
<td>Dry sub-humid</td>
<td>21.1</td>
</tr>
<tr>
<td>0 to +20</td>
<td>Moist sub-humid</td>
<td>10.2</td>
</tr>
<tr>
<td>+20.1 to +99.9</td>
<td>Humid</td>
<td>7.8</td>
</tr>
<tr>
<td>100</td>
<td>Pre-humid</td>
<td>8.3</td>
</tr>
</tbody>
</table>

*Source: Government of India, National Centre for Disaster Management (1999).*

**Cyclones**
India has a long coastline of approximately 8,000 km. There are two distinct cyclone seasons: pre-monsoon (May-June) and post-monsoon (October-November). The impact of these cyclones is confined to the coastal districts, the maximum destruction being within 100 km from the centre of the cyclones and on either side of the storm track. Most casualties are caused due to coastal inundation by tidal waves, storm surges and torrential rains.

The occurrence of tropical cyclone is almost a common natural phenomenon. However, their characteristics like frequency, intensity and coastal impact vary from region to region. But many of these have been the deadliest after crossing the coast bordering the north bay of Bengal like coastal areas of Andhra Pradesh, Orissa, West Bengal and Bangladesh, mainly because of the serious storm surge problem in this area. The classification of cyclonic disturbances (low pressure areas) is made by the strength of the associated winds. The classification used in India is given in Table-4.

**Table-4: Classification of Cyclonic Disturbances**

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Disturbance</th>
<th>Wind Speed (Knots)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Low</td>
<td>Less than 17</td>
</tr>
<tr>
<td>2</td>
<td>Depression</td>
<td>17-27 (32-50 km/h)</td>
</tr>
<tr>
<td>3</td>
<td>Deep depression</td>
<td>28-33 (51-62 km/h)</td>
</tr>
<tr>
<td>4</td>
<td>Cyclonic Storm</td>
<td>34-47 (63-88 km/h)</td>
</tr>
<tr>
<td>5</td>
<td>Severe cyclonic storm with a core of Hurricane winds</td>
<td>48-63 (89-118 km/h)</td>
</tr>
</tbody>
</table>

*Source: Government of India, National Centre for Disaster Management (1999).*
The Indian Ocean is one of the six major cyclones-prone regions of the world. In India, cyclones from Indian ocean usually occur between April and May, and also between October and December. The eastern coastline is more prone to cyclones than the western coast. About 80 per cent of total cyclones generated in the region hit the eastern coast. Out of approximately six cyclones formed every year, two to three may be severe (Table-5).

Table - 5: Cyclone Formations in the Bay of Bengal and Arabian Sea During 1877-1990

<table>
<thead>
<tr>
<th>Cyclone Type</th>
<th>Bay of Bengal</th>
<th>Arabian Sea</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Cyclonic Depression</em></td>
<td>1240</td>
<td>322</td>
</tr>
<tr>
<td>Cyclonic Storm (wind speed 34-47 knots*)</td>
<td>1542</td>
<td>227</td>
</tr>
<tr>
<td>Severe Cyclonic Storm (wind speed above 47 knots)</td>
<td>259</td>
<td>114</td>
</tr>
</tbody>
</table>

Source: Government of India, National Centre for Disaster Management (1999).

*Knot is a unit of speed, equal to one nautical mile (A nautical mile or sea mile is a unit of length) per hour. 1 international knot = 1 nautical mile per hour = 1.852 kilometres per hour exactly, or (approximately) 1 international knot = 1.1507794 miles per hour = 0.51444444 meters per second.*
Wind and Cyclone vulnerability map of India
Earthquakes

The Himalayan mountain ranges are considered to be the world’s youngest fold mountain ranges. The subterranean Himalayas are geologically very active. In a span of 53 years four earthquakes exceeding magnitude 8 have occurred in this region. The peninsular part of India comprises stable continental crust. Although these regions were considered seismically least active, earthquakes, which occurred in Latur in Maharashtra on September 30, 1993 of magnitude 6.4 on the Richter scale and Gujarat 2001 of magnitude 6.9 on the Richter scale caused substantial loss of lives and damage to infrastructure.

India has a large part of its land area liable to wide range of probable maximum seismic intensities where shallow earthquake of magnitudes of 5.0 or more on Richter Scale have been known to occur in the historical past or recorded in the last about 100 years. The Himalayas frontal that are flanked by the Arakan Yoma fold belt in the east and the Chaman fault in the west constitute one of the most seismically active regions in the world. Table-6 gives major earthquakes in last two decades indicating area, intensity and deaths.

Table – 6: Major Earthquakes In different parts of the world during 1980-2000

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Date</th>
<th>Place</th>
<th>Intensity</th>
<th>Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>30.10.1983</td>
<td>Turkey</td>
<td>6.9</td>
<td>1300</td>
</tr>
<tr>
<td>2</td>
<td>19.9.1985</td>
<td>Mexico</td>
<td>8.1</td>
<td>9500</td>
</tr>
<tr>
<td>3</td>
<td>15.3.1987</td>
<td>Equador</td>
<td>7.0</td>
<td>1000</td>
</tr>
<tr>
<td>4</td>
<td>7.12.1988</td>
<td>Soviet Russia</td>
<td>6.9</td>
<td>25000</td>
</tr>
</tbody>
</table>

36
<table>
<thead>
<tr>
<th></th>
<th>Date</th>
<th>Location</th>
<th>Magnitude</th>
<th>Casualties</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>15.8.1988</td>
<td>North-Eastern India</td>
<td>6.8</td>
<td>10000</td>
</tr>
<tr>
<td>6</td>
<td>21.6.1990</td>
<td>Iran</td>
<td>7.7</td>
<td>35000</td>
</tr>
<tr>
<td>7</td>
<td>16.7.1990</td>
<td>Philippines</td>
<td>7.8</td>
<td>1600</td>
</tr>
<tr>
<td>8</td>
<td>1.2.1991</td>
<td>Pakistan / Afghanistan</td>
<td>6.8</td>
<td>1200</td>
</tr>
<tr>
<td>9</td>
<td>20.10.1991</td>
<td>Uttarkashi, India</td>
<td>6.6</td>
<td>769</td>
</tr>
<tr>
<td>10</td>
<td>12.12.1992</td>
<td>Indonesia</td>
<td>6.8</td>
<td>2200</td>
</tr>
<tr>
<td>11</td>
<td>30.9.1993</td>
<td>Latur, India</td>
<td>6.4</td>
<td>7600</td>
</tr>
<tr>
<td>12</td>
<td>17.1.1995</td>
<td>Japan</td>
<td>7.2</td>
<td>6430</td>
</tr>
<tr>
<td>13</td>
<td>28.3.1995</td>
<td>Russia</td>
<td>7.5</td>
<td>1900</td>
</tr>
<tr>
<td>14</td>
<td>28.2.1997</td>
<td>Iran</td>
<td>5.5</td>
<td>1000</td>
</tr>
<tr>
<td>15</td>
<td>4.2.1998</td>
<td>Afghanistan</td>
<td>6.1</td>
<td>4200</td>
</tr>
<tr>
<td>16</td>
<td>30.5.1998</td>
<td>Afghanistan</td>
<td>6.9</td>
<td>4000</td>
</tr>
<tr>
<td>17</td>
<td>17.7.1998</td>
<td>Papua-New Guinea</td>
<td>7.1</td>
<td>2000</td>
</tr>
<tr>
<td>18</td>
<td>25.1.1999</td>
<td>Columbia</td>
<td>6.3</td>
<td>1100</td>
</tr>
<tr>
<td>19</td>
<td>29.3.1999</td>
<td>Chamoli, India</td>
<td>6.8</td>
<td>103</td>
</tr>
<tr>
<td>20</td>
<td>17.8.1999</td>
<td>Turkey</td>
<td>7.4</td>
<td>15000</td>
</tr>
<tr>
<td>21</td>
<td>21.9.1999</td>
<td>Taiwan</td>
<td>7.6</td>
<td>2000</td>
</tr>
<tr>
<td>22</td>
<td>26.1.2001</td>
<td>India (Gujarat)</td>
<td>6.9</td>
<td>20,000</td>
</tr>
</tbody>
</table>

*Source: Government of India, National Centre for Disaster Management (1999).*

Landslides
The Himalayas, the Northeast hill ranges and the Western Ghats experience considerable landslide activity of varying intensities. River erosions, seismic movements and heavy rainfalls cause considerable landslide activity. Heavy monsoon rainfall often in association with cyclonic disturbances result in considerable landslide activity on the slopes of the Western Ghats.

The Himalayan, the north-east hill and the westem ghats experience considerable land-slides activities of varying intensities. The rock and debris carried by the rivers like kosi originating in the Himalayas cause enormous landslide in the valleys. The seismic activity in the Himalayan region also results in considerable landslide movement. The Government of India is collaborating with a wide range of Indian academic institutions on hill research. Broadly the country has been divided into the following regions in term of incidence and severity of landslides (Table -7):

**Table -7: Incidences of Landslides in India**
Landslides Zonation Mapping is a modern method to identify landslide prone areas and has been in use in India since 1980s.

<table>
<thead>
<tr>
<th>Ranges</th>
<th>Incidences of Landslide</th>
</tr>
</thead>
<tbody>
<tr>
<td>Himalayas</td>
<td>Very high to high</td>
</tr>
<tr>
<td>North –eastern Hills</td>
<td>High</td>
</tr>
<tr>
<td>Western Ghats &amp; Nilgiris</td>
<td>High to moderate</td>
</tr>
<tr>
<td>Eastern Ghats</td>
<td>Low</td>
</tr>
<tr>
<td>Vindhyachal</td>
<td>Low</td>
</tr>
</tbody>
</table>

*Source: Government of India, National Centre for Disaster Management (1999).*
Earthquake vulnerability map of India
Avalanches

Avalanches constitute a major hazard in the higher elevations of Himalayas. Parts of the Himalayas receive snowfall round the year and adventure sports are in abundance in such locations. Severe snow avalanches occur in Jammu & Kashmir, Himachal Pradesh and the Hills of Western Uttar Pradesh. The population of about 20,000 in Nubra and Shyok valleys and mountaineers and trekkers face avalanche hazard on account of a steep falls. Losses of life and property have been reported due to avalanches.

Manmade Disasters

The fast pace of growth and expansion in the name of development without comprehensive understanding or preparedness has brought forth a range of issues that seek urgent attention at all levels. In the absence of such measures growing numbers in our population are at a risk of prospective hazards such as air accidents, boat capsizing, building collapse, electric fires, festival related disasters, forest fires, mine flooding, oil spills, rail accidents, road accidents, serial bomb blasts, and fires. The safeguards within existing systems are limited and the risks involved high. Nuclear, Chemical and Biological threats are apparent in the present scenario. Deliberate international terrorism or accidental secondary fallout can be fatal. Creation of specific infrastructure is

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imperative to avoid a catastrophe in the future. However, rapid and effective response needs intensive research and laboratory support.

**Forest Fires**

Forests face many hazards but the most common hazard is fire. Forests fires are as old as the forests themselves. They pose a threat not only to the forest wealth but also to the entire regime of fauna and flora seriously disturbing the bio-diversity and the ecology and environment of a region.

During summer, when there is no rain for months, the forest becomes littered with dry senescent leaves and dry twigs, burst into flames ignited by the slightest spark. The Himalayan forests particularly Garhwal Himalayas have been burning regularly during the last few summers, with colossal loss of vegetation cover of that region.

Forest fires are usually seasonal. They usually start in the dry season and can be prevented by adequate precautions. State Governments are aware of the severe damage caused by fires not only trees but also to forests and ecology of the area. Successive Five Year Plans have provided funds for forest fire fighting.
However, results have not been very encouraging so far. Traditional methods of fire control are inadequate and limited in India. The modern methods of fire control are yet to be placed on the ground in the required measure.

Forest Fire Line

During the British period, the fire was prevented in the summer through removal of forest litter all along the forest boundary. This was called “Forest Fire Line”. This line use to prevent fire breaking into the forest from one part or compartment to another. The collected litter was burnt in isolation. Generally, the fire spreads only if there is continuous supply of fuel (dry vegetation) along its path. The best way to control a forest fire is, therefore, to prevent it from spreading, which can be done by creating fire breaks in the shape of small clearings of ditches in the forest. Use of water is usually the last resort, as delivering water on to the fire in dense forests on hill slopes, is usually a difficult job. In many developed countries, special aircraft equipped with waster tanks are used to drop tones of water on the burning trees. Unfortunately, in India, there is as yet no proper action plan to control forest fires. As a result, once started the fires rage on for weeks, destroying vast tracts of prime forest area till the rains come and douse them.

The terrorist attacks on New York and Washington D.C. on September 11, 2001, further highlighted the need to create mechanisms that are capable of managing unprecedented but now foreseeable manmade disasters of such large magnitudes. The problem is further compounded by recurrence of different disasters in the same area. In India most of the states experience more than one type of disaster (Table-8).

Table-8: DISASTERS OCCURRING IN DIFFERENT STATES & UNION ERRITORIES IN INDIA

<table>
<thead>
<tr>
<th>S No.</th>
<th>Name of State/UT</th>
<th>Type of Natural Disaster</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Cyclone</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1. Andhra Pradesh</td>
<td>2</td>
</tr>
<tr>
<td>---</td>
<td>------------------</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>√</td>
<td>-</td>
</tr>
<tr>
<td>2.</td>
<td>Arunchal Pradesh</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Assam</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Bihar including Jharkhand</td>
<td>-</td>
</tr>
<tr>
<td>5.</td>
<td>Goa</td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Gujarat</td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>Haryana</td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>Himachal Pradesh</td>
<td>-</td>
</tr>
<tr>
<td>9.</td>
<td>Jammu &amp; Kashmir</td>
<td>-</td>
</tr>
<tr>
<td>10.</td>
<td>Karnataka</td>
<td>-</td>
</tr>
<tr>
<td>11.</td>
<td>Kerala</td>
<td>-</td>
</tr>
<tr>
<td>12.</td>
<td>Madhya Pradesh including Chhattisgarh</td>
<td>-</td>
</tr>
<tr>
<td>13.</td>
<td>Maharashtra</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Maniup</td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>--------</td>
<td>----</td>
</tr>
<tr>
<td>15.</td>
<td>Meghalaya</td>
<td></td>
</tr>
<tr>
<td>16.</td>
<td>Mizoram</td>
<td>-</td>
</tr>
<tr>
<td>17.</td>
<td>Nagaland</td>
<td>-</td>
</tr>
<tr>
<td>18.</td>
<td>Orissa</td>
<td>√</td>
</tr>
<tr>
<td>19.</td>
<td>Punjab</td>
<td>-</td>
</tr>
<tr>
<td>20.</td>
<td>Rajasthan</td>
<td>-</td>
</tr>
<tr>
<td>21.</td>
<td>Sikkim</td>
<td>-</td>
</tr>
<tr>
<td>22.</td>
<td>Tamilnadu</td>
<td>√</td>
</tr>
<tr>
<td>23.</td>
<td>Tripura</td>
<td>-</td>
</tr>
<tr>
<td>24.</td>
<td>Uttar Pradesh including Uttaranchal</td>
<td>-</td>
</tr>
<tr>
<td>25.</td>
<td>West Bengal</td>
<td>√</td>
</tr>
<tr>
<td>26.</td>
<td>Andaman &amp; Nicobar</td>
<td>√</td>
</tr>
<tr>
<td>27.</td>
<td>Chandigarh</td>
<td>-</td>
</tr>
<tr>
<td>28.</td>
<td>Dadar &amp; Nagal Haveli</td>
<td>-</td>
</tr>
<tr>
<td>29.</td>
<td>Daman Diu</td>
<td>-</td>
</tr>
<tr>
<td>30.</td>
<td>Delhi</td>
<td>-</td>
</tr>
<tr>
<td>31.</td>
<td>Lakshadweep</td>
<td>-</td>
</tr>
</tbody>
</table>
Indeed, concurrent to these occurrences, the government at various levels too, has responded by taking appropriate measures for prevention and mitigation of the effects of disasters. While long term preventive and preparedness measures have been taken up, the unprecedented nature of the disasters has called in for a nationwide response mechanism wherein there is a pre-set assignment of roles and functions to various institutions at central, state and the district level.

**THE ADMINISTRATIVE RESPONSE**

**At Central Level**

In the federal set-up of India, the responsibility to formulate the Government's response to a natural calamity is essentially that of the concerned State government. However, the Central Government, with its resources, physical and financial does provide the needed help and assistance to buttress relief efforts in the wake of major natural disasters. The dimensions of the response at the level of Central Government are determined in accordance with the existing policy of financing the relief expenditure and keeping in view the factors like

(i) the gravity of a natural calamity,

(ii) the scale of the relief operation necessary, and

(iii) the requirements of Central assistance for augmenting the financial resources at the disposal of the State Government.

The Division of Disaster Management of Ministry of Home Affairs, Government of India is the nodal ministry for all matters concerning disasters at
the Centre except the drought. The Drought Management is looked after by the Ministry of Agriculture, Government of India. The National Contingency Action Plan (NCAP) facilitates launching of relief and rescue operations without delay. The CAP identifies initiatives required to be taken by various Central Ministries, and Public Departments like in the wake of natural calamities, sets down the procedures and determines the focal points in the administrative machinery.

**At State Level**

As pointed out earlier, the central government only supplements the efforts of the State Government. State Governments are autonomous in organizing relief operations in the event of natural disaster and in the long-term preparedness/rehabilitation measures. The States have Relief Commissioners who are in charge of the relief measures in the wake of natural disasters in their respective states. In the absence of the Relief Commissioner, the Chief Secretary or an Officer nominated by him is overall in-charge of the Relief operations in the concerned State.

The Chief Secretary is the head of the State Administration. The State Headquarters has, in addition, a number of Secretaries who head the various Departments handling specific subjects under the overall supervision and coordination of the chief Secretary. At the level of the State Government natural disasters are usually the responsibility of the Revenue Department or the Relief Department. While important policy decisions are taken at the State Headquarters by the Cabinet of the State headed by the Chief Minister, day-to-day decisions involving policy matters are taken or exercised by the Secretary in the Department

**At District Level**

States are further divided into districts, each headed by a District Collector (also known as District Magistrate or Deputy Commissioner). It is the District Collector who is the focal point at the district level for directing, supervising and monitoring relief measures for disaster and for preparation of district level plans.
NON GOVERNMENTAL ORGANIZATIONS

Emerging trends in managing natural disasters have highlighted the role of Non Governmental Organizations (NGOs) as one of the most effective alternative means of achieving an efficient communication link between the Disaster Management agencies and the affected community. Many different types of NGOs are already working at advocacy level as well as grassroots level; in typical disaster situations they can be of help in preparedness, relief and rescue, rehabilitation and reconstruction and also in monitoring and feedback.

The role of NGOs is a potential key element in disaster management. The Non Governmental sector that operates at grassroots level can provide a suitable alternative as they have an edge over governmental agencies for invoking community involvement.

THE COMMUNITY

It has now been revealed that the community as an institution in itself is emerging as an effective player in the entire mechanism of disaster administration. In the event of actual disasters, the community, if well aware of the preventive actions it is required to take can substantially reduce the damage caused by the disaster. Awareness and training of the community is particularly useful in areas that are prone to frequent disasters. While the community as an effective institution is yet to take shape in the country, considerable efforts are being made to form and strengthen community based organizations at grassroots levels.

NEW STRATEGIES FOR A SAFER FUTURE

PREPAREDNESS, MITIGATION AND PREVENTION

In disaster situations, a quick rescue and relief mission is inevitable; however damage can be considerable minimized if adequate preparedness levels are
achieved. Indeed, it has been noticed in the past that as and when attention has been given to adequate preparedness measures, the loss to life and property has considerably reduced. Going along this trend, the disaster management setup in India has, in the recent years, oriented itself towards a strong focus on preventive approaches, mainly through administrative reforms and participatory methods.

Preparedness measures such as training of role players including the community, development of advanced forecasting systems, effective communications, and above all a sound and well networked institutional structure involving the government organizations, academic and research institutions, the armed forces and the non-governmental organizations have greatly contributed to the overall disaster management in the country. This can clearly be seen from the various instances of reduced damages from disasters due to better preparedness and coordinated inter-agency response. Preparedness is the key to breaking the disaster cycle.

The good practices are a result of the heightened awareness and sensitivity towards communities at risk. The approach of reducing community vulnerability for reducing disasters has paid rich dividends. The first step in this direction has been of identification of vulnerable communities. Those communities periodically exposed to natural hazards, and within them those with low levels of coping powers, such as economically weaker sections, are the first focus of preparedness efforts. Marginal sections of rural communities and dwellers of informal settlements and slums in urban areas fall within this class.

Efforts in the direction of integrating disaster prevention into habitat planning processes are one of the most viable disaster prevention means. The National Centre for Disaster Management’s work on developing and testing methods for integrating risk reduction using community participation into urban planning.

Coastal Andhra Pradesh and Tamil Nadu Disaster Relief and Capacity Building Programme: a programme directly implemented by CASA.
Initiated during the 1977 cyclone, this programme is operational in 243 coastal villages. The Machilipatnam, Bapatla and Tiruchirapalli sector offices of CASA coordinate the programme. It promotes self-reliance of people’s organizations and networks them for collective action on issues of concern. The programme has a sharp focus on “empowerment” through community based disaster preparedness and human potential enhancement. As part of the strategy the development programmes and human potential enhancement. As part of the strategy, the Development programmes integrate community based disaster planning is in its long-term perspective.
planning is one such initiative. The general direction of current efforts is one of multi-pronged approach of mobilization of community perceptions towards a culture of prevention of natural disasters.
The Case of Community Based Rehabilitation in Patanka, Gujarat

Patanka, a village of about 250 families, suffered extensive damage during the quake, with about 170 houses collapsing and the rest being badly damaged. Since it lies in Patan, outside the focus of most relief teams that had headed for Kutch, it somehow received less attention from aid givers. Even the government compensation, as everywhere, was taking time to come by.

Kheemabhai, village leader from Patanka, came across representatives of the Delhi based disaster management organization, SEEDS, and expressed the village’s desire to work themselves to rebuild their lives, and requested for logistics support. SEEDS had been working in the area through its Ahmedabad office, but for the first time came across a community that was wanting to work for itself and was not looking for charity. Things moved fast and never stopped since then.

Local Government Support

A meeting was organized with the Additional District Collector, Mr. V.M. Thakkar, to ensure speedy disbursal of compensation so that the villagers could start rebuilding their homes. Mr. Thakkar visited the village, and on seeing the enthusiasm there, extended full support to the initiative.

Rebuilding: for the people, by the people

Patanka today is a scene of hectic activity. Farmers, who would otherwise be sitting idle in the village square, are scurrying all over the village; everyone is busy in building his house, getting material from the specially set up material depot, and interacting with engineers on technical details of earthquake resistant construction. Villagers can now get their construction steel tailored at the village steel workshop, and their roof timber at the wood workshop. Whole families are involved, with women and children seen curing the masonry work with water, or ferrying material to their sites.

The partnership approach: everyone contributes

The initiative is truly community led. Helping hands have come in from all directions, of course. The SEEDS team helps the villagers procure building material, with limited amounts of cement and steel, within a ceiling of Rs. 10,000, being provided by them also. The villages get their own stone, bricks, wood, roof-tiles and labour. Architects and engineers from SEEDS train the masons, labourers and the villagers themselves on earthquake resistant technology through on-hands training as the work goes on, and through periodic training workshops.

International cooperation at grassroot level

Patanka is on its way to becoming an international good practice in community led rehabilitation and local imbibement of state-of-the-art technology on earthquake resistant construction. Two expert masons have come all the way from NSET (National Society of Earthquake Technology), Nepal, to teach their Gujarati brethren how to build safe houses, under the grassroot cooperation programme between SEEDS and NSET. They command a very good rapport with all villagers, and
Role of Local Bodies

The Constitution 73rd and 74th Amendments paved the way for a constitutional status for local governments - Urban Local Bodies and Panchayati Raj institutions, to play a greater role in matters of immediate concern. While they have started taking active interest and initiatives in most of the subjects under their jurisdiction, disaster management is a topic that has not captured their attention so far. Though some of the enlisted items such as social welfare, health, maintenance of community assets etc. can be said to indirectly address disaster impacts, there is a strong need to focus more direct attention on natural disaster reduction.

Local governance institutions, with their grass-root level contacts with the common people, can make a substantial contribution to the process of spreading awareness and ensuring an active people’s participation in disaster mitigation activities. They are the ideal channels for NGOs and other agencies that conduct any disaster management programme, right from relief, recovery and rehabilitation to planning for mitigation and prevention. However, in order to tap this potential to its fullest, awareness raising and sensitization programs need to be conducted within these institutions for making them better equipped.
The parliament of India has enacted the National Disaster Management Act in November 2005, which brings about a paradigm shift in India’s approach to disaster management. The centre of gravity stands visibly shifted to preparedness, prevention and planning from earlier response and relief centric approach. The proposed legislation is in the concurrent list of constitution thus having the advantage that it will permit the States also to enact their own legislation on disaster management. The new Act provides that
There shall be a National Disaster Management Authority (NDMA) of which the Prime Minister of India will be the Chairperson, helped by a Vice Chairperson. The NDMA shall have the responsibility of laying down the policies, plans and guidelines for disaster management. There shall be created State Disaster Management Authorities (SDMAs), expected to be chaired by the Chief Minister of the State. There shall be created District Disaster Management Authority (DDMA) co-chaired by District Collector and President of the elected body of the district. The Central Government shall constitute the National Institute of Disaster Management (NIDM). NIDM shall plan and promote training and research in disaster management, documentation and development of national level information base relating to disaster management policies, prevention mechanism and mitigation measures. There shall be disaster management funds available to the Union, State and District Authorities to meet the immediate needs of providing rescue and relief to the victims of Disasters.

The Government of India has also constituted Cabinet Committee on Management of Natural Calamities and Cabinet committee on Security. Besides above there are High Level Cabinet Committee and Inter Ministerial Group in place.

The training of eight battalions of Para-military forces has begun, to serve as Disaster Management Response Force (NDRF). It is proposed to establish four training centres in different parts of the country by respective paramilitary forces. A National Disaster Mitigation Fund and a National Disaster Response Fund are proposed to be created. A broad view of disaster administration in the country is depicted in the following figure.

National Disaster Management Authority
Emergence of an organization is always through an evolutionary process. Establishment of NDMA has also gone through same stage. Towards this aim, the Government of India (GOI), in recognition of the importance of Disaster Management as a national priority, has set up a High-Powered Committee (HPC) in August 1999 and also a nation committee after the Gujarat earthquake, for making recommendations on the preparation of Disaster Management plans and suggestion effective mitigation mechanisms. The Tenth Five-Year Plan Document also had, for the first time, a detailed chapter on Disaster Management. Similarly, the Twelfth Finance Commission was also mandated to review the financial arrangements for Disaster Management.

On 23 December 2005, the Government of India enacted the Disaster Management Act, which envisaged the creation of the National Disaster Management Authority (NDMA), headed by the Prime Minister, and State Disaster Management Authorities (SDMAs) headed by respective Chief Ministers, to spearhead and implement a holistic and integrated approach to Disaster Management in India.

NDMA as the apex body is mandated to lay down the policies, plans and guidelines for Disaster Management to ensure timely and effective response to disasters. Towards this, it has the following responsibilities:-

- Lay down policies on disaster management;
- Approve the National Plan;
- Approve plans prepared by the Ministries or Departments of the Government of India in accordance with the National Plan;
- Lay down guidelines to be followed by the State Authorities in drawing up the State Plan;
• Lay down guidelines to be followed by the different Ministries or Departments of the Government of India for the Purpose of integrating the measures for prevention of disaster or the mitigation of its effects in their development plans and projects;
• Coordinate the enforcement and implementation of the policy and plan for disaster management;
• Recommend provision of funds for the purpose of mitigation;
• Provide such support to other countries affected by major disasters as may be determined by the Central Government;
• Take such other measures for the prevention of disaster, or the mitigation, or preparedness and capacity building for dealing with the threatening disaster situation or disaster as it may consider necessary;
• Lay down broad policies and guidelines for the functioning of the National Institute of Disaster Management.

National Disaster Management Authority has been constituted with the Prime Minister of India as its Chairman, a Vice Chairman with the status of Cabinet Minister, and eight members with the status of Ministers of State. Each of the members has a well defined functional domain covering various states as also disaster specific areas of focus and concern. To carry out the mandated functions, NDMA has evolved a lean and professional organization which is IT-enabled and knowledge based. Skills and expertise of the specialists are extensively used to address all the disaster related issues. A functional and operational infrastructure has been built which is appropriate for disaster management involving uncertainties coupled with desired plans of action. The concept of the organization is based on a disaster divisions-cum-secretariat system. Each member of the Authority heads disaster-specific divisions for specific disaster and functional domains. Each member has also been given the responsibility of specified states and UTs for close interaction and coordination. The NDMA Secretariat, headed by a Secretary is responsible to provide secretarial support and
continuity. It is proposed to have two Disaster Management Wings under the Secretariat. They are:

- DM I wing dealing with mitigation, preparedness, plans, reconstruction, community awareness and dealing with financial/administrative aspects.
- DM II wing is proposed to be composed of the National Disaster Management Operations Centre with the state-of-the-art multi-redundant communication systems, to carry out the tasks of capacity development, training and knowledge management.

**State Disaster Management Authority (SDMA)** at state level coordinating all activities which comprises of eight members to be nominated by the Chief Minister and the
Chairperson of the State Executive Committee. One of the members may be designated as the Vice-Chairperson of the State Authority by the Chief Minister. SDMA may constitute an Advisory Committee of experts, as and when necessary.

**The State Government** shall establish a **District Disaster Management Authority (DDMA)** in each district. The District Authority will be headed by District Magistrate and shall consist of members, not exceeding seven, as may be prescribed by the State Government. The District Authority shall act as the district planning, coordinating and implementing body for disaster management.

**The Local Authority** shall ensure training of its officers and employees and maintenance of resources so as to be readily available for use in the event of a disaster. It ensures that all construction projects under it conform to the standards and specifications lay down. It carries out relief, rehabilitation and reconstruction activities in the affected area within its jurisdiction.

**National Institute of Disaster Management (NIDM)** is constituted by the Central Government. NIDM shall plan and promote training and research in disaster management & Start documentation, development of national level information base of disaster management policies, prevention mechanisms, mitigation measures & Networking.

**National Disaster Response Force (NDRF):** The training of eight battalions of Paramilitary forces has begun, to serve as Disaster Management Response Force (NDRF). It is proposed to establish four training centres in different parts of the country by respective paramilitary forces. A National Disaster Mitigation Fund and a National Disaster Response Fund are proposed to be created. A broad view of disaster administration in the country is depicted in the following figure.

The Government of India has also constituted Cabinet Committee on Management of Natural Calamities and Cabinet committee on Security. Besides above there are High Level Cabinet Committee and Inter Ministerial Group in place.
National Policy on Disaster Management

The broad features of the policy are enunciated below:-

- A holistic and pro-active approach for prevention, mitigation and preparedness will be adopted for disaster management.
- Each Ministry/Department of the Central/State Government will set apart an appropriate quantum of funds under the Plan for specific schemes/projects addressing vulnerability reduction and preparedness.
- Where there is a shelf of projects, projects addressing mitigation will be given priority. Mitigation measures shall be built into the on-going schemes/programmes
- Each project in a hazard prone area will have mitigation as an essential term of reference. The project report will include a statement as to how the project addresses vulnerability reduction.
- Community involvement and awareness generation, particularly that of the vulnerable segments of population and women has been emphasized as necessary for sustainable disaster risk reduction. This is a critical component of the policy since communities are the first responders to disasters and, therefore, unless they are empowered and made capable of managing disasters, any amount of external support cannot lead to optimal results.
- There will be close interaction with the corporate sector, nongovernmental organizations and the media in the national efforts for disaster prevention/vulnerability reduction.
- Institutional structures/appropriate chain of command will be built up and appropriate training imparted to disaster managers at various levels to ensure coordinated and quick response at all levels; and development of inter-State arrangements for sharing of resources during emergencies.
- A culture of planning and preparedness is to be inculcated at all levels for capacity building measures.
- Standard operating procedures and disaster management plans at state and district levels as well as by relevant central government departments for handling specific disasters will be laid down.
- Construction designs must correspond to the requirements as laid down in relevant Indian Standards.
- All lifeline buildings in seismic zones III, IV & V – hospitals, railway stations, airports/airport control towers, fire station buildings, bus stands major administrative centre will need to be evaluated and, if necessary, retro-fitted.
- The existing relief codes in the States will be revised to develop them into disaster management codes/manuals for institutionalizing the planning process with particular attention to mitigation and preparedness.

THE RIO DECLARATION ON ENVIRONMENT AND DEVELOPMENT (1992) PREAMBLE

The United Nations Conference on Environment and Development, Having met at Rio de Janeiro from 3 to 14 June 1992, Reaffirming the Declaration of the United Nations Conference on the Human Environment, adopted at Stockholm on 16 June 1972, and seeking to build upon it, With the goal of establishing a new and equitable global partnership through the creation of new levels of co-operation among States, key sectors of societies and people, Working towards international agreements which respect the interests of all and protect the integrity of the global environmental and developmental system, Recognizing the integral and interdependent nature of the Earth, our home, Proclaims that:

PRINCIPLE 1 Human beings are at the centre of concerns for sustainable development. They are entitled to a healthy and productive life in harmony with nature.

PRINCIPLE 2 States have, in accordance with the Charter of the United Nations and the principles of international law, the sovereign right to exploit their own resources pursuant to their own environmental and developmental policies, and the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction.

PRINCIPLE 3 The right to development must be fulfilled so as to equitably meet developmental and environmental needs of present and future generations.
PRINCIPLE 4 In order to achieve sustainable development, environmental protection shall constitute an integral part of the development process and cannot be considered in isolation from it.

PRINCIPLE 5 All States and all people shall co-operate in the essential task of eradicating poverty as an indispensable requirement for sustainable development, in order to decrease the disparities in standards of living and better meet the needs of the majority of the people of the world.

PRINCIPLE 6 The special situation and needs of developing countries, particularly the least developed and those most environmentally vulnerable, shall be given special priority. International actions in the field of environment and development should also address the interests and needs of all countries.

PRINCIPLE 7 States shall co-operate in a spirit of global partnership to conserve, protect and restore the health and integrity of the Earth’s ecosystem. In view of the different contributions to global environmental degradation, States have common but differentiated responsibilities. The developed countries acknowledge the responsibility that they bear in the international pursuit of sustainable development in view of the pressures their societies place on the global environment and of the technologies and financial resources they command.

PRINCIPLE 8 To achieve sustainable development and a higher quality of life for all people, States should reduce and eliminate unsustainable patterns of production and consumption and promote appropriate demographic policies.

PRINCIPLE 9 States should co-operate to strengthen endogenous capacity-building for sustainable development by improving scientific understanding through exchanges of scientific and technological knowledge, and by enhancing the development, adaptation, diffusion and transfer of technologies, including new and innovative technologies.

PRINCIPLE 10 Environmental issues are best handled with the participation of all concerned citizens, at the relevant level. At the national level, each individual shall have appropriate access to information concerning the environment that is held by public authorities, including information on hazardous materials and activities in their communities, and the opportunity to participate in decision-making processes. States shall facilitate and encourage public awareness and participation by making information widely available. Effective access to judicial and administrative proceedings, including redress and remedy, shall be provided.

PRINCIPLE 11 States shall enact effective environmental legislation. Environmental standards, management objectives and priorities should reflect the environmental and developmental context to which they apply. Standards applied by some countries may be inappropriate and of
unwarranted economic and social cost to other countries, in particular developing countries. PRINCIPLE 12 States should co-operate to promote a supportive and open international economic system that would lead to economic growth and sustainable development in all countries, to better address the problems of environmental degradation. Trade policy measures for environmental purposes should not constitute a means of arbitrary or unjustifiable discrimination or a disguised restriction on international trade. Unilateral actions to deal with environmental challenges outside the jurisdiction of the importing country should be avoided. Environmental measures addressing transboundary or global environmental problems should, as far as possible, be based on an international consensus.

PRINCIPLE 13 States shall develop national law regarding liability and compensation for the victims of pollution and other environmental damage. States shall also co-operate in an expeditious and more determined manner to develop further international law regarding liability and compensation for adverse effects of environmental damage caused by activities within their jurisdiction or control to areas beyond their jurisdiction.

PRINCIPLE 14 States should effectively co-operate to discourage or prevent the relocation and transfer to other States of any activities and substances that cause severe environmental degradation or are found to be harmful to human health.

PRINCIPLE 15 In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.

PRINCIPLE 16 National authorities should endeavour to promote the internalization of environmental costs and the use of economic instruments, taking into account the approach that the polluter should, in principle, bear the cost of pollution, with due regard to the public interest and without distorting international trade and investment.

PRINCIPLE 17 Environmental impact assessment, as a national instrument, shall be undertaken for proposed activities that are likely to have a significant adverse impact on the environment and are subject to a decision of a competent national authority.

PRINCIPLE 18 States shall immediately notify other States of any natural disasters or other emergencies that are likely to produce sudden harmful effects on the environment of those States. Every effort shall be made by the international community to help States so afflicted.

PRINCIPLE 19 States shall provide prior and timely notification and relevant information to potentially affected States on activities that may have a significant adverse transboundary environmental effect and shall consult with those States at an early stage and in good faith.
PRINCIPLE 20 Women have a vital role in environmental management and development. Their full participation is therefore essential to achieve sustainable development.

PRINCIPLE 21 The creativity, ideals and courage of the youth of the world should be mobilized to forge a global partnership in order to achieve sustainable development and ensure a better future for all.

PRINCIPLE 22 Indigenous people and their communities, and other local communities, have a vital role in environmental management and development because of their knowledge and traditional practices. States should recognize and duly support their identity, culture and interests and enable their effective participation in the achievement of sustainable development.

PRINCIPLE 23 The environment and natural resources of people under oppression, domination and occupation shall be protected.

PRINCIPLE 24 Warfare is inherently destructive of sustainable development. States shall therefore respect international law providing protection for the environment in times of armed conflict and co-operate in its further development, as necessary.

PRINCIPLE 25 Peace, development and environmental protection are interdependent and indivisible.

PRINCIPLE 26 States shall resolve all their environmental disputes peacefully and by appropriate means in accordance with the Charter of the United Nations.

PRINCIPLE 27 States and people shall co-operate in good faith and in a spirit of partnership in the fulfilment of the principles embodied in this Declaration and in the further development of international law in the field of sustainable development.

Vienna Convention for the Protection of the Ozone Layer

The Vienna Convention for the Protection of the Ozone Layer is a Multilateral Environmental Agreement. It was agreed upon at the Vienna Conference of 1985 and entered into force in 1988. In terms of universality, it is one of the most successful treaties of all time, having been ratified by 197 states (all United Nations members as well as the Holy See, Niue and the Cook Islands) as well as the European Union.

It acts as a framework for the international efforts to protect the ozone layer. However, it does not include legally binding reduction goals for the use of CFCs, the main chemical agents causing ozone depletion. These are laid out in the accompanying Montreal Protocol.

The Kyoto Protocol is an amendment to the United Nations Framework Convention on Climate Change (UNFCCC), an international treaty intended to bring countries together to reduce global warming and to cope with the effects of temperature increases that are unavoidable after 150
years of industrialization. The provisions of the Kyoto Protocol are legally binding on the ratifying nations, and stronger than those of the UNFCCC. Countries that ratify the Kyoto Protocol agree to reduce emissions of six greenhouse gases that contribute to global warming: carbon dioxide, methane, nitrous oxide, sulfur hexafluoride, HFCs and PFCs. The countries are allowed to use emissions trading to meet their obligations if they maintain or increase their greenhouse gas emissions. Emissions trading allow nations that can easily meet their targets to sell credits to those that cannot.

**Lowering Emissions Worldwide**
The goal of the Kyoto Protocol is to reduce worldwide greenhouse gas emissions to 5.2 percent below 1990 levels between 2008 and 2012. Compared to the emissions levels that would occur by 2010 without the Kyoto Protocol, however, this target actually represents a 29 percent cut. The Kyoto Protocol sets specific emissions reduction targets for each industrialized nation, but excludes developing countries. To meet their targets, most ratifying nations would have to combine several strategies:

- Place restrictions on their biggest polluters
- Manage transportation to slow or reduce emissions from automobiles
- Make better use of renewable energy sources—such as solar power, wind power, and biodiesel—in place of fossil fuels

**Current Status**
Most of the world’s industrialized nations support the Kyoto Protocol. One notable exception is the United States, which releases more greenhouse gases than any other nation and accounts for more than 25 percent of those generated by humans worldwide. Australia also declined.

**Background**
The Kyoto Protocol was negotiated in Kyoto, Japan, in December 1997. It was opened for signature on March 16, 1998, and closed a year later. Under terms of the agreement, the Kyoto Protocol would not take effect until 90 days after it was ratified by at least 55 countries involved in the UNFCCC. Another condition was that ratifying countries had to represent at least 55 percent of the world’s total carbon dioxide emissions for 1990. The first condition was met on May 23, 2002, when Iceland became the 55th country to ratify the Kyoto Protocol. When Russia ratified the agreement in November 2004, the second condition was satisfied, and the Kyoto Protocol entered into force on February 16, 2005.
As a U.S. presidential candidate, George W. Bush promised to reduce carbon dioxide emissions. Shortly after he took office in 2001, however, President Bush withdrew U.S. support for the Kyoto Protocol and refused to submit it to Congress for ratification.

**An Alternate Plan**

Instead, Bush proposed a plan with incentives for U.S. businesses to voluntarily reduce greenhouse gas emissions 4.5 percent by 2010, which he claimed would equal taking 70 million cars off the road. According to the U.S. Department of Energy, however, the Bush plan actually would result in a 30 percent increase in U.S. greenhouse gas emissions over 1990 levels instead of the 7 percent reduction the treaty requires. That’s because the Bush plan measures the reduction against current emissions instead of the 1990 benchmark used by the Kyoto Protocol.

While his decision dealt a serious blow to the possibility of U.S. participation in the Kyoto Protocol, Bush wasn’t alone in his opposition. Prior to negotiation of the Kyoto Protocol, the U.S. Senate passed a resolution saying the U.S. should not sign any protocol that failed to include binding targets and timetables for both developing and industrialized nations or that “would result in serious harm to the economy of the United States.”

**2002 Johannesburg Earth Summit on Sustainable Development**

From August 26th to September 4th, 2002, international attention focused on Johannesburg, as South Africa’s commercial capital played host to high-level diplomatic meetings assigned to alleviate poverty while protecting the earth’s environment. This article provides an introduction to the Summit’s issues, events, and outcomes.

**Understanding Sustainable Development**

*Explanation of the concept and how it is used*

Often heard but seldom considered, ‘sustainable development’ is a phrase that can be interpreted in many ways. In 1987, the UN’s definition stated, “sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs” ([*Our Common Future: Report of the World Commission on Environment and Development*](https://en.wikipedia.org/wiki/Our_Common_Future:_Report_of_the_World_Commission_on_Environment_and_Development) [The Brundtland Report], 1987). This definition touches on the concept’s most basic component: specifically, we can’t expend the earth’s limited potential today if we want human life to continue tomorrow.

Of course, the issue is more complicated than that. When delegates met in Johannesburg, they were after concrete measures that would balance our current and future needs. Along with their advisors, the delegates represented a number of perspectives for current and future sustainable
development. For instance, developing countries in Asia or Africa might argue that their people need economic development before environmental progress can be made. Meanwhile, many developed countries concentrated on encouraging cleaner energy technologies resulting in reduced pollution that benefited their citizens' health.

But there were other voices at the Summit aside from government officials. Stakeholders included business leaders, scientists, environmentalists, economists, and a variety of non-governmental organizations (NGOs). Each stakeholder has a unique take on sustainable development that falls into one or more of the following approaches:

**Three Pillars: Approaches to Sustainability**

**Economic:** Encouraging economic development and infrastructure also increases the capacity for change.

This approach asserts that the economically powerful developed world will invest in environmental protection, whereas developing countries must devote their energies elsewhere. Simply put, the poor can’t afford to share the costly interests of a healthy environment; surviving is enough of a task for many.

**Proponents**

- The Group of 77 (G77) developing countries has often supported this approach arguing that only when they ‘catch up’ to the developed world will they be able to participate in initiatives such as environmental protection and pollution reduction.
- Business leaders are likely to support this approach arguing that increased trade and commerce is the most efficient way to achieve development and thereby a capacity for environmental responsibili

**Environment:** Concrete prescriptions, rules, and enforcement must curb environmental degradation.

This approach asserts that traditional development methods have created critical problems for the survival of humans and the planet.

**Proponents**
The European Union has sponsored this approach calling for definitive action such as the targets laid out in the Kyoto Protocol.

Environmentalists largely favour this approach since it targets environmental destruction first and foremost.

Social Justice: Sustainable development is about protecting the environment as well as economic and social justice.

This approach asserts that economic capacity and ecological stability play into a larger sphere of interests. Human life requires a combination of these entities but also social stability, security, and equality.

Proponents

- Norway, Canada, and Japan have set their agendas based on some form of this combination.
- NGOs representing women's or human rights groups favour this approach since it addresses a wider range of issues affecting social development.

The Agenda of the Conference

With such diverse interests in mind, the UN chose to focus attention on a few broad objectives at the Summit:

1. Alleviating poverty.
2. Improving the ability of all countries, particularly in the South, to meet globalization's challenges.
3. Promoting responsible production and consumption.
4. Ensuring that all people have access to energy sources.
5. Reducing environmentally related health problems.
6. Improving access to clean water.

Global Balancing Act

Economic interests and environmental concerns

With such immense objectives and a diverse range of interests, the Summit's risk is that in its attempt to cover everything, it would achieve nothing. In principle, everyone is a proponent of
sustainable development. Politically, it is a term that can mobilize popular support through rhetorical use, but it plays out very differently in practice. Perhaps the most sensitive aspects of implementing plans for sustainable development are the associated economic costs.

In Johannesburg, delegates bound by the interests of their constituents blocked initiatives on a wide range of issues. Most notably, summit negotiations were stalled in three prominent areas: agriculture subsidies, energy interests, and poverty concessions.

**Europe and Agriculture**

Agriculture is widely recognized as a potential area to reduce poverty since trade barriers disproportionately affect farmers in poorer countries. Developed countries place heavy import tariffs on goods produced by developing countries because they want to protect their own farming industries. Europe, in particular (but not exclusively), subsidizes its farming industries in this manner and sought to maintain its right to do so at the Summit.

**Energy Concerns: United States, Canada, Australia**

With regard to the heavily polluting fossil fuel industries, some countries were similarly hesitant toward the Summit’s proposals. The United States, Canada, and Australia were notably reluctant to support fossil fuel reduction targets, although Canada did announce its plan to ratify the Kyoto Protocol. All three countries have economies particularly dependent on the oil and gas industries and would be markedly affected by such measures.

**Emphasis on Poverty: G77**

The Group of 77 developing countries insists that they:

a. Are not responsible for the majority of industrial pollution or CO2 emissions.
b. Cannot afford major environmental initiatives.

They, therefore, insist that the developed world carry the brunt of the economic burden for summit initiatives and increase the transfer of environmentally sound technologies to developing countries. Much of the developing world’s exemption from the Kyoto Protocol was one of the main reasons the United States refused to ratify.
History of the Earth Summits

From Rio to Johannesburg

Today’s environmental movement finds its origin in 1960s Europe and North America. It gained momentum throughout the decade, and the first international meeting focusing specifically on the environment and development was held in Stockholm in 1972. This meeting was called The United Nations Conference on the Human Environment.

1986 - Brundtland Commission

Following this conference, the United Nations appointed a World Commission on Environment and Development to find critical areas of environmental degradation around the globe. Led by Norway’s Prime Minister, Gro Harlem Brundtland, the commission delivered its findings and proposed solutions. Commonly referred to as the Brundtland Report, but officially titled Our Common Future: Report of the World Commission on Environment and Development, the research brought the concept of sustainable development to the fore and called for cooperative, international efforts to combat growing environmental problems.

1992 - The Rio Earth Summit

The Rio Summit was a response to this call for global environmental cooperation. Officially titled the United Nations Conference on Environment and Development, Rio hosted an unprecedented gathering to focus on environmental issues; more than 35,000 people, including 106 heads of state took part in the Summit. Public awareness and debate around environmental issues peaked with a number of new conventions agreed upon, including biodiversity and climate change, to name two. Institutionally, the UN formed the Commission on Sustainable Development (CSD) to monitor implementation of agreements reached in Rio. Crucially, Agenda 21 formed a ‘global plan-of-action’ for sustainable development at local, national, and international levels.

What is Agenda 21?

In 1992, the international community adopted Agenda 21 as a non-binding framework incorporating environmental, economic, and social concerns into a single scheme. It contains over 2,500 wide-ranging and concrete recommendations for action on issues such as:

- Reducing wasteful use of natural resources
- Fighting poverty
- Protecting the atmosphere, oceans, and animal and plant life
- Promoting sustainable agriculture practices that will feed the world's growing population.

2002 - Johannesburg Summit

The Johannesburg World Summit on Sustainable Development marked a continuation of the earlier efforts of Agenda 21. Often dubbed Rio-Plus-10, it was meant to reaffirm Agenda 21 as well as broaden the sustainable development debate to encourage partnerships between government, business, and civil society.

The Run-up to Johannesburg: Preparations

Most of the negotiations took place at the Summit's preparatory meetings. The tenth session of the United Nations Commission on Sustainable Development (known as CSD10) was the global Preparatory Committee (PrepCom) for the Johannesburg Summit. Four inter-governmental PrepCom meetings were held during 2001-2002 to agree on the agenda for the Summit.

The First Summit Preparatory Committee (PrepCom1) was held at the United Nations Headquarters in New York from April 31 to May 2, 2001. The Second Summit Preparatory Committee (PrepCom2) was held from January 28 to February 8, 2002 in New York, followed by the Third Summit Preparatory Committee (PrepCom3), also in New York, from March 25 to April 5, 2002. The final PrepCom (PrepCom4) committee convened at the ministerial level, and was held in Bali, Indonesia, from May 27 to June 7, 2002. Representatives from each of the major groups, including leaders from the NGO and business communities participated in these meetings.

Earth Summits: Promoting Multilateralism

Since 1970, a comprehensive series of multilateral agreements on crucial environmental and sustainability issues have been reached.

Canada's Role in the 2002 Earth Summit

Global concerns and domestic interests

The Canadian government's focus of its Johannesburg mission was touted “Global Sustainable Development with an Emphasis on Africa.” As mentioned in the section Understanding Sustainable Development, Canada’s approach at the time of the Summit was distinguished by
its combination of all three central pillars of sustainable development: environmental, economic, and social justice.

**Sustainable Development**

At the Johannesburg Summit, Canada emphasized partnerships in its sustainable development platform. With a large private sector contingent, the delegation stressed the practicality of partnerships for seeking, “cost-effective solutions to issues such as urban sustainability, capacity building and knowledge sharing on subjects from forest management to sustainable mining.”

**Governance**

President of the Governing Council of the United Nations Environment Program was probably Canada’s most valuable role at the Summit. Canada’s Minister of the Environment at the time, David Anderson, carried this title and pushed for consensus on ways to enforce and regulate environmental law. Given the complexity of organizing local, national, and international arrangements for environmental governance, the proceedings were hard fought, but did not move far.

**Health and Human Rights**

Canada’s emphasis on health care and human rights was another area that distinguished Canada’s platform from that of most other countries. Beyond environmental and economic initiatives, Canada’s delegation highlighted the importance of health care and medical services for social stability and economic development. With Canadian pressure, medical access is now deemed a human right alongside cultural and religious values.

With regard to human rights, the ‘human security’ agenda was forefront for Canada. This agenda placed importance on the capacity of individuals to live without fear of war or violence.

**Africa**

Subsequent announcements by the Canadian government played into summit proceedings. Over the next five years, $6 billion was earmarked to support new and existing investments in Africa’s development, including a $500 million Canada Fund for Africa.

The Fund includes:
• Elimination of tariffs and quotas on imports from the 48 Least Developed Countries, of which 34 are in Africa;
• $28 million to develop skills and expertise in the public sector;
• $9 million to strengthen the parliamentary system;
• $6 million for local governance;
• A doubling of Canada’s investment in basic education to $100 million by 2005;
• $50 million towards the development of an HIV vaccine; and
• $50 million to help eradicate polio.

**Domestic Concerns**

With pressure from sources within Canada, the delegation played a high profile on a few fronts. Energy was paramount in this regard; pressure from Alberta’s oil and gas industry as well as Ontario and BC governments made Canada’s plan to ratify the Kyoto Protocol uncertain. The delegation maintained its support for the accord’s flexibility mechanisms, such as emissions trading.

Fisheries were another area of specific interest for Canada as negotiations finalized plans to restore fisheries to their maximum sustainable yields by 2015.

**Highlights of the 2002 Earth Summit**

*Events & agreements*

A number of media outlets reported lacklustre progress on many of the Summit’s central themes. Despite this, the United Nations highlighted several of the Summit’s achievements. (Note that a variety of outcomes are listed, from invaluable and precise, to speculative and vague.)

**Water and Sanitation**

• Commitment to reduce by half the proportion of people without access to sanitation by 2015.
• The United States announced $970 million in investments over the next three years on water and sanitation projects.
• The European Union announced the “Water for Life” initiative that seeks to engage partners to meet water and sanitation goals, primarily in Africa and Central Asia. The
Asia Development Bank provided a $5 million grant to UN Habitat and $500 million in fast-track credit for the Water for Asian Cities Programme.

- Twenty-one other water and sanitation initiatives with at least $20 million in extra resources.

**Energy**

- Commitment to increase access to modern energy services, energy efficiency, and the use of renewable energy.
- To phase out, where appropriate, energy subsidies.
- To support the NEPAD objective of ensuring access to energy for at least 35% of Africa’s population within 20 years.
- The nine major electricity companies of the E7 signed a range of agreements with the UN to facilitate technical cooperation for sustainable energy projects in developing countries.
- The European Union announced a $700 million partnership initiative on energy and the United States announced that it would invest up to $43 million for the initiative in 2003.
- The South African energy utility Eskom announced a partnership to extend modern energy services to neighbouring countries.
- Thirty-two partnership submissions for energy projects with at least $26 million in resources.

**Health**

- Commitment that by 2020, chemicals should be used and produced in ways that do not harm human health and the environment.
- To enhance cooperation to reduce air pollution.
- To improve developing countries’ access to environmentally sound alternatives to ozone depleting chemicals by 2010.
- The United States announced their commitment to spend $2.3 billion through 2003 on health, some of which was earmarked earlier for the Global Fund.
- Sixteen partnership submissions for health projects with $3 million in resources.
Agriculture

- The GEF will consider the Convention to Combat Desertification as a focal area for funding.
- Development of food security strategies for Africa by 2005.
- The United States will invest $90 million in 2003 for sustainable agriculture programs.
- Seventeen partnership submissions with at least $2 million in additional resources.

Bio Diversity and Ecosystem Management

- Commitment to reduce biodiversity loss by 2010.
- Reverse the current trend in natural resource degradation.
- Restore fisheries to their maximum sustainable yields by 2015.
- Establish a representative network of marine protected areas by 2012.
- Improve developing countries’ access to environmentally sound alternatives to ozone depleting chemicals by 2010.
- Undertake initiatives by 2004 to implement the Global Program of Action for the Protection of the Marine Environment from Land Based Sources of Pollution.
- Thirty-two partnership initiatives with $100 million in resources.
- The United States has announced $53 million for forests in 2002-2005.

Other Issues

- Recognition that opening access to markets is a key to development for many countries.
- Support the phase out of all forms of export subsidies.
- Commitment to establish a 10-year framework of programs on sustainable consumption and production.
- Commitment to actively promote corporate responsibility and accountability.
- Commitments to develop and strengthen a range of activities to improve preparedness and response for natural disasters.
- Agreement to the replenishment of the Global Environment Facility, with a total of $3 billion ($2.92 billion announced pre-Summit and $80 million added by EU in Johannesburg).
**What is the Kyoto Protocol’s Status**

Ministers at the Johannesburg Summit indicated their support for the Kyoto Protocol. The agreed action plan read: "States that have ratified strongly urge those that have not done so to ratify Kyoto in a timely manner."

Countries like China, India, Brazil, and Thailand announced their ratification of the Kyoto Protocol at the Johannesburg Summit. Russia and Canada gave strong signals that they would ratify in the near future. The combined emissions of Russia and Canada would be sufficient to allow greenhouse gas figures to reach the required limit.

The Kyoto Protocol will enter into force 90 days after 55 governments have ratified, including developed countries which represent approximately 55% of 1990 carbon dioxide emissions (for ratifying states). As of September 2002, 94 countries had ratified, including all European Union member states and Japan, accounting for 37.1%.

**Shares of 1990 CO₂ emissions:**

<table>
<thead>
<tr>
<th>Country</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States</td>
<td>36.1 %</td>
</tr>
<tr>
<td>European Union</td>
<td>24.2 %</td>
</tr>
<tr>
<td>Russian Federation</td>
<td>17.4 %</td>
</tr>
<tr>
<td>Japan</td>
<td>8.5 %</td>
</tr>
<tr>
<td>Canada</td>
<td>3.3 %</td>
</tr>
<tr>
<td>Australia</td>
<td>2.1 %</td>
</tr>
</tbody>
</table>

Recent weather-related crises throughout the world remind us of the changes that climate change is likely to bring. From droughts in India and North America to flooding throughout Europe, regional climate change scenarios are thought to be occurring.
Plan of Action

The Johannesburg Summit agreed upon a Plan of Implementation that underlines the importance of developing and disseminating innovative technologies in energy and other key sectors, including the private sector. Technology transfers to developing countries are highlighted in this plan.

Political Declaration

Participating governments negotiated the Plan of Action and a Political Declaration at the Summit.

Partnerships for Sustainable Development

- **Type I Outcomes**: Political commitments made at the Summit.
- **Type II Outcomes**: Partnerships consisting of a series of commitments and planned coalitions to further the implementation of sustainable development. Not negotiated, they are voluntary arrangements made by multiple stakeholders including the private sector and NGOs.

**QUESTIONS FOR PRACTICE**

**Part A**

1. Define environmental pollution.
2. Define water pollution.
3. Give a brief account of effects of air pollution.
4. Define land pollution and describe its sources.
5. Write short notes on:
   (i) Effects of noise pollution
   (ii) Sources of radio active pollution
6. How can man be held responsible for natural calamities such as flood, earthquake, etc.,?
7. Discuss the causes and effects of thermal pollution.
8. What are the alternatives to chemical fertilizers? What are their advantages?
9. Do you think moral values prevent pollution in the environment? Explain your views.

PART-B

1. What is radioactive pollution? Discuss sources and effects of radiation.

2. Give an account of solid waste management.

3. What do you understand by the term “disaster”? How is it classified? And what are the responsible factors of disaster?

4. Write an essay on air pollution- causes, effects, and control measures.

5. Give a comprehensive account of the management of various disasters.

6. Thermal power plants are deemed essential for generation of electricity but they also produce wastes which are harmful for man and his environment. Elucidate.

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- World Disasters Report 2006- International Federation of Red Cross and Red Crescent Societies
UNIT IV
SOCIAL ISSUES AND THE ENVIRONMENT

Definition for Sustainable Development

- It is defined as the development that meets the needs of the present without compromising the ability of the future generations to meet their own needs.

Components of Sustainable Development

- **Economic development**: like industrial development, creating job opportunities, utilization of natural resources for developing the quality of life.
- **Community development**: providing food, shelter, cloth, education and other essentials for the human beings.
- **Environmental protection**: Providing clean air, water and environment for the present and future generations and utilization of resources in a sustainable manner.

Measures for sustainable development

1. Using appropriate technology
2. Reduce, Reuse and Recycle
3. Promoting environmental education and awareness
4. Resource utilization as per carrying capacity. (Supporting- capacity to regenerate, assimilative capacity- to tolerate different stresses.)

Urban problems related to energy

**Urbanization:**

- It is **defined** as the process of movement of human population from rural areas to urban areas in search of better education, better economic interest, health needs etc.,

Energy demanding activities

- Residential and commercial lighting, Public transportation for moving from residence to work place, Usage of electrical gadgets in every day life.
Industrial plants using a large amount of energy, Disposal of wastes using energy based techniques.

**Solutions to the urban problems related to Energy**

- **Mass movement of rural areas to be stopped** by providing them better facilities and opportunities at their own places.
- **Energy is to be saved** by proper utilization.
- Cheap and eco-friendly energy resources to be identified.
- Gap between generation point and consumption point to be minimized.
- **More energy to be generated** from sustainable form of resources

**Water conservation**

- The production, development and efficient management of water resources for beneficial is called as water conservation.

**Techniques for water conservation**

- Rain water harvesting.
- Water shed management.
- Construction of storage reservoirs.
- Reuse of industrial waste water.
- Better agricultural practices.

**Rain Water Harvesting**

- The process of collection of rain water directly or recharging it into the ground to improve ground water storage is called rainwater harvesting.

**Objectives of Rain Water Harvesting**

- To reduce run off loss
- To avoid flooding of roads
- To meet the increasing demands of water
- To raise the water table by recharging ground water
- To reduce ground water contamination
- To supplement ground water supplies during rain season.

**Method of Rain Water Harvesting**

- Roof top rain-water harvesting is a low cost and effective technique for urban houses and buildings.
- The rain-water from the top of the roofs, road surfaces, Play grounds, open land and run off water are diverted into the recharge pits.
- This percolates towards the ground water table.
- The pit-base is filled with stones and sand. This serves as the filter.
- The water is then diverted into the well diverted into the well from the pit base through pipes.
- This can be later used for several purposes.
Advantages of Rain Water Harvesting

- Increase of ground water level, decrease of salt content in ground water.
- Prevents soil erosion and flood, decreases problems related to drinking water deficiency.
- Prevents soil erosion and flood, requires less space.
- Does not require major construction work,
- Less maintenance cost.
- Reduces the reliability on water storage dams.
- Reduction in the use of energy for pumping water and consequently the costs.
**Water Shed**

- It is defined as the land area from which water drains under gravity to a common drain.

- Eg. Himalayas are one of the most critical water sheds in the world.

**Water Shed Management**

- It is a process aimed at protecting and restoring the habitat and water resources of a water shed.

**Objectives of Water Shed Management**

- Conservation, up gradation and optimum utilization of natural resources and vegetation in an integrated manner.

- Generation of huge employment opportunities in the backward rain-fed areas to ensure live-hood security, particularly poorest section of the rural people.

- To manage the water shed for beneficial development activities like domestic water supply, irrigation, hydropower generations etc.,
A Watershed
Resettlement

- It is the process of simple relocation or displacement of human population without considering their individual, community or social needs.

Rehabilitation  It is defined as the process of

- Replacing the lost economic assets.
- Rebuilding the community systems that have been weakened by displacement.
- Attending to the psychological trauma of forced separation from livelihood.
- Resettlement and rehabilitation is the most serious problems posed by the developmental activities.
- Among other developmental activities, dam construction has so far displaced million of people.
Causes of relocation

Factors contributing to displacement and relocation of human settlements on a large scale are

- Developmental activities
  - Construction of dams, roads, railways, airports, irrigation and canals etc.,
- Disasters
- Natural disasters like earthquake, floods, land slides, forest fires, etc.,
- Conservation initiation
- Protection of wildlife, forests, water body conservation etc.,

ENVIRONMENTAL ETHICS

- It refers to the issues, principles and guidelines relating to human interactions with their environment.
- To safeguard environment, our activities should be in the following ways.
- Reduce the consumption of goods and services which reduces the environmental qualities.
- Minimize resource utilization and conservation of resource
- To get good environment, it is necessary to limit our economic growth.

ENVIRONMENTAL ISSUES AND POSSIBLE SOLUTIONS

- Environmental problem – It is the excessive depletion and pollution. Both affect the quantity and quality of environment.

Sources of environmental problems

- Excessive usage of resource.
- All types of economic activities pollute and deteriorate the nature.
- Over – population
- Over exploitation and increased consumption of non-renewable resources.
- The industrial growth releases huge quantities of effluents, smoke and solid wastes into the environment.
- Various problems due to improper distribution of money, food, housing, education etc.,

**Important environmental issues**

- Population explosion leads to deforestation.
- More usage of fossil fuel increases CO$_2$ content in the atmosphere. This leads to global warming.
- Destruction of ecosystem and consequent loss of genetic diversity.
- Plasticizing of modern agriculture and overgrazing.
- Waste disposal
- Depletion of ozone content in the atmosphere
- Acid rain fall, oil spillage and pollution during war time

**Solutions to Environment problems:**

- Reduce the waste of matter and energy resources
- Place more emphasis on pollution prevention and waste reduction.
- Recycle and reuse of waste products and resources.
- Depends on renewable source of energy.
- Sustain earth’s biodiversity by protecting vital habitats for wild life species.
Climatic Change

Climate:

- It is the sum of all statistical weather information of the atmosphere elements with specified area over a long period of time.

Climatic Change:

- It is the common deviation from the average as well as extreme conditions.

Causes of Climatic Change:

- Variation in the earth orbital characteristics, Atmospheric CO$_2$ variations
- Volcanic eruptions, Variations in Solar output.

Effects of Climatic Change:

- Mean sea level is increased on a average of 1.8 mm per year.
- Rate of species extinction increase
- Human agriculture forestry and water recourses will be affected
- Many ecosystems have to adopt rapid change in global temperature
Unexpected flooding and drought

**Green House gases**

- The chemical substances that increase the earth’s surface temperature are called green house gases.

**Green house effect**

- It is defined as the progressive warming up of the earth’s surface due to blanketing effect of man – made carbon –di-oxide in the atmosphere.
- The solar radiations are shorter radiations.
- It is absorbed at the earth’s surface and converted to heat.
- It is reemitted back from the surface as infrared radiations.
- These are longer radiations. Hence they cannot easily escape from the atmosphere.
- Some of the radiations are trapped by a number of gases.
- This effect is called greenhouse effect.

**Four major greenhouse gases**

- Carbon – di-oxide, Methane, Nitrous oxide, Chlorofluorocarbons

**Global Warming**

- It is defined as a increasing temperature of which causes more changes in climate.

**Effects of Global Warming**

- More heat waves, Expansion of desert area , Natural fire in forest land
- More evaporation of water from oceans and water bodies, Melting of ice caps in Artic and Antarctic regions, More Cloud formation in the atmosphere, Changes in rain fall pattern. The food production will be affected
- Shorter and warmer winters and longer and hotter summers, Raise in sea level, Flooding and submergence of low lying coastal areas
- More drought, Decline of biodiversity, Surface temperature of oceans changes affecting marine ecosystems

Control Measures of Global Warming
- Reduction in consumption of fossil fuels such as coal and petroleum
- Use of bio gas plants
- Use of nuclear power plants
- Increasing forest cover to absorb CO₂ from the atmosphere
- Use of unleaded petrol in the automobile
- Installation of pollution control devices in automobiles and industries

Acid Rain
- 1. It is defined as rain which have a higher content of acid.
- 3. They form acids and descend as acid rain.

Mechanism of acid rain

\[
\begin{align*}
S + O_2 & \rightarrow SO_2, \\
2SO_2 + O_2 & \rightarrow 2SO_3, \\
SO_3 + H_2O & \rightarrow H_2SO_4, \\
O_3 + NO_2 & \rightarrow NO_3 + O_2 \\
NO_3 + NO_2 & \rightarrow N_2O_5, \\
N_2O_5 + H_2O & \rightarrow 2HNO_3
\end{align*}
\]

Effects of acid rain
1. Both dry and wet deposition of sulphur – di –oxide significantly increases the rate of corrosion of limestone, sandstone and marble.

2. Forest tree population is affected.

3. Acid rain affects the aquatic ecosystem.

4. Acid rain in combination with ozone may damage the waxy coating on leaves.

5. Acid rain adds hydrogen ions to the soil. These hydrogen ions leaches the important nutrients from the soil.

6. It reduces the decomposition of dead plants and animals.

7. It disrupts the ecological balance by killing many bacteria and blue green algae.

8. Acid rain also causes skin and lung diseases.

9. Acid rain affects the buildings and materials.

**Control of acid rain**

- Reducing pollution from industries. The release of SO2 is reduced from coal burning power plants in the following ways.
  - By using less sulphur coal
  - By washing the coal to remove some of the sulphur.
  - By installing pollution control devices like scrubbers to remove the SO2
- Liming of lakes and soils should be done to correct the adverse effects of acid rain.
- Reduce the usage of fossil fuels.
- Improvement in technologies and switching to clean technologies.
OZONE LAYER DEPLETION

Importance of ozone layer depletion

1. Ozone is odorless, colorless gas composed of three atoms of oxygen.

2. Ozone is naturally formed by short wavelength ultraviolet radiations in the upper stratosphere.

3. Wavelength less than 240nm are absorbed by normal oxygen molecules which dissociates to give O atoms. The O atoms in combinations with other oxygen molecules produce ozone.

4. The ozone layer is present in the stratosphere between the height of 35 and 50km.

5. Ozone layer prevents the harmful UV-rays from entering into the earth’s surface.

CFC

- CFC is the chloro fluorocarbon these substances are

  Non-toxic, Non-flammable, Non-reaction with other chemical compounds.

- These are largely insoluble in water, These are resistance to physical and biological break down.

- These chemicals consist of chlorine or bromine atoms which are reactive when they are in free state.

- Chlorofluorocarbons (CFC) **Sources:** Refrigerants, propellant in a aerosol spray.

- Hydrofluoro carbons (HCFC) **Sources:** Refrigerants, blowing agents.

- Bromofluoro carbons (BFC) **Source:** Fire extinguisher.

Ozone layer Depletion process

- In the stratosphere region, ozone is constantly being produced and destroyed naturally.

- The balanced between the creation and removal of ozone is affected by increasing concentration of chlorine, nitrogen, bromine, hydroxides etc.
● These act as catalyst and speed up the removal process.

● Ozone is a highly unstable molecule that readily donates its extra oxygen molecule to free radical elements such as nitrogen, hydrogen, bromine and chlorine

● Ozone depletion due to chlorofluorocarbons

\[ \text{Cl} + \text{O}_3 \rightarrow \text{ClO} + \text{O}_2 \quad \text{ClO} + \text{O} \rightarrow \text{Cl} + \text{O}_2 \]

● Each atom of chlorine can attack several ozone molecules.

● Ozone destruction by nitrogen oxide (NO)

\[ \text{O}_3 + \text{NO} \rightarrow \text{O}_2 + \text{NO}_2 \quad \text{O}_3 + \text{NO}_2 \rightarrow \text{O}_2 + \text{NO}_3 \]

● Ozone layer depletion varies with latitude it is lowest over the equator increasing towards the poles

**Harmful effects of ozone layer depletion**

● **Human Health**

● Reddening of skin in sun shine

● Skin cancer

● Reduction in bodies’ immunity to diseases.

● Eye disorders like cataract and blindness

**Effect on climate**

● Depletion of ozone layer leads to increase in the absorption of UV rays by the earth surface. This increase the temperature of the earth’s surface.

● Increase in hydrogen peroxide in the troposphere. This reduces acid rain

**Other living things**

● The UV rays are harmful to other forms of wild life particularly small plants and animals living in the sea called Plankton. Plankton forms the basin of zone food chain.

● UV rays damages certain crops like rise, Soybeans, Cotton, wheat etc.
- These can damage polymers used in paint, clothing and other materials.

**Control Measures**

- Replacing CFC’s by materials which are less damaging.

- Use of gases such as methyl bromide which is a crop fumigant also to be controlled.

**Nuclear accidents and Holocaust**

- Nuclear hazard results from nuclear testing, nuclear reactor explosions, mining of radioactive ores, drainage from hospitals and nuclear institutes etc.

**Nuclear accidents**

1. Nuclear test causes settling down of radioactive debris on the earth’s surface.

2. When the explosion is on or near the ground, a large depression is produced.
3. Radioactive dust from the depression rises in the air causing air pollution.

**Nuclear holocaust**

- These kinds of destructions are happened in a nuclear war. A large number of living beings are usually destroyed. Ex. Hiroshima and Nagasaki

**Control measures**

- Suitable precautions to be taken properly trained staff to be employed
- Constant monitoring of the radiation level

**Waste land reclamation**

- Waste land: Any land which is not put to optimal use.

**Reason for wasteland formation:**

- Deforestation, Desertification, Soil loss, Industrial pollution
- Overgrazing and over exploitation
- Population explosion, Mining activities
- Various irrigation and power projects

**Classification of Wasteland**

- Barren and uncultivable wasteland
  - They cannot be brought under cultivation or economic use except at very high cost.
  - They are mostly lands such as hilly slopes, rocky exposures, and sandy deserts.

**Cultivable wastelands**

- these are cultivable but not cultivated for more than five years
- it comprises all lands available for cultivation
**Waste land reclamations methods**

- Formation of wasteland can be prevented by conserving the soil. Soil conservation can be done by bringing the land under vegetal cover.
- these lands can be brought under cultivation by using abundant water and fertilizers
- Afforestation and agronomical practices to be adopted to conserve the soil
- Contour bunds are constructed for safe disposal of water in the catchment areas.

**Consumerism and waste products**

- Consumerism: consumption of resources by the people

**Traditionally favourable rights of sellers**

- The right to introduce any product, The right to charge any price, The right to spend any amount to promote their product, The right to use incentives to promote their products.

**Traditional buyer rights**

- The right to buy or not to buy
- The right to expect a product to be safe.
- The right to except the product to perform as claimed

**Objectives of consumerism**

- To improves the rights of powers of the buyers.
- To involve making the manufacturer liable for the entire life cycle of a product.
- It force the manufacturer to reuse and recycle the product after usage.
- The items which are very difficult to decompose like polymeric goods, computers, televisions etc., can be returned to the manufacturer for reclaiming useful parts and disposing the rest.
- The reusable packing materials like bottles can be taken back to the manufacturer. It makes the products cheaper and avoids littering and pollution.
Active consumerism improves human health and happiness and also it saves resources.

**ENVIRONMENTAL LEGISLATION AND LAWS**

The major environmental problems around us are,

- Air and water pollution by industries
- Forestry
- Land resources
- Urbanization
- Waste Management

**IMPORTANT PROTECTION ACTS**

The GOVT of India and State GOVT have implemented a number of protection Acts,

- Forest (Conservation) Act, 1980

**Water (Prevention and control of Pollution) Act 1974**

- This act provides for maintaining and restoring the sources of water and also preventing and controlling water pollution.
- Important features of Water Act
- To protect water from all kinds of pollution and to preserve the quality of water in all aquifers.
- Further provides for the establishment of Central Board and state Boards for prevention of water pollution.

- The states are empowered to restrain any person from discharging a pollutant or sewage or effluent into any water body without the consent of the Board.

- Any contravention of the guidelines or standards would attract penal action including prison sentence ranging from 3 months to 6 years.

- The Act is not clear about the definition of pollutant, discharge of pollutant, toxic pollutant which allows scope for misinterpretation at the time of decision whether the law is violated or not.

- The Amendment Act of 1988 requires permission to set up an industry which may discharge effluent

**AIR (PREVENTION AND CONTROL OF POLLUTION) ACT, 1981**

- This act was enacted in the Conference held at Stockholm in 1972. Deals with problems relating to air pollution

- It envisages the establishment of Central and State Control Boards endowed with absolute powers to monitor air quality and pollution control.

**IMPORTANT FEATURES OF AIR ACT**

- The Central Board may lay down the standards for the quality of air.

- The Central Board coordinates and settle disputes between State boards, in addition to providing technical assistance and guidance to State Boards.

- The State Boards are empowered to lay down the standards for emissions of air pollutants from industrial units or automobiles or other sources.

- The State Boards are to collect and disseminate information related to air pollution and also to function as inspectorates of air pollution.

- The State Boards are to examine the manufacturing processes and the control of equipment to verify whether they meet the standards prescribed.
• The State Boards can advise the State Government to declare certain heavily polluted areas as pollution control areas and can advice to avoid the burning of

• The directions of the Central Board are mandatory on State Boards.

• The operation of an industrial unit is prohibited in a heavily polluted areas without the consent of the Central Board.

• Violation of law is punishable with imprisonment for a term which may extend to 3 months or fine upto Rupees 10,000 or both.
  
  • This act applies to all pollution industries.
  
  • The Air Act, like water Act. Confers wide powers on State Boards to order closure of any industrial unit or stoppage or regulation of supply of water, electricity or other services, if it is highly polluting

FOREST (CONSERVATION) ACT, 1980

• This Act provides conservation of forests and related aspects.

• This act also covers all type of forests including reserved forests, protected forests and any forested land.

• This act is enacted in 1980. It aims at to arrest deforestation.

IMPORTANT FEATURES OF FOREST ACT

• The reserved forests shall not be diverted or de reserved without the prior permission of the central government.

• The land that has been notified or registered or forest land may not be used for non-forest purposes.

• Any illegal non-forest activity within a forest area can be immediately stopped under act.

IMPORTANT FEATURES OF AMENDMENT ACT OF 1988

• Forest departments are forbidden to assign any forest land ‘by way of lease or otherwise to any private person’ or non-government body for re-afforestation.
Clearance of any forest land of naturally grown trees for the purpose of re-afforestation is forbidden.

The diversion of forest land for non-forest uses is cognizable offence and anyone who violates the law is punishable.


This act is aimed to protect and preserve wildlife. Wildlife refers to all plants and animals. India has rich wildlife heritage. It has 350 species mammals, 1200 species birds and about 20,000 known species of insects. Some of them are listed as ‘endangered species’ in Wildlife (Protection) Act.

The wildlife is declining due to human actions, the wildlife products—skins, furs, feathers, ivory etc have decimated the populations of many species.

Wildlife populations are regularly monitored and management strategies formulated to protect them.

IMPORTANT FEATURES

1. The Act covers the rights and non-rights of forest dwellers.
2. It provides restricted grazing in sanctuaries but prohibits in national parks.
3. It also prohibits the collection of non-timber forest.

ENVIRONMENT (PROTECTION) ACT, 1986

This is a general legislation law in order to rectify the gaps and laps in the above acts.

This act empowers the Central Government to fix the standards for quality of air, water, soil and noise and to formulate procedures and safe guards for handling of hazardous substances.

IMPORTANT FEATURES OF ENVIRONMENT ACT
The act further empowers the Government to lay down procedures and safeguards for the prevention of accidents which cause pollution and remedial measures if an accident occurs.

The Government has the authority to close or prohibit or regulate any industry or its operation, if the violations of the provisions of the Act occur.

The penal sections of the Act contains more stringent penalties. Any person who fails to comply or who contravenes any provision of the Act shall be punishable with imprisonment for a term extending to 5 years or be punishable with fine upto rupees 1,00,000 or both.

If the violation continues, an additional fine of Rupees 5,000 per day may be imposed for the entire period of violation of rules.

The Act fixes the liability of the offence punishable under Act on the person who is directly in charge.

- Whether he/she is the director or Manager or Secretary or any other officer, unless he/she proves that it was committed without his/her knowledge or consent.

The Act empowers the officer of Central Government to inspect the site or the plant or the machinery for preventing pollution; and to collect samples of air, water, soil or other material from any factory or its premises for testing.

The Environment (Protection) Act is the most comprehensive legislation with powers for the Central Government to directly act, avoiding many regulatory authorities or agencies.

ISSUES INVOLVED IN ENFORCEMENT OF ENVIRONMENTAL LEGISLATION

- There are number of environmental laws in the forms of Acts for safeguarding our environmental quality. But we cannot implement it strictly; still we are losing our wildlife and natural resources.

- There are so many drawbacks and problems in implementing environmental legislations.

MAJOR ISSUES RELATED TO THESE LEGISLATION

Drawbacks of the Wildlife Protection Act, 1972.
Since this act has been enacted just as a fallout of Stockholm Conference held in 1972, it has not included any locally evolved conservation measures.

The ownership certificates for some animal articles (like leopard and tiger skins) often serves as a tool for illegal trading.

Since Jammu and Kashmir has its own Wildlife Act, hunting and trading of many endangered species, prohibited in other states, are allowed in J and K.

The offenders of the Act are not subjected to very harsh fines. It is just a fine of Rs25,000 or imprisonment for up to 3 years.

**Drawbacks of the Forest (conservation) Act, 1980.**

- This act just transfers the powers from state to centre to decide the conversion of reserve forest lands to non-forest areas.
- The power has been centralized at the top, local communities have been completely neglected from the decision making process regarding the nature of forest area.
- The tribal who lived in the forest were totally dependant on forest resources. When they are stopped from taking any resources from there, they involve in criminal activities like smuggling, killing etc.,
- This law is concentrated on protecting the trees, birds and animals, but is less concentrated on poor people.
- The forest-dwelling tribal communities have a rich knowledge about the forest resources, their importance and conservation. But their role and contribution is not acknowledged.

**Drawbacks of Pollution related Act**

- The power and authority has been given only to Central Government with little of power to state government. It hinders effective implementation of the Act in the states.
- The penalties in the act is very small when compared to the damage caused by the big industries due to pollution.
- A person cannot directly file a petition in the court.
- Litigation, related to environment is expensive, since it involves technical knowledge.
- For small unit it is very expensive to install effluent treatment plant.
- the position of chairman of the boards is occupied by political appointee. Hence it is difficult to implement the act without political interference.

PUBLIC AWARENESS

OBJECTIVES

- To create awareness among people of rural and city about ecological imbalances, local environment, technological development and various developmental plants.
- To organize meetings, group discussion on development, tree plantation programmes, exhibitions.
- To focus on current environment problems and situations.
- To train our planners, decision-makers, politicians and administrators.
- To eliminate poverty by providing employment that overcome the basic environmental issues.
- To learn to live simple and eco-friendly manner.

METHODS TO CREATE ENVIRONMENTAL AWARENESS

- Must be created through formal and informal education to all sections of the society.

Environmental awareness in schools and colleges

- Environmental education must be imparted to the students in schools and colleges.

Through mass-media

- Media like Radio, TV and cable network can educate the people on environmental issues through cartoons, documentaries, plantation campaign, street plays.

Cinema

- Film about environmental education should be prepared and screened in
• the theatre compulsorily. This film may be released with tax free to attract the public.

News papers

• All the newspaper as well as magazines must publish the environment related problems.

Audio-visual media

• To disseminate the concept of environment, special audio-visual and slide shows should be arranged in all public places.

Voluntary organizations

• The services of the voluntary bodies like, Rotary club, NCC, NSS should be effectively utilized for spreading the environmental awareness.

Traditional techniques

• The traditional techniques like folk plays, dramas, may be utilized to spread environmental messages to the public. These techniques attract the rural people very much.

Arranging Competitions

• Story writing, essay writing and painting competitions on environmental issues should be organized for students, as well as for the public. Attractive prizes should be awarded for the best effort.

Leaders appeal

• Political leaders, cine actors and popular social reformers can make an appeal to the public about the urgency of environmental protection.

Non-Government Organizations (NGOs)

• Voluntary organization can help by advising the government about some local environmental issues. Also they can be effective in organizing public movements for protection of environment through creation of awareness.
QUESTIONS FOR PRACTICE

Part A
1. What are the various acts for the protection of the environment?
2. Under which section of wildlife protection act are endangered species included?
3. When is world Environment day?
4. Write two issues in enforcing the Environmental legislation
5. Write four ways to create public awareness about Environment protection.

PART-B
1. List the salient features of Environment Protection Act
2. Write in detail about The Air (Prevention And Control Of Pollution) Act
3. Elaborate in detail about the salient features of Water (Prevention and Control of Pollution) Act.
4. Write in detail about the The Wildlife Protection Act
5. List the salient features of Forest Conservation Act
6. Write short notes on a) EIA, b) Public awareness about Environment protection.
UNIT V
HUMANS POPULATION AND THE ENVIRONMENT

POPULATION:
It is defined as a group of individuals belonging to the same species, which live in a given area at a given time.

POPULATION DENSITY:
It is expressed as the no. of individuals of the population per unit area or per unit volume.

Parameters affecting population size:
• Birth rate or Natality.
• Death rate or mortality.
• Immigration
• Emigration

CHARACTERISTICS OF POPULATION GROWTH
• Exponential growth ($10, 10^2, 10^3$)
• Doubling Rate
• Infant mortality rate
• Total fertility rate

No of children delivered by a woman in her life time

• Replacement level

Parents replaced by children in numbers

• Male Female Ratio

PROBLEMS IN POPULATION GROWTH
• Increasing demand for food and Resources
• Inadequate housing and Health Services
• Loss of agricultural lands
• Un-employment and socio-political unrest
• Environmental pollution

VARIATION OF POPULATION AMONG NATIONS

• Existing population is not evenly distributed
• Less developed countries have 80% population while the developed countries have 20%.
• Africa, Asia and South America have 80% of total world population and occupy less than 20% of total land area.
• Developed countries like U.S.A, Canada, Australia, the population increase is less than 1% per year.
• Kenya is the fastest population growing country-20 million
• China and India( 1000 million) share one third of world’s population
• Europe and North America accounts for 14% of world’s population.

POPULATION EXPLOSION

The enormous increase in population, due to low death rate and high birth rate, is termed as population explosion. The human population is not increasing at a uniform rate in all parts of the world

CAUSES/REASONS:

Invention of modern medical facilities
Invention of life expectancy
Illiteracy
EFFECTS OF POPULATION EXPLOSION/ ENVIRONMENTAL AND SOCIAL IMPACTS OF POPULATION

- Poverty
- Infant mortality (Still 1 in 10 children die before reaches the age of 5 in 34 developing countries)
- Environmental Degradation
- Over exploitation of natural resources
- Renewable resources like forests, grasslands under threat
- Increase diseases, economic inequality and communal war

FAMILY WELFARE PROGRAMME

- It was implemented by the Govt. of India.
- It is an integral part of overall national policy of growth covering human health, maternity, family welfare, child care and women’s right.

OBJECTIVES:

1. Slowing down the population explosion by reducing the fertility
2. Pressure on the environment due to over exploitation of natural resources is reduced

POPULATION STABILIZATION RATIO

- The ratio is derived by dividing crude birth rate by crude death rate

DEVELOPED COUNTRIES:

SR = 1, which is more or less stabilized.

DEVELOPING COUNTRIES:

SR = 3, which is expected to lower down by 2025

FAMILY PLANNING PROGRAMME
• It provides educational and clinical services.

• It provides information on birth spacing, birth control and health care for pregnant women and infants.

• It has reduced the number of legal and illegal abortions per year and decreased the risk of death from pregnancy.

OBJECTIVES:

1. Reduce infant mortality rate to below 30 per 1000 infants.

2. Achieve 100% registration of births, deaths, marriage and pregnancy.

3. Encourage late marriages and later child bearing

4. Enables to improve women’s health, education and employment.

5. Making family planning available to all women

6. Constrain the spread of AIDS/ HIV.

7. Prevent and control of communicable diseases.

8. Promote vigorously the small family norms.


FAMILY PLANNING PROGRAMME IN INDIA

• In 1952, India started the family planning programme

• In 1970’s Indian Govt. forced family planning campaign all over India

• In 1978, legally raised the min age of marriage for men from 18 to 21 years and for women 15 to 18 years

• In 1981, census report showed that there was no drop in population. Since then funding for family planning programmes has been increased further.

ENVIRONMENT AND HUMAN HEALTH

• Human health and environment are two inseparable entities.
• Generally a physically fit person not suffering from any disease is called a Healthy person.

• The factors like nutritional, biological, chemical or Psychological which cause harmful changes in body conditions are called Disease.

• Earth surface and the surrounding environment is very important to human health.

• Millions of people die every year due to illness caused by environment pollution.

**IMPORTANT HAZARDS AND THEIR HEALTH EFFECTS**

<table>
<thead>
<tr>
<th>S.NO</th>
<th>Physical Hazards</th>
<th>Health effect</th>
</tr>
</thead>
</table>
| 1.   | Radioactive radiations | Affects cells and glands  
                  | Cancer, organ disorders                     |
| 2.   | UV Radiations      | Skin cancer                                        |
| 4.   | CFC                | Damage O3 layer, allows more UV rays, skin cancer. |
| 5.   | Noise              | Painful and irreparable damage to human ear.       |
CHEMICAL HAZARDS AND THEIR HEALTH EFFECTS

<table>
<thead>
<tr>
<th>S.NO</th>
<th>Chemical Hazards</th>
<th>Health effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Combustion of Fossil fuel: Liberates ( \text{SO}_2, \text{NO}_2, \text{CO}_2 )</td>
<td>Asthma, Bronchitis, Lung diseases.</td>
</tr>
<tr>
<td>2</td>
<td>Industrial effulents (toxic)</td>
<td>Kills cells and causes cancer, death</td>
</tr>
<tr>
<td>3</td>
<td>Pesticides like DDT and others</td>
<td>Affect the food chain</td>
</tr>
<tr>
<td>4</td>
<td>Heavy metals like Hg, Cd, Pb, fluoride, nitrate.</td>
<td>Contaminate water, causes ill effects.</td>
</tr>
</tbody>
</table>

BIOLOGICAL HAZARDS AND ITS ILL EFFECTS

- Bacteria, Viruses and Parasites -- Diarrhoea, malaria, Parasitic worms, anemia, Respiratory disease, Cholera.

PREVENTIVE MEASURES

- Always wash your hands before sitting for food.
- Cut short and clean your nails systematically.
- Maintaining Skin, teeth and hair of our body.
- Drinking chemically treated and filtered water.
- Eat food always while it is in hot condition.
- Wash raw vegetables and fruits before using it.
- Try to avoid plastic containers and polythene bags.
- Do physical exercise to have proper circulation of blood.
HUMAN RIGHTS

• Human rights are the fundamental rights, possessed by all human beings irrespective of their caste, nationality, sex and language.

• It cannot be taken back by any government or legislature.

• Its aim is to ensure happiness to all the citizens with equal rights, opportunities and comfort.

• Every citizen must enjoy certain rights and also has certain duties towards the country.

FUNDAMENTAL RIGHTS

• Right to freedom

• Right to property

• Right to freedom of religion

• Right to culture and education

• Right to constitutional remedies

• Right to equality

• Right against exploitation

• Right to food and environment

• Right to good health

VALUE EDUCATION

Education:

It is nothing but learning, through which knowledge about particular thing can be acquired. With the help of knowledge and experience, we can identify our values and our relationship with others and their environment.

Types of education:

1. Formal education
2. Value education

3. Value-based environmental education

OBJECTIVES OF VALUE EDUCATION

• To improve the integral growth of human beings

• To create attitudes and improvement towards sustainable lifestyle

• To increase awareness about our national history, cultural heritage, constitutional rights, national integration, community development and environment.

• To create and develop awareness about the values and its significance

• To know about environment, living and non living beings and its interaction with the environment.

TYPES OF VALUES

• Universal values or social values:
  Tells about importance of human conditions like joy, love, tolerance service truth etc.,

• Cultural values: (right and wrong, good and bad )

• Individual values: ( personal principles, individual personality)

• Global values: civilization, natural harmony with the environment)

• Spiritual values: Promote conservationism, self-restraint, self discipline, reduction of wants.

WOMEN WELFARE

• Aim of women welfare is to improve the status of the women by providing opportunities in education, employment and economic independence.

NEED FOR WOMEN WELFARE:

• Women suffer gender discrimination and devaluation at home, workplace, matrimony, public life and power.
• High no of cases of dowry deaths, rape, domestic violence, criminal offences and mental torture to women

• In policy making and decision making women are neglected.

OBJECTIVES OF WOMEN WELFARE

• To provide education
• To impart vocational training
• To generate awareness about the environment
• To improve employment opportunities
• To aware problems of population
• To restore the dignity, status, equality and respect for women.

A NATIONAL COMMISSION FOR WOMEN

A national commission for women has been created by Govt. of India, its objectives are

1. To examine constitutional and legal rights for women

2. To review existing legislations.

3. To sensitize the enforcement and administrative machinery to women’s causes.

Various organizations towards women welfare

• The national network for women and mining (NNWM)

• United nations decade for women

• International convention on the elimination of all forms of Discrimination against women (CEDAW)

• Non government organizations (NGO)

• Ministry for women and child development.

CHILD WELFARE
• Children occupy nearly 40% of total population. They are considered to be the assets of a society.

REASONS FOR CHILD LABOURS:

1. Poverty.

2. Need for money.

RIGHT OF THE CHILD:

The international law defines right of the child to survival, participation, development and protection.

HIV/AIDS

AIDS-Acquired Immuno Deficiency Syndrome. Acquired means disease is not hereditary but develops after birth from contact with a disease causing agent. Immune deficiency means that the disease is characterized by a weakening of immune system HIV-Human immune deficiency virus cause AIDS disease. Virus is passed through infected blood, semen Transmission of AIDS Prostitution Homosexual activity Use of contaminated syringe in blood transfusion and drug addicts Maternal-fetal transmission

Symptoms:
 Persistent fever
 Fatigue, weakness
 Diarrhea
 Wait loss
 Low number of T cells in blood
 Swelling lymph nodes, neck
 Susceptible to infections

Treatment:
 AZT-Azidi thymidine *
 DDI – Dideoxyinosine *

Screening test:
 ELISA-Enzyme Linked Immuno Sorbant Assay
 Western blot
Role of Information Technology in Environment and Human Health:

Computer based instruments for environment studies:

There are several on-line use instruments by which data can be collected automatically at fixed interval of time. E.g.

1. Instruments for monitoring and analysis of meteorological parameters, the acoustic sounding system, radar is used.
2. Atomic absorption spectrophotometer (AAS) – performs complex chemical and heavy metal analysis in water and waste water.
3. Inductive coupled plasma spectrometer (ICPS), attached with powerful computers to facilitate easy manipulations, is used for waste water analysis.

Application of computers in the field of Environment & human health:

1. The mapping of polluted sectors can be carried out.
2. Unknown parameters can be stimulated by computer techniques.
3. EIA (Environmental Impact Assessment) problems can be analyzed.
4. Inventories of emission sources are compiled and maintained.
5. Net-work analysis, statistical analysis and the status of environmental pollutions can be highlighted.
6. Comprehensive administrative system can be developed by using computer network techniques.

Remote sensing-Graphical Interface System are useful for coral reef mapping and ocean resources. They are also useful to access the loss of biodiversity/hot spots etc. The understanding of environmental concerns and issues related to human health has exploded during the last few years due to the sudden growth of Information Technology. The computer age has turned the world around due to the incredible rapidity with which IT spreads knowledge. IT can do several tasks extremely rapidly, accurately and spread the information through the world’s networks of millions of computer systems.

A few examples of the use of computer technology that aid environmental studies include software such as using Geographical Information Systems (GIS). GIS is a tool to map land use patterns and document change by studying digitized tops sheets and/or satellite imagery. Once
this is done, an expert can ask a variety of questions which the software can answer by producing maps which helps in Land use planning.

The Internet with its thousands of websites has made it extremely simple to get the appropriate environmental information for any study or environmental management planning. This not only assists scientists and students but is a powerful tool to help increase public awareness about environmental issues.

Specialized software can analyze data for epidemiological studies, population dynamics and a variety of key environmental concerns. The relationship between the environment and health has been established due to the growing utilization of computer technology. This looks at infection rates, morbidity or mortality and the etiology (causative factors) of a disease. As knowledge expands, computers will become increasingly efficient. They will be faster, have greater memories and even perhaps begin to think for themselves.

VISIT TO A LOCAL AREA TO DOCUMENT ENVIRONMENTAL ASSETS RIVER/FOREST/GRASSLANDS/ HILL/MOUNTAIN

Documenting the nature of an ecosystem gives us a deeper appreciation of its value to mankind. Each ecosystem has something different to offer us. It may contain natural resources that local people depend on; or provide important ecological functions for us all; or have tourist or recreational potential; or simply have a strong aesthetic appeal that is difficult to quantify in economic terms. In fact it can have multiple benefits for mankind at global, national and local levels.

QUESTIONS FOR PRACTICE

Part A

1. What is meant by Population growth?

2. What is the difference between population growth and population explosion?

3. What are the major reasons for population explosion?

4. What are the various methods to arrest the population growth level?

5. What is meant by immigration and emigration?
6. Define doubling time.

7. Define exponential growth rate.

8. What are the benefits of family welfare programs?

9. What is meant by value education?

10. Mention the various values that can be inferred by the education.

11. Expand HIV and AIDS.

12. What are the symptoms for AIDS?

13. What are the control measures to prevent the spread of HIV Virus?

14. What is the role of primary health centers?

15. What is meant by malnutrition and under-nutrition?

16. Mention the various human rights.

17. What is the importance of environmental education?

18. Give examples in which the IT sector is applicable to environmental studies.

19. What is the application of GIS?

**Part B**

1. Explain the need for the family welfare programs in detail.

2. Explain the importance of value education and the various values inferred from it.

3. Explain the ill-effects of AIDS and the preventive measures for the same.

4. Explain the role of Information Technology in Population studies and control.

5. Population Explosion leads to Environmental degradation. Comment on this statement and judge the opinion.

6. Explain the need for women and child welfare in detail.